Elliott Bay Projec

Request for Letter of Authorization
Marine Mammal Protection Act

FINAL

September 2012

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:

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REQUEST FOR LETTER OF AUTHORIZATION
MARINE MAMMAL PROTECTION ACT

Agreement No. T09-24

FINAL

SEPTEMBER 2012

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:

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City of Seattle

Elliott Bay Seawall Project

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ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

AMAR	Autonomous Multichannel Acoustic Sound Recorder
BMP	Best Management Practice
City	City of Seattle
CSO	combined sewer overflow
dB	decibel
DPS	Distinct Population Segment
EBSP	Elliott Bay Seawall Project
EIS	Environmental Impact Statement
ESA	Endangered Species Act
IWC	International Whaling Commission
LoA	Letter of Authorization
MMPA	Marine Mammal Protection Act of 1972
MLLW	Mean Lower Low Water
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
RMS	root mean square
SDOT	Seattle Department of Transportation
SEL	sound exposure level
SPCC	Spill Prevention Control and Countermeasures
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
WSDOT	Washington State Department of Transportation

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SECTION 1. INTRODUCTION

The Seattle Department of Transportation (SDOT), on behalf of the City of Seattle (City), is submitting this request for a Letter of Authorization (LoA) for the Elliott Bay Seawall Project (EBSP). The proposed project involves replacement of the Elliott Bay Seawall from S. Washington Street to Broad Street along the Seattle waterfront abutting Elliott Bay, King County, Washington (Figure 1). This is an important area of commerce for Seattle. The project also includes nearshore ecosystem restoration elements to improve habitat for outmigrating juvenile salmon and to increase ecosystem productivity in the nearshore.

Figure 1. Elliott Bay Seawall Project Location Map

The purpose of the EBSP is to reduce the risks of coastal storm and seismic damages and to protect public safety, critical infrastructure, and associated economic activities along Seattle's central waterfront. Additionally, the project would improve the degraded ecosystem functions and processes of the Elliott Bay nearshore in the vicinity of the existing seawall.

The Marine Mammal Protection Act (MMPA) of 1972 prohibits the taking of marine mammals, defined as "harass, hunt, capture or kill, or attempt to harass, hunt, capture or kill," except under certain situations. Section 101 (a) (5)(D) allows for the issuance of an incidental harassment authorization provided an activity would have negligible impacts to marine mammals and would not adversely affect subsistence uses of marine mammals. The project timing, duration and specific types of activities (such as pile driving) may result in the incidental taking by harassment of marine mammals protected under the MMPA.

SDOT is requesting a LoA for the potential to "take" the following marine mammal species or distinct population segments (DPS) that may occur in the project vicinity: Pacific harbor seal (*Phoca vitulina*), California sea lion (*Zalophus californianus*), harbor porpoise (*Phocoena phocoena*), Dall's porpoise (*Phocoenoides dalli*), gray whale (*Eschrichtius robustus*), both southern resident and transient killer whales (*Orcinus orca*), Steller sea lion (*Eumetopias jubatus*), and humpback whale (*Megaptera novaengliae*). Of these, the southern resident killer whale, Steller sea lion, and humpback whale are protected under the Endangered Species Act (ESA). Pertinent information for each of these species is presented in this document to provide the necessary background to understand their demographics and distribution in the area.

This request for a LoA assesses potential and predicted effects on marine mammals from proposed pile installation and removal activities associated with the EBSP. This request focuses primarily on in-water pile installation and removal activities because they have the potential to produce noise in the aquatic marine environment at strength and frequencies that could affect marine mammals. Both vibratory (continuous) and impact (impulsive) driving are proposed as part of the EBSP. Other construction activities (such as those associated with the installation of the seawall face and habitat restoration measures, barging, and other in-water activities) will be evaluated through ESA compliance.

Fundamental to this assessment is documenting compliance with the current guidelines implemented by the National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NOAA/NMFS) (NOAA 2010a) on sound characteristics in the context of the MMPA. To demonstrate compliance with the NOAA/NMFS MMPA guidelines, this document includes in-water noise thresholds for each marine mammal species for which they have been established and projected in-water noise values calculated using the most current available project design data for pile-related activities. Comparisons between established marine mammal noise thresholds and predicted noise values from pile-related activities are also presented in this document and allow for projected effects to be assessed at varying distances from a noise source (i.e., the site of pile-related activities). Proposed mitigation and conservation strategies are also presented that would function to substantially reduce potential negative effects on marine mammals.

SECTION 2. PROJECT DESCRIPTION

SDOT and the United States Army Corps of Engineers (USACE) are partnering on the EBSP to replace the existing seawall. The EBSP will be constructed in two construction phases (Figure 2). Phase 1 extends for approximately 3,600 linear feet from S. Washington Street to Virginia Street. Phase 2 extends for approximately 3,500 linear feet from Virginia to Broad Streets.

Figure 2. Elliott Bay Seawall Project Area Map

2.1 SEAWALL STRUCTURE REPLACEMENT

The new seawall would be constructed landward of the existing seawall face and result in a net setback of the wall from its existing location. The majority of seawall construction would occur behind a temporary steel sheet pile containment wall that would be placed waterward of the existing seawall complex and extend the full length of the construction work area during each construction season. The approximate proposed location of the new seawall face relative to the existing seawall face is as follows:

- S. Washington Street to Madison Street – approximately 15 feet landward (Figure 3);
- Madison Street to University Street – approximately 10 to 15 feet landward (Figure 3); and
- University Street to Broad Street – approximately 10 feet landward (Figure 4).

The seawall structure will consist of a soil improvement structure that will stabilize the soils behind the existing seawall and may include anchors or tie-backs that extend down to non-liquefiable soil for seismic stability. The proposed location of the new seawall face was determined by considering factors that would make the installation of the new seawall most efficient. Analysis showed that it is most efficient to leave the existing seawall in place during construction and to build the new structure landward of the existing face. Following installation of the new seawall structure, the portion of the existing seawall waterward of the new structure would be demolished behind the temporary containment wall.

A number of public and private utilities are located within proposed areas of excavation for the seawall. These include electricity, water, wastewater management, stormwater collection, and natural gas, steam, communications, and telecommunications services. SDOT is working closely with utility owners to develop acceptable alternatives for protecting utilities in place where possible. Relocation of utilities will be closely coordinated so that each utility adjustment does not conflict with other utility relocation plans.

2.2 TEMPORARY AND RESTORED ROADWAY

Alaskan Way (a four-lane primary arterial serving the waterfront) runs along the entire length of the seawall and is located immediately east of the sidewalk that runs along the western edge or is cantilevered over the seawall. During construction, Alaskan Way would need to be relocated eastward of its current location to accommodate the work zone. Following seawall construction, Alaskan Way would be moved back to the existing roadway location and the sidewalk and trail would be restored to their original function and capacity. For the proposed project, an additional permanent northbound through lane would be added between S. King and Madison Streets to achieve better traffic flow in this segment. A sidewalk of approximately the same width as the existing sidewalk would be provided on the west side of the street. The multi-use trail on the east side of Alaskan Way would be extended north to Clay Street, then cross Alaskan Way, and continue on the west side of Alaskan Way to Broad Street, where it would join with the existing trail north of Broad Street.

Stormwater treatment would be installed to treat stormwater runoff from the project area using basic treatment technology to meet City code (Seattle Municipal Code 22.800). Stormwater outfalls will be consolidated to the extent practicable so that a number of small individual outfalls will be routed into the existing larger outfalls at S. Washington, Madison, Seneca, University, Pine, Pike, and Vine Streets. This will reduce the total number of outfalls that discharge along the seawall from approximately 50 outfalls to seven outfalls. Stormwater quality would be improved through the installation of basic treatment which would remove the bulk of suspended solids and oils and greases.[1] This would improve stormwater quality at an estimated 50 small individual outfalls and improve the project footprint portion of the stormwater draining out of the seven major CSO outfalls along the waterfront.

[1] Currently, no stormwater treatment exists along the seawall.

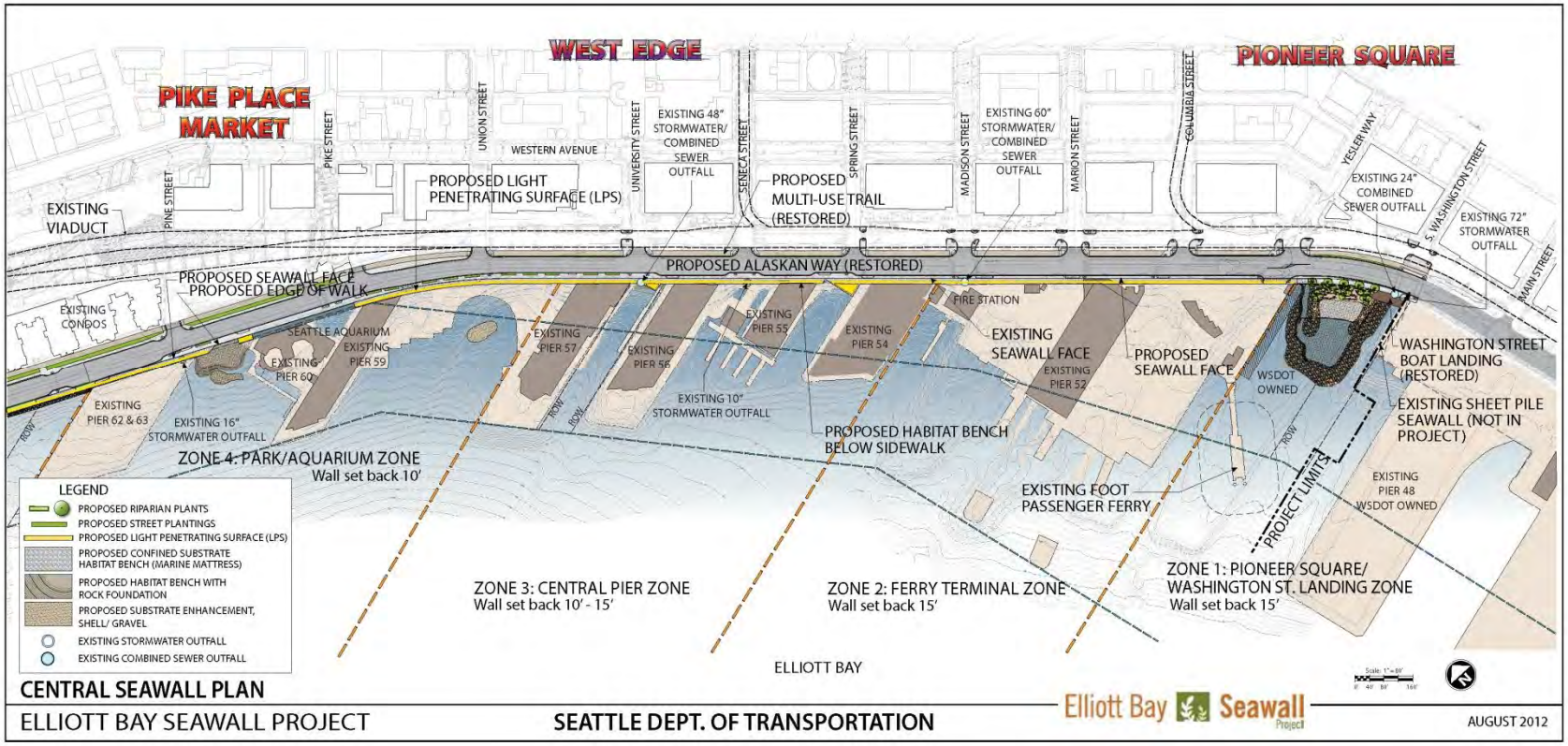


Figure 3. Proposed Elliott Bay Seawall Project Plan View, Central Seawall

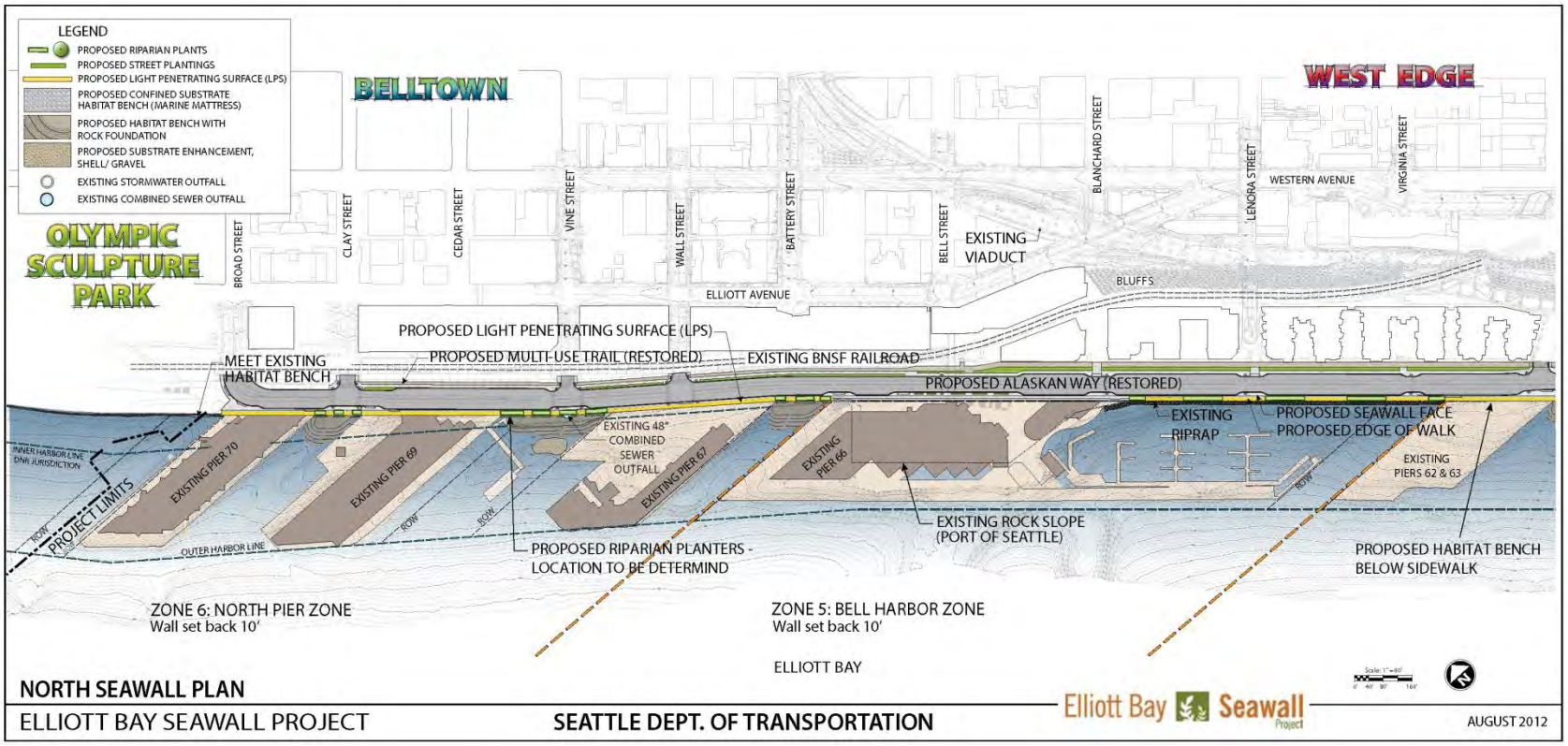


Figure 4. Proposed Elliott Bay Seawall Project Plan View, North Seawall

Existing outfalls above the Mean Lower Low Water (MLLW) water level would be vertically relocated below MLLW. This vertical relocation would be accomplished by placing a drop structure with treatment facility on the upland side of the seawall and installed landward for ease of maintenance, while penetrating the new seawall at the appropriate lower elevation.

2.3 HABITAT ENHANCEMENT

Enhancement of the marine nearshore habitat along the seawall is also proposed as part of the seawall project. The two primary goals of the proposed project for habitat enhancement are to:

- Provide an improved intertidal migration corridor for juvenile salmonids along the seawall; and
- Enhance ecosystem function.

Providing an improved migration corridor would be accomplished by the following specific measures:

- Modifying depths to achieve intertidal and shallow-water habitat elevations preferred by migrating juvenile salmon (+0.5 to -4.5 feet relative to the North American Vertical Datum of 1988 [NAVD 88]);
- Improving underwater substrates (three-inch and smaller aggregate) for salmon prey species;
- Increasing daylight illumination of the proposed habitat bench and other nearshore habitat by including a light-penetrating surface in the cantilevered sidewalk above;
- Providing wall faces with textures to encourage attachment and growth of aquatic organisms; and
- Adding riparian plants along the sidewalk.

For enhanced ecosystem function, selected subtidal areas would be modified with the addition of substrate enhancements (pea gravel and shell hash at -10-foot to -15-foot elevation [NAVD 88]), as well as the textured wall face, riparian plantings, a light-penetrating surface, and suitable bench substrate previously mentioned. No net loss of ecological function or intertidal elevation would occur, and the intent is to improve ecological function.

The south end of the project area would include an expanded area of intertidal bench with a narrow beach bordered by backshore riparian plants, rocks, and drift logs.

2.4 PUBLIC AMENITIES

Public amenities in the EBSP include improved water viewing at select locations, replaced railings, restoration of Washington Street Boat Landing, riparian planters, and street plantings along Alaskan Way. Reconstructed sidewalks would extend from the restored Alaskan Way curb line to the western Alaskan Way right-of-way line (i.e., same location as the western edge of the existing sidewalk). The new sidewalks would be cantilevered or pile-supported in the majority of zones. A light-penetrating surface along with railing, planter, and overlook configuration would add variety to the waterfront by defining gathering spaces, viewing areas, and building entries.

Zone 1 includes Washington Street Boat Landing, which would be restored and reinstalled within the Washington Street right-of-way. North of the boat landing, a narrow beach with backshore would allow limited physical access to, and viewing of, the new intertidal habitat bench.

Zone 3 would include enhanced viewing areas between the piers that would create more opportunities for public gathering, seating, and water viewing. The enhanced viewing areas would be perpendicular to the sides of the adjacent piers, thereby directing the view out to Elliott Bay and the Olympic mountain range. Light-penetrating surfaces would be implemented in the majority of these viewing areas.

Public amenities (e.g., replaced railings, new sidewalks, street plantings, and riparian planters) and creation of a habitat bench would occur in the area through Bell Harbor (Zone 5). No seawall construction would occur and no cantilevered sidewalks would be installed in this area.

2.5 Construction Sequence and Schedule

The EBSP construction schedule is anticipated to occur in two phases: Phase 1 which includes the area of the Central Seawall, and Phase 2 which includes the area of the North Seawall (Table 1). Phase 1 includes three construction segments and Phase 2 includes two construction segments; each segment represents 1 to two years of construction. During Phase 1, construction is proposed to occur starting at Virginia Street and move southward. Segment I would extend approximately 1,200 feet from Virginia Street to Union Street, Segment II would extend approximately 1,200 feet from Union Street to Madison Street, and Segment III would extend approximately 1,200 feet from Madison Street to S. Washington Street. During Phase 2, construction is proposed to occur starting at Broad Street and move southward. Phase 2, Segment I would extend approximately 1,750 feet from Broad Street to Wall Street, and Segment II would extend approximately 1,750 feet from Wall Street to Virginia Street.

Construction is scheduled to begin in fall 2013 once all permits and approvals are secured and would commence with Phase 1 work. The three segments of Phase 1 would be constructed over three construction seasons with two summer shutdown periods that are scheduled to occur from Memorial Day weekend through Labor Day weekend to accommodate the primary tourist and business season (Table 2). The construction of Phase 2 is anticipated to begin following completion of Phase 1. The two segments of Phase 2 would be constructed over 2 two-year construction seasons. As with Phase 1, summer shutdown periods would occur each year.

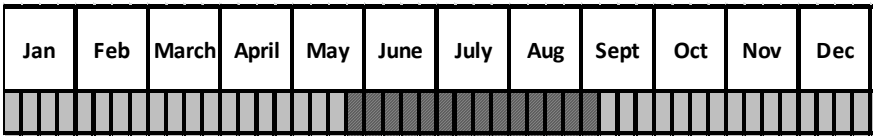
The five-year approval potentially granted through this permit process would allow for annual LoAs for each of the first five years of the project (a request for a second LoA or Incidental Harassment Authorization will be initiated and submitted prior to the end of the fifth year of construction for any work that would occur after five years). As a result, this request only covers the construction period from 2013 to 2017, or from the start of Phase 1, Segment I to the end of Phase 2, Segment I (as currently anticipated).

TABLE 1. ANTICIPATED ELLIOTT BAY SEAWALL PROJECT CONSTRUCTION SCHEDULE

Phase	Segment	Year of Construction
1 (Central Seawall)	I	Year 1 (Fall 2013–Spring 2014)
	II	Year 2 (Fall 2014– Spring 2015)
	III	Year 3 (Fall 2015– Spring 2016)
2 (North Seawall)	I	Years 4 & 5 (Fall 2016–Spring 2018)
	II	Years 6 & 7 (Fall 2018–Spring 2020)*

Note: * Years 6 and 7 are not covered under this LoA request but would be covered under a subsequent LoA or IHA request.

TABLE 2. GENERALIZED INTRA-ANNUAL ELLIOTT BAY SEAWALL PROJECT CONSTRUCTION SCHEDULE



Notes: Shaded cells indicate scheduled active construction.
Hatched cells indicate scheduled summer construction shutdown.
No construction is scheduled from Memorial Day weekend through Labor Day weekend; (i.e., from the end of May through beginning of September).

2.6 Pile Work Elements and Schedule

Construction activities associated with the EBSP that would require MMPA compliance are in-water vibratory and impact pile installation and removal. There are three pile-types associated with these activities: steel sheet piles, concrete piles, and timber piles. A summary of the proposed in-water pile installation and removal plan is provided in Tables 3, 4, and 5.

Prior to excavation and demolition of the existing seawall, a temporary containment wall constructed of steel sheet piles would be installed in each construction segment (Table 3). The temporary containment wall would be installed by vibratory driving and would be located in the water approximately five feet waterward of the existing seawall. It would remain in place throughout the duration of construction of each segment. After construction, the temporary containment wall would be removed with vibratory equipment. In the rare case where steel sheet piles would be load bearing, they may also be impact proofed or their installation would be completed by employing limited impact hammering to secure a solid purchase into the substrate. The temporary containment wall has been proposed as a Best Management Practice (BMP) to prevent adverse effects on nearshore marine habitat from the release of turbidity and contaminants associated with seawall excavation and demolition. Steel sheet piles would be installed in pairs and are assumed to be 48 inches in linear length per pair (SDOT 2012). Noise

created from the installation of steel sheet pile pairs is generally viewed to be similar to that of individual 24-to-36-inch-diameter columnar steel piles (CALTRANS 2009).

TABLE 3. TEMPORARY CONTAINMENT WALL INSTALLATION AND REMOVAL (STEEL SHEET PILES ONLY); SUMMARY PROVIDED FOR THE ENTIRE PROJECT DURATION

Construction Phase	Number Pile Pairs[1] (10% contingency included)	Maximum Duration	Maximum Hours per Day	Installation / Removal Method
Installation				
Phase I	1,023	50 days	12	Vibratory
Est. No. Impact Proofed[2]	209	4 days[3]	10	Impact
Phase II	715	35 days	12	Vibratory
Est. No. Impact Proofed[2]	143	3 days[4]	10	Impact
Removal				
Phase I	1,023	25 days	12	Vibratory
Phase II	715	15 days	12	Vibratory
Total Installed/Removed	**1,738**	--	--	--

Notes: [1] Steel sheet pile pairs (48 inches wide).
[2] Number equals 20 percent of estimated number of piles installed per phase.
[3] Total estimated installation time is 40 hours with 8 hours of actual impact driving.
[4] Total estimated installation time is 30 hours with 6 hours of actual impact driving.

TABLE 4. EXISTING PILE REMOVAL (TIMBER AND CONCRETE PILES ONLY); SUMMARY PROVIDED FOR THE ENTIRE PROJECT DURATION

Construction Phase	No. of Piles[1]	Pile Type	Justification for Removal	Removal Duration	Maximum Hours per Day	Removal Method
Phase I (Excluding Washington Street Boat Landing)	22	Creosote-treated timber[2]	Currently not used - from previous uses along wall	3 days	12	Vibratory
Phase I (Washington Street Boat Landing Only)	8	Creosote-treated timber[2]	Support existing pier structure	0.5 day	12	Vibratory
Phase II	50	Creosote-treated timber[2]	Currently not used – from previous uses along wall	2 days	12	Vibratory
Phase II	3	Concrete[3]	Currently not used – from previous uses along wall	1 day	12	Vibratory
Total Removed	**83**	--	--	6 days	--	--

Notes: [1] Number equals total plus 10% contingency.
[2] Assumed to be 14-inch diameter.
[3] Assumed to be 18-inch diameter.

TABLE 5. PERMANENT PILE INSTALLATION, 16.5-INCH-DIAMETER PRECAST CONCRETE OCTAGONAL PILES ONLY; SUMMARY PROVIDED FOR THE ENTIRE PROJECT DURATION

Construction Phase	No. of Piles[1]	Justification for Installation	Installation Duration	Maximum Hours per Day	Installation Method
Phase I (Excluding Washington Street Boat Landing)	77	To support sidewalk, viewing areas, and vehicular traffic access	10 days	10	Impact
Phase I (Washington Street Boat Landing Only)	17	To support new pier structure	2 days	10	Impact
Phase II	83	To support viewing areas and sidewalk	10 days	10	Impact
Total Installed	**175**	--	24 days	--	--

Note: [1] Number equals total plus 10% contingency.

Approximately 175 permanent concrete piles would be installed in-water using impact pile installation in two areas: (1) immediately landward of the temporary sheet pile containment wall, and (2) waterward of the temporary sheet pile containment wall (i.e., in the open nearshore) (Table 5). The use of attenuation devices such as coffer dams (without dewatering) or steel sleeves when impact driving is conducted are estimated to decrease sound in the range of 0 to 10 dB (Caltrans 2007, 2009). The concrete pilings installed landward of the temporary containment wall are intended to provide permanent structural support for cantilevered sidewalks and pier areas with high vehicle traffic. The approximately 17 permanent concrete pilings installed in-water and waterward of the temporary containment wall would provide structure for the replacement of Washington Street Boat Landing (scheduled for construction in year 3 of Phase I) (SDOT 2012). All in-water permanent piles are assumed to be 16.5-inch-diameter precast concrete octagonal piles and would be installed by means of impact driving.

In-water pile removal would also occur as part of the EBSP (Table 4). Existing creosote-treated timber piles and concrete piles located waterward of the existing seawall face that would interfere with construction would be removed whole, wherever possible, using a vibratory extraction method (SDOT 2012). Timber pilings that break during extraction would be cut off two feet below the mudline.

To account for potential changes in pile numbers, a 10 percent contingency was added to each estimated number of in-water piles from the design. Contingency numbers are used in all calculations and assessments in this document. Because annual biological patterns are typical of marine mammals, the unit of comparison used in this assessment is each construction season (September through May). Roughly the same number and distribution of in-water steel sheet piles and permanent piles is assumed for each year of construction within each phase, because the linear length of the construction area and type of construction will be approximately equal each year.

Piles installed in areas that are considered upland do not require MMPA compliance measures because current consensus suggests noise from upland sources is largely attenuated through upland substrate. Substrate-produced sound waves, which are sound waves (usually from impact pile installation) that

penetrate up through the ground from upland pile installation near the water line, have been observed extending up to 150 feet into the water column during studies at the Vashon Island's ferry terminal (WSDOT 2010). Regardless, NOAA/NMFS considers pile installation in upland areas to be outside the disturbance zone of in-water work, because there is little data available on marine mammal effects. Potential does exists for the disturbance of pinnipeds from upland pile installation as a result of airborne noise. In the most extreme case, such effects are anticipated to be localized and only result in disturbance and displacement. Existing anthropomorphic disturbances are likely to already cause relatively loud baseline ambient noise in the area of potential effects, which have added to the degradation of habitat quality for all marine mammals.

2.7 Area of Potential Effects

The area of potential effects considered in this assessment is the area of potential direct and/or indirect effects to marine mammals that would likely receive noise pollution from pile-related activities at levels that could cause "take" of marine mammals. This area of potential effects includes the construction zone, Elliott Bay, and portions of Puget Sound. In other words, the area of potential effects represents the maximum area of Puget Sound where marine mammals could be affected by the proposed action (Figure 5). For reasons described below, this area is defined by the distance to which noise from vibratory pile-related activities maintains high enough volume to disturb marine mammals.

The construction zone extends for approximately 7,100 linear feet (2,165 meters) along the Seattle shoreline and is mostly concentrated in upland areas. The area of in-water pile installation and removal activities would be restricted to the length of the seawall and waterward to within 15 feet of the seawall face and to depths less than -30 feet NAVD88. This analysis uses the Practical Spreading Loss Model which describes noise from both proposed pile installation methods to propagate from a point-source in a predictable manner that allows intensity at defined distances to be calculated (see Section 8 of this document and NOAA/NMFS 2008). Of the two pile installation methods, vibratory installation has been shown to propagate a larger area of potential effects on marine mammals than impact pile installation. Noise from vibratory pile installation and removal creates a continuous source of relatively low frequency sound that perpetuates through water across long distances while maintaining intensities that could potentially cause behavioral effects in marine mammals. In contrast, impact pile installation creates pulses of noise of greater intensity but of higher frequency and shorter duration that more readily degrades as it moves through water. Therefore, the outer limits of the area of potential effects has been defined by the calculated distance that noise from vibratory pile installation maintains an intensity that could affect marine mammals.

Sound waves propagate in all directions when they travel through water until they dissipate to background levels (as measured as "ambient noise") or encounter barriers that absorb their energy, such as a landmass. In the case of the proposed action, unattenuated and unobstructed impact pile installation was calculated to propagate up to 3,280 feet (0.62 mile) and maintain enough intensity to cause behavioral effects in marine mammals (Figure 5). In comparison, unattenuated and unobstructed vibratory pile installation (or removal) was calculated to propagate up to 2.5 miles and maintain intensity enough to cause behavioral effects in marine mammals. Therefore, it is expected that pile-related construction noise would extend throughout the nearshore and open water environments to

just west of Alki Point and a limited distance into the East Waterway of the Lower Duwamish River (a highly industrialized waterway). Because landmasses block in-water construction noise, a "noise shadow" created by Alki Point is expected to be present immediately west of this feature.

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Figure 5. Area of Potential Effects. Included are Projected Areas of Effects for Vibratory (Red) and Impact Pile Installation (Orange) and Removal. The Project Area is Located within the Yellow Polygon

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SECTION 3. NOISE, BEHAVIOR, AND THE MMPA

When anthropogenic disturbances such as those from construction, elicit responses in marine mammals it is not always clear whether visual stimuli, the presence of humans or structures, or acoustic stimuli are responsible. However, because sound can travel well underwater it is reasonable to assume that, in most conditions, marine mammals would be able to detect sounds from anthropogenic activities before receiving visual stimuli. As such, exploring the acoustic effects of the proposed project provides a reasonable and conservative estimate of the magnitude of disturbance caused by construction in the marine environment as well as the specific effects of sound on marine mammal behavior (NMFS 2010a, 2010b).

Marine mammals rely on sound to communicate and derive information about their environment such as through echolocation for navigation, finding prey, and avoiding predators. These species may be negatively affected when ambient noise is present at high levels, which could interfere with these actions. There is growing concern about the effect of increasing ocean noise levels due to anthropogenic sources on marine organisms, particularly marine mammals. Effects of exposure on marine organisms can be characterized by the following range of physical and behavioral responses (Richardson et al. 1995); note that they are listed from the least to most severe:

1. ***Behavioral reactions***: Range from brief startle responses, to changes or interruptions in feeding, diving, or respiratory patterns, to cessation of vocalizations, to temporary or permanent displacement from habitat.
2. ***Masking***: Reduction in ability to detect communication or other relevant sound signals due to elevated levels of background noise.
3. ***Temporary threshold shift***: Temporary, fully recoverable reduction in hearing sensitivity caused by exposure to sound.
4. ***Permanent threshold shift***: Permanent, irreversible reduction in hearing sensitivity due to damage or injury to ear structures caused by prolonged exposure to sound or temporary exposure to very intense sound.
5. ***Non-auditory physiological effects***: Effects of sound exposure on tissues in non-auditory systems either through direct exposure or as a consequence of changes in behavior, e.g., resonance of respiratory cavities or growth of gas bubbles in body fluids.

Richardson et al. (1995) also defined four zones of noise influence for marine species depending on the distance between a strong noise source and the animal. These zones, starting from the most distant to the closest, are as follows:

1. ***Zone of Audibility***: The zone of audibility is farthest from the source, and extends to the limits of hearing, until the sound is lost to ambient background noise.
2. ***Zone of Masking***: The zone of masking is the area in which noise is strong enough to interfere with the detection of other sounds such as those used for communication and echo-location.

3. ***Zone of Responsiveness***: The zone of responsiveness in the area in which the noise is strong enough to elicit behavioral and/or physiological responses from the animal. Such responses include alarm movements or area avoidance.
4. ***Zone of Hearing Loss***: The area closest to the noise source is the zone of hearing loss, where the sound pressure is high enough to cause tissue damage either temporarily or permanently. Even more severe physical damage is possible depending on the strength of the sound source.

3.1 INTERIM SOUND THRESHOLD GUIDANCE

As of June 2012, NOAA/NMFS has not yet released formal guidance measures for marine mammals. However, NOAA/NMFS identified interim guidelines for assessing the effects of sound on marine mammals in "Effects of Sound on Marine Mammals and Existing Programmatic [Corps of Engineers] COE Consultations in Washington State" (NOAA/NMFS 2010a). NOAA/NMFS interim guidelines are also identified on the NOAA/NMFS website under "Interim Sound Threshold Guidance" (NOAA/NMFS 2010b). The NOAA/NMFS memorandum (dated August 17, 2010) and website (updated January 31, 2012; NOAA/NMFS 2012a) both identify the interim guidance as applicable for ESA consultations and MMPA permits until formal guidance measures are available.

As part of MMPA compliance, projects typically evaluate both ESA and non-ESA listed marine mammals. Under the current interim guidance, thresholds for "take" of marine mammals or behavioral disruption and injury are applied in MMPA permits and ESA consultations for marine mammals to evaluate the potential for sound effects (NOAA/NMFS 2010a, 2010b). *Take* is defined under the MMPA as: "harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect" marine mammals (NOAA/NMFS 2010a, 2010b).

NOAA/NMFS uses the following definitions for behavioral disruption and injury disruption for marine mammals, both of which would constitute "take" under the MMPA (Table 6):

1. ***Behavioral Disruption*****:** Significant behavioral response in a biologically important behavior or activity, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.
2. ***Injury Disruption*****:** A wound or other physical harm.

TABLE 6. MARINE MAMMAL DISTURBANCE AND INJURY THRESHOLDS FOR MARINE CONSTRUCTION NOISE

Functional Hearing Group	Airborne Noise Thresholds	Underwater Noise Thresholds		
	In-Air Sound Pressure Level (RMS)	Vibratory Pile Driving Disturbance Threshold	Impact Pile Driving Disturbance Threshold	Injury Threshold
Pinnipeds	90 dB_{rms} (un-weighted) for Pacific harbor seals; 100 dB_{rms} (un-weighted) for sea lions and all other pinnipeds (re: 20 ìPa²sec)	120 dB_{rms}	160 dB_{rms}	190 dB_{rms} [1]
Cetaceans	N/A	120 dB_{rms}	160 dB_{rms}	180 dB_{rms} [1]

Notes: [1] Source: 71 FR 3260
rms – root mean squared

3.2 PILE INSTALLATION NOISE AND SOUND THRESHOLDS

This request for a LoA assesses potential and predicted effects on marine mammals from proposed pile installation activities of the EBSP. This request focuses on in-water pile installation activities as they produce noise with the greatest potential to affect marine mammals in the aquatic marine environment, and both vibratory (continuous) and impact (impulsive) pile installation techniques are proposed as part of the EBSP. Other construction activities which are not expected to cause substantial impacts will be evaluated through the ESA-consultation process.

As specified under the current interim guidance, marine mammal exposure to in-water noise from continuous sources (i.e., vibratory pile installation) above an intensity of 120 dB_{rms} is assumed to cause behavioral or physiological effects. For impulsive sources (i.e., impact pile installation), marine mammal exposure to in-water sound above an intensity of 160 dB_{rms} is the lowest threshold for behavioral disruption. There is potential for injury of marine mammals from exposure to in-water sound levels at or above 190 dB_{rms} for pinnipeds and 180 dB_{rms} for cetaceans. In-water pile installation sound threshold levels of harassment permitted under the current NOAA/NMFS interim guidelines are summarized in Table 6.

Several recent pile replacement/installation projects have performed acoustic monitoring during construction activities. Collectively, this body of research has provided what can be considered to be expected estimates of noise produced through the pile-related aspect of the proposed action. Sampled noise values are available for different pile types (steel, concrete, or timber), pile-related activities (installation or removal), and methods of pile-related actives (vibratory or impact). A summary of sampled noise values is provided in Section 8 along with an assessment of anticipated effects.

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SECTION 4. EXISTING NOISE AND DISTURBANCE IN THE AREA OF POTENTIAL EFFECTS

Disturbance is common in an urbanized setting like the area of potential effects. Vessels move continually throughout the area, and construction and maintenance are universal as are general noise, vibration, and light from anthropogenic sources. These ubiquitous disturbances affect the distribution of organisms and displace individuals particularly sensitive to disturbance.

Underwater background noise levels have been shown to vary across specific locations and are influenced by human activities and natural phenomena such as wave action. Under the current interim guidance, the 120 dB_{rms} disturbance threshold may be somewhat adjusted if background noise levels have been shown to be at or above this threshold; other environmental conditions influence the threshold for significant physiological effects that can cause injury and would likely not be adjusted in the same manner. Quantifying background sound levels provides useful data that can be used to negotiate an adjustment in the 120 dB_{rms} threshold with NOAA/NMFS. Data on existing sound levels in Elliott Bay have been collected and used for two primary projects which required in-water pile installation in order to reduce the potential zone of marine mammal disturbance.

Washington State Department of Transportation (WSDOT) quantified background noise in Elliott Bay in April 2011 utilizing NOAA/NMFS guidance on collecting and reporting underwater background noise levels (WSDOT 2011b). One hydrophone was deployed with the Autonomous Multichannel Acoustic Recorder (AMAR) approximately 10 feet from the bottom and 2,864 feet from Colman Dock ferry terminal (Figure 6). Results of this survey identified average background levels of 126 dB_{rms} over a three-day period (Laughlin 2011). This result was thought to be due to the presence of individual large ships in the area which can cause peak noise levels to be much higher than background levels elsewhere.

A similar study performed over two contiguous days off of Pier 48 (on the south end of the project area) measured the average background noise to be 130 dB_{rms} (and a peak of 150 dB) (Hart Crowser 2012). At most times during the work day, noise levels (rms) ranged from 130 to 138 dB, with the higher values generally associated with small boat traffic and intermittent construction related activity on a work barge (Hart Crowser 2012).

Figure 6. Location of the Autonomous Multichannel Acoustic Sound Recorder (AMAR). The Elliott Bay Seawall Project Area is Located within the Yellow Polygon

SECTION 5. MARINE MAMMALS POTENTIALLY IN THE AREA OF POTENTIAL EFFECTS

Nine marine mammal species or distinct population segments may have the potential to occur in the area of potential effects considered in this application (Table 7). For the purpose of this application, the relative frequency of occurrence is either common, occasional, infrequent, or rare. All nine species have been observed in Puget Sound at certain periods of the year. Marine mammals are managed as stocks and individuals from those stocks may occur over a broader geographic area than just the area of potential effects and therefore may be encountered throughout the Puget Sound, Strait of Juan de Fuca, Strait of Georgia, and the outer coast.

TABLE 7. MARINE MAMMAL SPECIES WITH LIKELIHOOD OF OCCURRENCE IN THE AREA OF POTENTIAL EFFECTS

Marine Mammal Species	ESA Listing Status	Likelihood of Occurrence	Timing in Area
Pinnipeds			
Pacific harbor seal (*Phoca vitulina*)	Not Listed	Occasional	Year round
California sea lion (*Zalophus californianus*)	Not Listed	Occasional	August - April
Steller sea lion (*Eumetopias jubatus*)	Threatened, Designated Critical Habitat	Rare	August - April
Cetaceans			
Harbor porpoise (*Phocoena phocoena*)	Not Listed	Rare	Year Round
Dall's porpoise (*Phocoenoides dalli*)	Not Listed	Rare	Winter - Spring
Southern resident killer whale DPS (*Orcinus orca*)	Endangered, Designated Critical Habitat	Occasional	Year Round
Transient killer whale (*Orcinus orca*)	Not Listed	Rare	Year Round
Humpback whale (*Megaptera novaengliae*)	Endangered	Rare	February – June
Gray whale (*Eschrichtius robustus*)	Not Listed	Rare	January - September

Note: Rank frequency of occurrence is as follows: common, occasional, infrequent, or rare.

5.1 PACIFIC HARBOR SEAL

5.1.1 General Biology

This small stocky seal is found throughout the temperate and arctic waters of the Northern hemisphere and has the widest distribution of any pinniped (Jeffries et al. 2000). It is considered a non-migratory species, breeding and feeding in the same area throughout the year. In water, harbor seals use their hind flippers for propulsion, but on land they hitch along using only the fore flippers (Jeffries et al. 2000). The harbor seal is the most common and widely distributed pinniped found in Washington waters and is frequently sighted by recreational boaters, ferry passengers, and other users of the marine environment.

Harbor seals use hundreds of sites to rest or haul-out along coastal and inland waters, including intertidal sand bars and mudflats in estuaries; intertidal rocks and reefs; sandy, cobbley, and rocky beaches; islands; log booms, docks, and floats in all marine areas of the state (Jeffries et al. 2000). Group sizes typically range from small numbers of animals on some intertidal rocks to several thousand animals found seasonally in coastal estuaries. Males and females are similar in size (to 250 pounds) and coloration. Females produce 1 pup per year, beginning at age four or five. Pups are precocious at birth, capable of swimming and following their mothers into the water immediately after birth and typically remain with their mothers until weaning at four to six weeks of age (Jeffries et al. 2000).

5.1.2 Abundance, Productivity, and Trends

The harbor seal is the only pinniped species which is found year-round and breeds in Washington waters (Jeffries et al. 2000). Pupping seasons vary by geographic region, with pups born in coastal estuaries (Columbia River, Willapa Bay, and Grays Harbor) from mid-April through June; Olympic Peninsula coast from May through July; San Juan Islands and eastern bays of Puget Sound from June through August; southern Puget Sound from mid-July through September; and Hood Canal from August through January (Jeffries et al. 2000). The harbor seal; Washington inland population includes Hood Canal, Puget Sound, and the Strait of Juan de Fuca out to Cape Flattery (Carretta et al. 2007). In 1999, Jefferies et al. (2003) recorded a mean count of 9,550 harbor seals in Washington's inland marine waters.

5.2 CALIFORNIA SEA LION

5.2.1 General Biology

The California sea lion is the most frequently sighted pinniped found in Washington waters and uses haul-out sites along the outer coast, Strait of Juan de Fuca, and in Puget Sound (Jeffries et al. 2000). Haul-out sites are located on jetties, offshore rocks and islands, log booms, marina docks, and navigation buoys. This species also may be frequently seen resting in the water (rafted) together in groups in Puget Sound (Jeffries et al. 2000). Only male California sea lions migrate into northwest waters, with females remaining in waters near their breeding rookeries off the coast of California and Mexico. All age classes of males are present in Washington; with individuals ranging in size from 200 to 1,000 pounds. California

sea lions feed on a variety of fish and shellfish including various salmonids, rockfish, forage fish, and squid (Jeffries et al. 2000).

5.2.2 Abundance, Productivity, and Trends

The California sea lion was considered rare in Washington waters prior to the 1950s. Today, peak numbers of 3,000 to 5,000 animals move into Northwest waters (i.e., Washington and British Columbia) during the fall and remain until the late spring when most return to breeding rookeries in California and Mexico (Jeffries et al. 2000). Peak counts of over 1,000 animals have been made in Puget Sound in recent years.

The U.S. stock of California sea lion breeds in California and southern Oregon between May and July; California sea lions do not breed in Washington. They are typically observed in Washington between August and April, after they have dispersed from breeding colonies. Because California sea lions do not breed in Washington, accurate estimates of the non-breeding population in Washington are difficult and not available. Estimates from the 1980s suggest the population size was fewer than 3,000 by the mid-1980s (Bigg 1985). The number of California sea lions in Washington had stabilized by the 1990s (Calambokidis and Baird 1994).

5.3 STELLER SEA LION

5.3.1 General Biology

Steller sea lions are colonial breeders. Adult males, known as bulls, establish and defend territories on rookeries to mate with females. Bulls sexually mature between three and eight years of age, but typically are not large enough to hold territory successfully until nine or 10 years old. Mature males may go without eating for one to two months while aggressively defending their territory. Females, known as cows, typically reproduce for the first time at four to six years of age, usually giving birth to a single pup each year. At birth, pups are about 3.3 feet (1 meter) in length and weigh 35 to 50 pounds (16 to 22.5 kilograms). Adult females stay with their pups for a few days after birth before beginning a regular routine of alternating foraging trips at sea with nursing their pups on land. Female Steller sea lions use smell and distinct vocalizations to recognize and create strong social bonds with their newborn pups. Females usually mate again with males within two weeks after giving birth. Males can live to be up to 20 years old, while females can live to be 30 (summarized from NOAA 2011).

Steller sea lions prefer the colder temperate to sub-arctic waters of the North Pacific Ocean. Haul-outs and rookeries usually consist of beaches (gravel, rocky, or sand), ledges, and rocky reefs. In the Bering Sea and Okhotsk Sea, this species may also haul-out on sea ice, but this is considered atypical behavior (NOAA/NMFS 2005).

Steller sea lions are opportunistic predators, foraging and feeding primarily at night on a wide variety of fishes such as salmonids, rockfish, forage fish, bivalves, cephalopods, and gastropods. Steller sea lions forage in the nearshore and in pelagic waters. They are capable of traveling long distances in a season and can dive to approximately 1,300 feet (400 meters) in depth. Their diet may vary seasonally

depending on the abundance and distribution of prey. They may disperse and range far distances to find prey but are not known to migrate.

5.3.2 Abundance, Productivity, and Trends

While there are approximately 44,500 to 48,000 Steller sea lions in the eastern DPS, the portion within Washington is declining as is the western DPS (NOAA 2011). To safeguard their critical habitat, protective zones, catch/harvest limits, and other measures have been implemented around major haul-outs and rookeries.

5.4 HARBOR PORPOISE AND DALL'S PORPOISE

Harbor porpoise and Dall's porpoise species are analogous in natural history and distribution in regards to the proposed EBSP and are therefore described and assessed together.

5.4.1 General Biology

Harbor porpoises have a small, robust body with a short, blunt beak. Females are slightly larger than males. Harbor porpoises inhabit northern temperate and subarctic coastal and offshore waters (NOAA/NMFS 2012c). They are commonly found in bays, estuaries, harbors, and fjords less than 650 feet (200 meters) deep. They feed on demersal and benthic species, mainly schooling fish and cephalopods (NOAA/NMFS 2012c).

Dall's porpoises are fast swimming members of the porpoise family and are common in the North Pacific Ocean. This species prefers temperate or cooler waters that are more than 600 feet (180 meters) deep and with temperatures between 36°F (2°C) and 63°F (17°C) (NOAA/NMFS 2012b). They can be found in offshore, inshore, and nearshore oceanic waters. They feed on small schooling fish, mid- and deep-water fish, cephalopods, and occasionally crabs and shrimp. Feeding usually occurs at night when their prey vertically migrates up toward the water's surface. Dall's porpoises are capable of diving up to 1,640 feet (500 meters) in order to reach their prey (NOAA/NMFS 2012b).

5.4.2 Abundance, Productivity, and Trends

There are 10 stocks of harbor porpoises in United States waters: Bering Sea, Gulf of Alaska, Gulf of Maine-Bay of Fundy, Inland Washington, Monterey Bay, Morro Bay, Northern California-Southern Oregon, Oregon-Washington Coastal, San Francisco-Russian River, and Southeast Alaska. National Marine Fishery Service Stock Assessment Reports include estimated population sizes for the 10 U.S. stocks. The stock found in the area of potential effects; the inland Washington stock, is estimated to be 10,682 individuals as of 2006 (NOAA/NMFS 2012c).

For management purposes, Dall's porpoises inhabiting United States waters have been divided into two stocks: the Alaska Stock and the California/Oregon/Washington Stock (NOAA/NMFS 2012b). For both stocks, insufficient data are available to understand their current population trends. However, Dall's porpoises are generally considered reasonably abundant. For example, in the North Pacific, there are possibly 1.2 million animals. In U.S. waters, it is estimated that there are 130,000 individuals including

76,000 to 99,500 off the U.S. Pacific Coast (California, Oregon, and Washington) and 77,000 to 83,500 for the Alaska stock (NOAA/NMFS 2012b).

5.5 KILLER WHALE

Southern resident killer whales are expected to have the highest potential of the killer whale DPS to occur in the area of potential effects. As a result, they will be the DPS of primary focus in this document. Transient killer whales may occasionally occur and are discussed where appropriate.

5.5.1 General Biology

Although relatively little is known about the winter movements and range of southern resident killer whales, they have been seen in coastal waters off of Oregon, Washington, Vancouver Island, central California and the Queen Charlotte Islands (NOAA 2006). They are known to move through Elliott Bay on occasion but typically remain offshore and out of the area of potential effects. Killer whale pods aggregate temporarily throughout the year and are often seen traveling and socializing together (Osborne et al. 1988; Osborne 1999; Ford et al. 2000; Kriete 2007). Breeding is assumed to also take place during these social encounters, although it has never reliably been observed in the wild. Though mating is thought to occur from May to October, young are born year-round (Osborne et al. 1988; Osborne 1999; Ford et al. 2000; Kriete 2007). Gestation averages 17 months in captive situations (Asper et al. 1988, Walker et al. 1988, Duffield et al. 1995). Killer whales are known to be polygamous and males commonly mate with females outside their pods (Dahlheim and Heyning 1999; Barrett-Lennard 2000; Barrett-Lennard and Ellis 2001). Female and male southern resident killer whales reach sexual maturity at about 15 years of age.

The lifespan of killer whale females is estimated to be between 80 and 90 years and 50 to 60 years for males (Olesiuk et al. 1990). The life expectancy at birth ranges from 17 years for males to 29 years for females (Olesiuk et al. 1990). That number increases greatly for whales that survive the first six months of life; from 50 to 60 years for females and 29 years for males.

Southern resident killer whales feed primarily on salmonids and other marine fishes and large marine animals. They are often found in and around Puget Sound during the summer and early fall pursuing migrating salmon (Osborne et al. 1988; Osborne 1999; Kriete 2007). At times, they have also been observed preying on marine mammals including pinnipeds and other cetaceans (NOAA 2006). Their unique foraging strategies include cooperative hunting, food sharing, and innovative learning (Smith et al. 1981; Pitman et al. 2003). However, very little is known about winter feeding habits of southern resident killer whales.

5.5.2 Abundance, Productivity, and Trends

The southern resident killer whale DPS is composed of three pods: J, K, and L pods, number upwards of 90 whales total. They are found in and around Puget Sound and the San Juan Islands during the summer and early fall feeding on migrating salmon, although J pod is the most consistent (Osborne et al. 1988; Osborne 1999; Kriete 2007; Osborne 2008). More commonly, they are found in Haro Strait, Boundary Passage, the southern Gulf Islands, eastern portions of the Strait of Juan de Fuca, and in the southern

Strait of Georgia (Heimlich-Boarn 1988; Felleman et al. 1991; Olson 1998; Ford et al. 2000). This DPS has experienced a marked decline in recent years and several pods along the Strait of Juan de Fuca and in Hood Canal may be moving towards extinction (NOAA 2006).

5.6 HUMPBACK WHALE

5.6.1 General Biology

The California/Oregon/Washington stock of humpback whales spends summer and fall in high latitude waters off the coast of southern California to southern British Columbia (NOAA 1991). During this period, they spend the majority of their time feeding in the highly productive systems to build up fat stores (blubber) to sustain them through the winter. In the winter, they migrate to low-altitude areas of Central America and Mexico where they mate and give birth (NOAA 1991). Though humpback whales are observed along the northwest coast of the U.S. and British Columbia in most every month, it is unknown whether they use these areas for purposes other than migration (NOAA 1991).

Humpbacks feed primarily on krill (tiny crustaceans), plankton, and small fish. Of the baleen whales, humpbacks exhibit the most diverse feeding behaviors, including a highly complex method of herding incorporating "bubble netting" where individuals work in defined roles to distract, scare, and herd prey that is corralled near the surface (NOAA 1991).

5.6.2 Abundance, Productivity, and Trends

The population of humpback whales has been in severe decline due to commercial whaling (Rice 1978). Since the cessation of commercial whaling in 1967 by the International Whaling Commission, there is evidence that humpback populations are increasing at an estimated rate of seven percent per year from 1990 to 2002 (IWC 2012). The status of the humpbacks in the North Pacific have not been fully assessed; however, their abundance in the *total* North Pacific is estimated at 17,000 (IWC 2012). Whaling is only permitted for subsistence, yet current threats still include entanglement in fish gear, ship collisions, entrapment, disturbance due to shipping and boating, pollutants, exploration for gas and minerals, habitat loss, and competition (NMFS 1991).

5.7 GRAY WHALE

5.7.1 General Biology

Gray whales spend April through November in Arctic feeding grounds and December through April in Mexican breeding areas. Between October and February, the species migrates south along the West Coast, returning north between February and July. This round trip migration of 7,400 to 12,400 miles every year is believed to be the longest of any mammal (Rice et al. 1984; Rugh et al. 2001).

The gray whale is unique among cetaceans as a bottom-feeder that rolls onto its side, sucking up sediment from the seabed. Benthic organisms that live in the sediment are trapped by the baleen plates as water and silt are filtered out. Gray whales feed in shallow waters, usually 150 to 400 feet deep. Adults can consume 1 to 1½ tons of food per day during peak feeding periods (Rugh et al 2001).

5.7.2 Abundance, Productivity, and Trends

Systematic counts of Eastern North Pacific gray whales migrating south along the Central California Coast have been conducted by shore-based observers at Granite Canyon most years since 1967. The most recent abundance estimates are based on counts made during the 1997/98, 2000/01, and 2001/02 southbound migrations, and range from about 18,000 to 30,000 animals. In contrast, the Western North Pacific population remains highly depleted and its continued survival is questionable. This population is estimated to include fewer than 100 individuals.

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SECTION 6. STATUS AND OCCURRENCE OF SPECIES

Species status under the ESA and MMPA are discussed in this section to provide a reference of additional sources of protection for certain Elliott Bay species. This is important for understanding what other protections the species discussed in this document may have and what agencies are responsible for enforcing these protections. Status and occurrence in the area of potential effects are presented in Table 7 (see Section 5).

Quantifying the occurrence of each species in the area of potential effects is problematic and difficult to accomplish accurately for several reasons. Marine mammal biology and behavior that facilitates living in water with little if any ties to land makes it inherently difficult for land-based scientists to study marine mammal demographics. Observations of marine mammals at or above the water surface, although useful when documented, likely only occur during a fraction of the time that an individual is in any one area, and as a result only constitute a small look into where they may actually range. Although observational data collected by organizations such as The Whale Museum are regarded as the best, most complete demographic data available for the region, they are collected via "citizen science" by untrained observers who may overlook or misidentify certain species, incorrectly estimate numbers of individuals, and/or double-count individuals. Such errors can inflate or deflate population estimates. Furthermore, as the public is responsible for reporting sightings, waters nearest areas of highest human densities have the greatest probability for observations to occur. In contrast, waters further from humans likely allow marine mammals to remain unnoticed. Observational bias cannot be controlled in these types of data and needs to be recognized and considered with each population estimate for each marine mammal species. Collecting more accurate demographic data is possible but would require an extensive investment of time, materials, and capital. These constraints result in the proposed collection of more accurate data to be considered cost prohibitive.

Population data used for this analysis were obtained only from sources considered relatively reliable and/or accurate: The Whale Museum, NOAA/NMFS stock assessment reports, WDFW publications, and Federal Register ESA documents. Although these sources are appropriate to use and reference, the data they provide have limited utility for MMPA assessments. Stock reports and ESA documents typically do not provide spatial data at a fine enough scale to be used for estimating demographics in areas as small as the area of potential effects. When specific population estimates are available as in the case for pinniped haul-outs, they are provided as wide estimates (i.e., less than 100, 100 to 500, and greater than 500), which when applied to calculating maximum values for "take" estimates are likely to greatly inflate the results. However, these data are the best available for estimating "take" in the area of potential effects and were used accordingly in this analysis. Procedures, calculations, and assumptions used in estimating "take" inherently inflate numbers by allowing for an individual to incur "take" every 24 hours and assume that all individuals in a population of an estimated size have the potential to move through the area of potential effects each day. Estimates of "take" may become substantially inflated when maximum population sizes are used for the calculations; a procedural step that allows estimates to be conservative.

The constraints of the data and potential for inflation of "take" estimates should be considered when reviewing the findings of this document. Because the goal of this exercise is to provide conservative

"take" estimates, only maximum population values were used in the calculations. It is anticipated that calculated "take" estimates would not be reached in application during the proposed construction (as long as they are tallied accurately in the field). Additional anecdotal information is also described to provide best professional perspective on how accurate each "take" estimate is anticipated to be. Anecdotal sources include the following:

- Appendix K Technical Memo; Ecological and Human Health Risk Assessments Pacific Sound Resources Marine Sediments Unit, Volume II, EPA Region X: Provides a description of California sea lions hauled-out on floats and navigation buoys moored within the Marine Sediment Unit during September 1996.
- The Blubber Blog: Includes unsubstantiated observations of various pinnipeds in and out of the area of potential effects.
- Seal Sitters: Includes unsubstantiated observations of various pinnipeds in and out of the area of potential effects.
- KOMO News Blog: Includes unsubstantiated observations of various marine mammals in and out of the area of potential effects.
- ARCS Quality Assurance Concurrence Feasibility Study: Provides descriptions of observations of pinniped in and around the area of potential effects.
- Lower Duwamish Waterway Superfund Site, Terminal 117 Early Action Area; Terminal 117 Engineering Evaluation/ Cost Analysis: Unsubstantiated descriptions of common pinniped haul-outs and harbor porpoise use in and around the area of potential effects.

6.1 PACIFIC HARBOR SEAL

6.1.1 Species Status

The Pacific harbor seal is not currently listed under the ESA. No critical habitat has been designated for this species.

Harbor seals are not considered to be "depleted" under the MMPA. Based on currently available data, the level of human-caused mortality and serious injury is not known to exceed a potential biological removal of 1,343 harbor seals per year. Therefore, the Oregon/Washington Coast stock of harbor seals is not classified as a "strategic" stock.

6.1.2 Occurrence in the Area of Potential Effects

Individuals occur along the Elliott Bay shoreline (WSDOT 2004). There is one documented harbor seal haul-out area near Bainbridge Island, approximately six miles from the EBSP and outside of the area of potential effects, and it is estimated at less than 100 animals (Jefferies et al. 2000). The haul-out consists of intertidal rocks and reef areas around Blakely Rocks and is within the area of potential effects but at the outer extent near Bainbridge Island (Jefferies et al. 2000). Harbor seals are perhaps the most commonly observed marine mammal in the area of potential effects and are known to be comfortable and seemingly curious around anthropomorphic disturbance.

6.2 CALIFORNIA SEA LION

6.2.1 Species Status

California sea lions are not listed under the ESA and are not listed as "depleted" under the MMPA. They are not considered a "strategic" stock under the MMPA because total human-caused mortality (1,483 fishery-related mortalities plus 78 from other sources) is less than the potential biological removal (i.e., the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population) of 8,333 individuals (Caretta et al. 2007).

6.2.2 Occurrence in the Area of Potential Effects

There are three documented California sea lion haul-outs near the project area; all are located approximately six miles away (Jefferies et al. 2000) and outside of the area of potential effects. These haul-outs include a yellow 'T' buoy off Alki Point, a yellow 'SG' buoy between West Point and Skiff Point, and a red buoy off Restoration Point (Jefferies et al. 2000). The haul-outs have all been identified to have populations less than 100 individuals. It is assumed that California sea lions seen in and around the project area use these haul-outs. California sea lions are occasionally observed in the area of potential effects and are known to be comfortable and seemingly curious around anthropomorphic disturbance.

6.3 STELLER SEA LION

6.3.1 Species Status

Steller sea lions were listed as threatened range-wide under the ESA on November 26, 1990 (55 Federal Register 49204). The population is comprised of two recognized management stocks (eastern and western), separated at 144 West longitude (NOAA 2011). The western stock was listed as endangered under the ESA on May 4, 1997 and the eastern stock remains classified as threatened (62 FR 24345). Only the eastern stock is considered in this application because the western stock occurs outside of the geographic area of the activities under consideration. Steller sea lions are listed as "depleted" under the MMPA. Both stocks are thus classified as strategic.

Critical habitat for the Steller sea lion was designated August 27, 1993, based on the location of terrestrial rookery and haul-out sites, spatial extent of foraging trips, and availability of prey; no critical habitat was designated in Washington.

6.3.2 Occurrence in the Area of Potential Effects

Steller sea lions are at most a rare visitor to the EBSP area of potential effects. Steller sea lions use haul-out locations in Puget Sound. The nearest haul-out to the project area is located approximately six miles away and outside the area of potential effects. This haul-out is composed of net pens offshore of the south end of Bainbridge Island. The population of Steller sea lions at this haul-out has been estimated at less than 100 individuals (Jeffries et al. 2000). Review of many anecdotal accounts indicated that this species is rarely seen in the area of potential effects.

6.4 HARBOR PORPOISE AND DALL'S PORPOISE

6.4.1 Species Status

Neither harbor porpoise nor Dall's porpoise currently receive special protection beyond that provided by the MMPA.

6.4.2 Occurrence in the Area of Potential Effects

Harbor porpoise are known to occur year-round in the inland trans-boundary waters of Washington and British Columbia, Canada (NOAA/NMFS 2006). Although differences in density exist between coastal Oregon/Washington and inland Washington waters, a specific stock boundary line cannot be identified based upon biological or genetic differences. However, harbor porpoise movements and rates of intermixing within the eastern North Pacific are restricted, and there has been a significant decline in harbor porpoise sightings within southern Puget Sound since the 1940s, and today, harbor porpoise are rarely observed. Recently, there have been confirmed sightings of harbor porpoise in central Puget Sound (NOAA/NMFS 2006); however, no reports of harbor porpoises in the area of potential effects were made during 2011 (Whale Museum 2011). The harbor porpoise stock report estimates the total number of individuals which incur human-caused mortality throughout all of Puget Sound was 15.2 approximately five years ago (NOAA/NMFS 2006). It is likely that harbor porpoises only rarely occur in the area of potential effects.

Dall's porpoises are endemic to temperate waters of the North Pacific Ocean. Off the U.S. West Coast, they are commonly seen in shelf, slope, and offshore waters. Sighting patterns from aerial and shipboard surveys conducted in California, Oregon, and Washington at different times suggest that north-south movement between these states occurs as oceanographic conditions change, both on seasonal and inter-annual time scales. Only rarely have reports of Dall's porpoises been made for the area of potential effects. The mean annual human-caused mortality of this species in Puget Sound is approximately 0.2 individuals or approximately 1 individual every five years (NOAA/NMFS 2011b). No reports of Dall's porpoises were made in or near the area of potential effects during 2011 (Whale Museum 2011). It is likely that Dall's porpoise only rarely occur in the area of potential effects.

6.5 KILLER WHALE

6.5.1 Species Status

The southern resident killer whale DPS was listed as endangered under the federal ESA on November 18, 2005 (70 FR 69903). Critical habitat was designated on November 29, 2006 (71 FR 69054), and includes all marine waters greater than 20 feet in depth. Critical habitat for the this DPS includes three specific areas: the summer core area in Haro Strait and waters around the San Juan Islands; Puget Sound; and the Strait of Juan de Fuca (NOAA 2006). By formally receiving a listing status as endangered under the ESA, southern resident killer whales were automatically considered as a "strategic" stock under the MMPA. This stock was considered "depleted" prior to its 2005 listing under the ESA. Transient killer whales are currently listed as "depleted" but have no listing status under the ESA.

6.5.2 Occurrence in the Area of Potential Effects

A long-term database maintained by the Whale Museum monitors sightings and geospatial locations of southern resident killer whale, among other marine mammals, in inland waters of Washington State (Osborne 2008). Data are largely based on opportunistic sightings from a variety of sources (i.e., public reports, commercial whale watching, Soundwatch, Lime Kiln State Park land-based observations, and independent research reports) but is regarded as a robust but difficult to quantify inventory of occurrences. The data provides the most comprehensive assemblage of broad-scale habitat use by the DPS in inland waters. Based on reports from 1990 to 2008, the greatest number of unique killer whale sighting-days near or in the area of potential effects occurred from November through January, although observations were made during all months except May (Osborne 2008). Most observations were of southern resident killer whales passing west of Alki Point (82 percent of all observations), which lies on the edge or outside the area of potential effects; a pattern potentially due to the high level of human disturbance or highly degraded habitat features currently found within Elliott Bay. Of the pods that compose this DPS, J Pod, with an estimated 26 members, is the pod most likely to appear year-round near the San Juan Islands, in the lower Puget Sound near Seattle, and in Georgia Strait at the mouth of the Fraser River. J Pod tends to frequent the west side of San Juan Island in mid to late spring (CWR 2011). An analysis of 2011 sightings described an estimated 93 sightings of southern resident killer whales near the area of potential effects (Whale Museum 2011). During this same analysis period, 12 transient killer whales were also observed near the area of potential effects. The majority of all sightings in this area are of groups of killer whales moving through the main channel between Bainbridge Island and Elliott Bay and outside the area of potential effects (Whale Museum 2011). The purely descriptive format of these observations make it impossible to discern what proportion of the killer whales observed entered into the area of potential effects; however, it is assumed individuals do enter into this area on occasion.

6.6 HUMPBACK WHALE

6.6.1 Species Status

The humpback whale was listed as endangered under the ESA on December 2, 1970 (35 FR 18319). No critical habitat has been designated for this species. By formally receiving a listing status as endangered under the ESA, humpback whales were automatically considered as a “strategic” stock under the MMPA.

6.6.2 Occurrence in the Area of Potential Effects

Humpback whales are found in coastal waters of Washington as they migrate from feeding grounds in Alaska to California to winter breading grounds in Mexico. Humpbacks are only rare visitors to Puget Sound. In 1976 and 1978, two sightings were reported in Puget Sound and later, 1 sighting in 1986 (Everitt et al. 1980; Osborne et al. 1988; Calambokidis and Steiger 1990; Calambokidis and Baird 1994). There is evidence of increasing numbers in recent years (Falcone et al. 2005). A rare encounter with 1 and possibly two humpbacks occurred in Hood Canal (well away from the area of potential effects) as recently as February 2012 (Whale Museum 2012). Humpbacks do not visit Puget Sound every year and

are considered rare in the area of potential effects (Whale Museum 2011); however, they have the potential to occur at least once during the proposed EBSP construction period during its seven-year duration.

6.7 GRAY WHALE

6.7.1 Species Status

The Eastern North Pacific stock of the gray whale, which is found in Washington waters, has been delisted under the ESA. The Western North Pacific stock of gray whales that does not occur in the Pacific Northwest has not recovered and remains listed as endangered. No critical habitat is currently established in the EBSP area of potential effects. Gray whales currently have no formal designation under the MMPA.

6.7.2 Occurrence in the Area of Potential Effects

Eastern North Pacific gray whales occur frequently off the coast of Washington during their southerly migration in November and December, and northern migration from March through May (Rugh et al. 2001; Rice et al. 1984). Gray whales are observed in Washington inland waters regularly between the months of January and September, with peaks between March and May (CWR 2011; Whale Museum 2012). Gray whale sightings are typically reported in February through May and include an observation of a gray whale off the ferry terminal at Pier 52 heading toward the East Waterway in March 2010 (CWR 2011; Whale Museum 2012). Three gray whales were observed near the project area during 2011 (Whale Museum 2011) but the narrative format of the observations make it difficult to discern whether these individuals entered into the area of potential effects. It is assumed that gray whales might rarely occur in the area of potential effects.

SECTION 7. AUTHORIZATION REQUESTED

SDOT requests a LoA for behavioral "take" of marine mammals protected under the MMPA for construction of the proposed EBSP but only occurring from the beginning of September to the end of May each construction season. If provided, the five-year authorization would allow for annual LoAs for each of the first five construction seasons. A request for a second LoA or Incidental Harassment Authorization will be initiated and submitted prior to the end of the fifth year of construction. An expected maximum estimate of "take" for each species was calculated through analysis in this document (details are presented in the following sections). The expected analysis estimates range from small to moderate numbers of instances of "take" for each species, all of which would be through behavioral disruption. No injury or death to any marine mammal is expected to occur due to the proposed project and monitoring would be included as a protective measure (see Sections 12 and 14). In general, the proposed project would result in the potential for minor effects on all marine mammal populations found in the area of potential effects. Seattle Department of Transportation is requesting a LoA to cover the expected long duration of construction and allow work to continue without frequent shutdown periods when marine mammals travel through the area, well away from the area of active construction.

The MMPA defines ''harassment'' as "any act of pursuit, torment, or annoyance which (1) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment], or (2) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment] (50 C.F.R, Part 216, Subpart A, Section 216.3-Definitions). Level A is the more severe form of harassment because it may result in injury or death, whereas Level B only results in disturbance without the potential for injury.

SDOT requests a LoA for "take" from Level B (behavioral only) harassment that will cover construction of the EBSP for California sea lion, Pacific harbor seal, Steller sea lion, harbor porpoise, Dall's porpoise, killer whale (both southern resident DPS and transient), humpback whale, and gray whale. Vibratory and impact pile installation are the construction activities with the greatest potential for causing Level B harassment. The only scenario that has any potential to cause Level A harassment to marine mammals is unattenuated impact pile driving of steel sheet piles; the calculated distance to Level A thresholds from the point-source of impact pile driving is 152 feet for cetaceans and 33 feet for pinnipeds. Use of attenuation techniques is limited for steel sheet piles; thus, unattenuated levels have been assumed in all calculations. As pile driving would only occur within 10 feet of the existing seawall, little suitable habitat for pinnipeds would be present within the threshold distances and virtually no habitat is present for cetaceans. It is therefore anticipated that Level A harassment (injury) of cetaceans would not occur due to noise from pile driving activities; and with the implementation of prescribed conservation and mitigation plans and techniques (presented in Sections 12 and 14), Level A harassment of marine mammals is not likely to occur. Using "soft start" techniques and employing marine mammal observers would work in concert to ensure all marine mammals in the area of potential effects are inventoried and tracked at all times, and will have sufficient opportunity to move away from any thresholds prior to being harmed in anyway. Observers would primarily function to stop construction if a marine mammal

were to enter the exclusion zone around the pile driving activities where threat of harm could be possible. No area of potential injury exists from vibratory pile driving.

Due to constraints of the available data used for this analysis (as described in Section 6), all "take" estimates presented here are conservative and were calculated using maximum population estimates corrected by available observations or anecdotal information for each species from the area of potential effects from the last five years. It was assumed that individual marine mammals could incur "take" up to once every day of active construction. This conservative approach is intended to provide appropriate "take" estimates to prevent exceedances from occurring (and hence requiring re-consulting with NOAA/NMFS); however, it is anticipated that actual "take" values will be much smaller.

SECTION 8. ANTICIPATED EFFECTS ON MARINE MAMMALS

A threshold of 120 dB_{rms} for behavioral disruption of marine mammals from vibratory pile driving translates to a large area of potential effects using the practical spreading model (equation below). This area was estimated to extend from the seawall to Bainbridge Island (Figure 5; see Section 2). Noise attenuates as the distance from the source of the noise increases. Noise attenuation levels also vary due to factors such as background sound levels, source noise frequency, pile material and size, substrate type, distance to the nearest land mass, water depth, and use of sound attenuation devices (such as cushioning blocks).

PRACTICAL SPREADING MODEL

Transmission loss (dB) = F*log(D1/D2)

Where:

D1 = The distance at which the targeted transmission loss occurs;

D2 = The distance from which transmission loss is calculated (usually 10 meters);

F = A site-specific attenuation factor based on several conditions, including water depth, pile type, pile length, substrate type, and other factors; and

Transmission loss (TL) = The initial sound pressure level (dB) produced by a sound source (i.e., pile driving) minus the ambient sound pressure level or a target sound pressure level (e.g., the injury threshold for salmon). TL also can be thought of as the change in sound pressure level between D1 and D2.

The practical spreading loss model assumes that sound energy decreases at a rate of 4.5 dB per doubling of distance.

Federal and state agencies have developed models to calculate noise attenuation for in-water pile installation activities. Although there is consensus on existing noise attenuation models, research on in-water noise and the effects on wildlife species is an ongoing effort. For sound level analysis, A-Z steel sheet piles have been measured as having sound levels of 175 dB peak levels, 160 dB_{rms}, and 160 dB_{sel} for vibratory pile installation (CALTRANS 2007) (Table 8). Based on these data and the noise attenuation practical spreading model used by NOAA/NMFS, WSDOT, and the Washington State Ferries, the following sound level attenuation distances have been identified for in-water vibratory pile installation (NOAA/NMFS 2010c; WSDOT 2011a): 160 dB_{rms} sound level reduces to 120 dB_{rms} (126 dB_{rms} ambient) at 11.5 miles from the source (dB_{rms} was used for this estimate as vibratory pile installation creates only continuous noise and not pulse noise).

TABLE 8. SUMMARY OF NEAR-SOURCE (10-METER) UNATTENUATED SOUND PRESSURES FOR IN-WATER PILE INSTALLATION USING AN IMPACT HAMMER AND NEAR-SOURCE (10-METER) UNATTENUATED SOUND PRESSURES FOR IN-WATER PILE INSTALLATION USING A VIBRATORY DRIVER/EXTRACTOR

Pile Type and Approximate Size	Method	Relative Water Depth	Average Sound Pressure Measured in dB	
			Peak	RMS
Creosote-treated 14-inch-diameter timber pile	Vibratory Removal	~15 meters	164	150
16.5-inch-diameter precast concrete octagonal pile	Impact	~15 meters	188	176
Steel sheet pile pair; 48-inches in length per pair	Vibratory (Installation and Removal)	~15 meters	182	165
Steel sheet pile pair; 48-inches in length per pair	Impact (Installation Proofing)	~15 meters	205	190

Sources: CALTRANS 2009 and WSDOT 2011a
Notes: dB = decibels, RMS = root mean squared, SEL = sound exposure level

Note that Elliott Bay is less than three miles wide. In many areas of Puget Sound, such as Elliott Bay, intersection with a land mass is likely to occur before the attenuation distance is reached.

Distance thresholds that account for each pile-related activity (impact or vibratory), pile type (steel sheet pile or concrete pile), and the biology of each taxa (their sensitivity to noise), have been calculated and are presented in Table 9. Additional details are also considered in these threshold calculations such as whether attenuation devices are employed and the measured ambient noise in the construction area.

TABLE 9. CALCULATED DISTANCES TO THRESHOLD VALUES FOR PILE-RELATED NOISE

Criterion Definition	Distance Pinnipeds	Distance Cetaceans
24-inch Steel Sheet Pile (Vibratory)		
Injury	0.2 m (0.7 ft.)	1 m (3.3 ft.)
Behavioral Effects	3,981 m (2.5 mi)	3,981 m (2.5 mi)
24-inch Steel Sheet Pile (Impact, Unattenuated)		
Injury	10 m (33 ft.)	46 m (152 ft.)
Behavioral Effects	1000 m (3,280 ft.)	1000 m (3,280 ft.)
24-inch Concrete Pile (Impact, Unattenuated)		
Injury	1 m (3.3 ft.)	5 m (18 ft.)
Behavioral Effects	117 m (383 ft.)	117 m (383 ft.)
24-inch Concrete Pile (Impact, Attenuated)		
Injury	0.5 m (1.8 ft.)	2.5 m (8.2 ft.)
Behavioral Effects	54 m (177 ft.)	54 m (177 ft.)

Most distances to injury thresholds (for vibratory steel sheet pile and impact concrete piling installations) were calculated to be located very close to the noise point-source, rendering them functionally at a distance of zero. In other words, the only way a marine mammal could be injured by noise from pile-related activities would be if they were located immediately adjacent to the pile being driven. However, longer distances to injury thresholds were calculated for impact pile installation for steel sheet pile: 152 feet for cetaceans and 33 feet for pinnipeds. In other words, if an individual of either taxon is present within their corresponding distance during impact driving of steel sheet piles, they could incur injury. However, as all piles will be driven within 10 feet of the existing seawall, effectively no habitat exists for pinnipeds within the 33-foot threshold and little is present within the 152-foot threshold for cetaceans. Using observers and other mitigation and conservation measures, such as an exclusion zone, would add robust insurance that no injury to any marine mammal will be caused by pile related noise.

Harassment (i.e., disturbance) thresholds were also calculated and are presented in Table 9. The greatest disturbance threshold distance from a noise point source was calculated to be 2.5 miles for vibratory installation of steel sheet pile. Marine mammals that are within 2.5 miles from vibratory installation or removal activities of steel sheet piles could be considered “harassed” and a “take” would be tallied for that individual.

Background noise present in the area of potential effects has reduced threshold distances somewhat. The unnaturally loud existing marine environment is viewed to render much of the area of potential effects poor quality habitat for marine mammals. Background noise in the area of potential effects is higher than the established noise threshold for disturbance of 120 dB_{rms}, and has been measured to average between 126 dB_{rms} and 130 dB_{rms} (Laughlin 2011). Background noise in the area of potential effects would be assumed to provide a near-constant disturbance to marine mammals, particularly during daylight hours when most if not all pile installation activities would occur. Anthropomorphic activities associated to the noise would likely also cause visual disturbance to marine mammals in close proximity. Such frequent and substantial baseline disturbance may translate into far fewer marine mammals actually being present in or near the area of potential effects.

Anticipated effects on marine mammals resulting from the EBSP include limited disturbance from increased human presence and marine traffic while individuals forage, rest, or travel in the area of potential effects, and disturbance from pile installation activities. Pile driving activities may also cause harm to prey species such as fish, alter marine mammal feeding behavior, or displace animals from the area. Other project activities may result in temporary modification in marine mammal behavior such as avoidance of the construction area or changes in foraging patterns due to increased noise and turbidity. Negative long-term effects are not anticipated. A net improvement in the nearshore environment would result from the proposed project and likely have a positive long-term effect on marine mammals.

Potential direct effects on marine mammals resulting from the project fall into three categories: effects from short-term construction-related noise, effects from installed habitat features on overall ecosystem quality, and effects from water and sediment quality improvements.

Construction-Related Noise: In-water noise can alter movement patterns, delay or eliminate feeding, or cause direct damage or mortality to individual marine mammals at close range. In the area of potential

effects, construction-related noise and underwater sound pressure, particularly from pile installation activities, may affect marine mammals that occur in the area of potential effects during active construction. Potential effects, however, would be substantially reduced through the use of noise attenuation measures for impact pile driving and monitoring for marine mammals during both vibratory and impact pile installation. If a non-ESA-listed marine mammal species enters the area of potential effects work would not be stopped, but the individual(s) would be continually observed to document behavior and continually assess risk to the individual from construction activities.

New Habitat Features: A large portion of the EBSP is proposed habitat enhancement in the nearshore, which includes improving the quality of substrate, adding riparian plantings, burying contaminated sediment, and adding light-penetrating surfaces to overwater structures to enhance the quality of the area for salmonid migration. There is a small potential that construction of these features would disturb marine mammals present in close proximity to the project area. As pile installation is not directly associated to any of these features, effects from pile installation noise would not apply. In-water work could, however, cause disturbance to marine mammals from general equipment/barge noise and temporarily increased turbidity. Overall, these habitat enhancements would likely benefit marine mammals indirectly as they are designed to increase habitat quality for prey species such as salmonids and marine invertebrates that sustain many species of marine mammals assessed in this document.

Water and Sediment Quality: Marine mammals are especially vulnerable to contaminants because they are high up in the trophic level and may experience bioaccumulation. Water quality would generally improve as a result of the construction of stormwater treatment facilities associated with the EBSP. Currently, stormwater from the project area is discharged untreated into Elliott Bay. After completion of the project, stormwater leaving the project site would receive basic treatment to remove the majority of suspended sediments and any pollutants bound to sediment. Analysis of post-project stormwater plumes conducted for the ESA analysis indicates that pollutants of concern to fish species will dilute to background concentrations generally within five feet of the outfalls; thus stormwater would have only negligible effects on marine mammal prey species. The installation of the habitat features would generally bury up to two acres of low to moderately contaminated sediments and reduce the potential exposure of marine invertebrates and salmonids to contaminants and the potential for bioaccumulation up the food chain to marine mammals.

SECTION 9. NUMBER AND SPECIES POTENTIALLY AFFECTED

Estimating number of "take" for each marine mammal species is a speculative endeavor for the EBSP as contemporary quantitative data on frequency of occurrence and/or demographics in the area of potential effects are not available. General estimates of frequency, however, are possible to quantify using qualitative information from a number of sources. The limits of the quality of this data require calculated estimates to remain coarse. As the philosophy of this LoA request is to calculate maximum but reasonable potential "take" estimates, the numbers presented here represent the highest reasonable expected per year "take" estimates for each marine mammal species in the area of potential effects due to vibratory pile-related activities for the EBSP.

The only expected "take" to occur due to the EBSP is Level B harassment (i.e., disturbance); as such, any individual marine mammal can theoretically incur "take" more than once every 24 hours if each disturbance does not cause their displacement from the area of potential effects. It is anticipated that individual marine mammals, such as harbor seals and California sea lions, may incur more than one "take" during construction activities as the level of disturbance from the EBSP will be relatively low, particularly relative to existing background noise levels. Multiple "take" events on single individuals are anticipated to occur more readily to resident marine mammals such as pinnipeds associated to local haul-outs located in or near the area of potential effects. Through consultation with NOAA/NMFS, the window of time between incidences of "take" on any one individual is set as a 24-hour period (NOAA/NMFS 2012a). "Take" estimates for each marine mammal species discussed in this document are presented and discussed in the following sections.

9.1 PACIFIC HARBOR SEAL

Individuals are known to occasionally occur along the Elliott Bay shoreline (WSDOT 2004). There is one documented harbor seal haul-out estimated at less than 100 animals near Bainbridge Island, approximately six miles from the EBSP and out of the area of potential effects. The haul-out consists of intertidal rocks and reef areas around Blakely Rocks. Only individuals swimming in the area of potential effects could incur "take" if present during active in-water pile-related work.

As Pacific harbor seals are present in Puget Sound year round, a maximum estimate of 100 individuals can be assumed to be potentially exposed to noise disturbance from vibratory pile installation and/or removal each day these activities occur. However, anecdotal reports indicate that at most only 1 to 5 individuals are present in the nearshore of the Seattle waterfront any one day. Taking into account individuals that may haul-out around Alki Point (the site of the largest consistently active haul-out in the area) approximately 2.4 miles from the seawall, an additional 20 may occur in the area of potential effects any one day. Therefore, using available anecdotal data and sighting information, a conservative estimate of 50 individuals in total would be expected to be in the area of potential effects each day of construction. The number of days vibratory pile installation and/or removal is scheduled to occur each calendar year will be used as the multiplier for the expected maximum estimated population present in the area of potential effects each day, with the sum providing the estimated "take" for this species per year. Based on data presented in Tables 1, 3, 4, and 5 and best available quantified demographic estimates for this species corrected by anecdotal observations, maximum estimates of "take" per year

and per day due to construction related pile installation and removal noise were calculated and are summarized in Table 10.

TABLE 10. ESTIMATED "TAKE" FOR PACIFIC HARBOR SEALS

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	895	50
2014	26.2	1,310	50
2015	26.2	1,310	50
2016	25.8	1,290	50
2017	0.5	25	25

Although some of the annual "take" estimates are moderately large, they are all for Level B harassment (behavioral only) and no Level A harassment (injury) is anticipated to occur. They also mostly represent "take" to the same individuals across consecutive days and do not represent a total number of individuals that incur "take" episodes. Because these are maximum expected estimates, many fewer "take" events are actually anticipated for this species. If individuals incur "take" more than once, it can be assumed that they are not in fact incurring significant effects since they remain in the area of potential effects. Furthermore, the majority of these animals likely already stay well away from the Seattle downtown waterfront due to the high level of existing background noise and disturbance. As few individuals use the area of potential effects relative to the greater Puget Sound population, any effects due to the EBSP are not anticipated to be substantial.

Harbor seals are perhaps the most commonly observed marine mammal in the area of potential effects and are known to be comfortable and seemingly curious around anthropomorphic disturbance. This behavior trait may allow them to tolerate "take" at frequencies higher than other marine mammals. This species is common and well adapted to urbanized areas where they are known to thrive.

Monitoring would occur each day of pile-related activities as described in Section 14 to survey for the presence of all marine mammals in the area of potential effects and document behavior and movements. It is intended to ensure no injury is incurred by any individual and disturbance is minimized to the extent possible.

9.2 CALIFORNIA SEA LION

There are three documented California sea lion haul-outs near the area of potential effects, located approximately six miles away from the project site. These haul-outs include a yellow 'T' buoy off Alki Point, a yellow 'SG' buoy between West Point and Skiff Point, and a red buoy off Restoration Point. Each of the haul-outs have all been identified as having populations of less than 100 individuals. It is assumed that California sea lions seen in and around the project area use these haul-outs. Only individuals swimming in the area of potential effects could incur "take" if present during active in-water pile related work.

California sea lions are present in Puget Sound from August through April, which overlaps with the construction schedule. Thus, a maximum estimate of 300 individuals could be assumed to be potentially exposed to noise from vibratory pile installation and/or removal each day these activities occur. However, anecdotal reports indicate that at most only 1 to 5 individuals are present in the nearshore of the Seattle waterfront any one day. Taking into account individuals that may haul-out around Alki Point (the site of the largest consistently active haul-out in the area) approximately 2.4 miles from the seawall, an additional 20 may occur in the area of potential effects any one day. Therefore, using available anecdotal data and sighting information, a conservative estimate of 50 individuals in total would be expected to be in the area of potential effects each day of construction. The number of days vibratory pile installation and/or removal is scheduled to occur each calendar year will be used as the multiplier for the expected maximum estimated population present in the area of potential effects each day, with the sum providing the estimated "take" for this species per year. Based on data presented in Tables 1, 3, 4, and 5 and best available quantified demographic estimates for this species corrected by anecdotal observations, maximum estimates of "take" per year and per day due to construction related pile installation and removal noise were calculated and are summarized in Table 11.

TABLE 11. ESTIMATED "TAKE" FOR CALIFORNIA SEA LIONS

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	895	50
2014	26.2	1,310	50
2015	26.2	1,310	50
2016	25.8	1,290	50
2017	0.5	25	25

Although some of the annual "take" estimates are moderately large, they are all for Level B harassment (behavioral only) and no Level A harassment (injury) is anticipated to occur. They also mostly represent "take" to the same individuals across consecutive days and do not represent a total number of individuals that incur "take" episodes. Because these are maximum expected estimates, many fewer "take" events are actually anticipated for this species. If individuals incur "take" more than once, it can be assumed that they are not in fact incurring significant effects since they remain in the area of potential effects. Furthermore, the majority of these animals likely already stay well away from the Seattle downtown waterfront due to the high level of existing background noise and disturbance. As few individuals use the area of potential effects relative to the greater Puget Sound population, any effects due to the EBSP are not anticipated to be substantial.

California sea lions are a commonly observed marine mammal in the area of potential effects and are known to be comfortable and seemingly curious around anthropomorphic disturbance. This behavior trait may allow them to tolerate "take" at frequencies higher than other marine mammals. This species is common and well adapted to urbanized areas where they are known to thrive.

Monitoring would occur each day of pile-related activities as described in Section 14 to survey for the presence of all marine mammals in the area of potential effects and document behavior and movements. It is intended to ensure no injury is incurred by any individual and disturbance is minimized to the extent possible.

9.3 STELLER SEA LION

Steller sea lions are at most a rare visitor to the area of potential effects. Steller sea lions use haul-out locations in Puget Sound including net pens and navigation buoys found on the south end of Bainbridge Island, seven miles from the project area and outside the area of potential effects. The population of Steller sea lions has been estimated at less than 100 individuals at this haul-out (breeding rookeries and haul-outs have not been documented in the area of potential effects). Only individuals swimming in the area of potential effects could incur "take" if present during active in-water pile related work.

Steller sea lions are present in Puget Sound from August through April, which overlaps with the construction schedule. Thus, a maximum estimate of 100 individuals could be assumed to be potentially exposed to noise from vibratory pile installation and/or removal each day these activities occur. However, anecdotal reports indicate that at most only 1 to 5 individuals are present in the nearshore of the Seattle waterfront any one day. Taking into account individuals that may haul-out around Alki Point (the site of the most consistently active haul-out in the area) approximately 2.4 miles from the seawall, an additional 20 may occur in the area of potential effects any one day. Therefore, using available anecdotal data and sighting information, a conservative estimate of 50 individuals in total would be expected to be in the area of potential effects each day of construction. The number of days vibratory pile installation and/or removal is scheduled to occur each calendar year will be used as the multiplier for the expected maximum estimated population present in the area of potential effects each day, with the sum providing the estimated "take" for this species per year. Based on data presented in Tables 1, 3, 4, and 5 and best available quantified demographic estimates for this species corrected by anecdotal observations, maximum estimates of "take" per year and per day due to construction related pile installation and removal noise were calculated and are summarized in Table 12.

TABLE 12. ESTIMATED "TAKE" FOR STELLER SEA LIONS

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	895	50
2014	26.2	1,310	50
2015	26.2	1,310	50
2016	25.8	1,290	50
2017	0.5	25	25

The population of Steller sea lions that actually use the area of potential effects is likely to be substantially smaller than that presented here. Review of many anecdotal accounts indicated that this species is not typically found in the area of potential effects and is rarely observed. The calculated "take" estimates are likely to be substantial overestimates.

Although some of the annual "take" estimates are moderately large, they are all for Level B harassment (behavioral only) and no Level A harassment (injury) is anticipated to occur. They also mostly represent "take" to the same individuals across consecutive days and do not represent a total number of individuals that incur "take" episodes. Because these are maximum expected estimates, many fewer "take" events are actually anticipated for this species. If individuals incur "take" more than once, it can be assumed that they are not in fact incurring significant effects since they remain in the area of potential effects. Furthermore, the majority of these animals likely already stay well away from the Seattle downtown waterfront due to the high level of existing background noise and disturbance. As few individuals use the area of potential effects relative to the greater Puget Sound population, any effects due to the EBSP are not anticipated to be substantial. It should be recognized that the Steller sea lion is ESA listed and receives additional protections; however, the effects incurred on this species by pile-related activities associated to the EBSP are viewed as minimal.

Monitoring would occur each day of pile-related activities as described in Section 14 to survey for the presence of all marine mammals in the area of potential effects and document behavior and movements. It is intended to ensure no injury is incurred by any individual and disturbance is minimized to the extent possible.

9.4 HARBOR PORPOISE AND DALL'S PORPOISE

Research performed for this document did not find any occurrences of harbor porpoise or Dall's porpoise in the area of potential effects. However, as they have been known to occur in adjacent areas of Puget Sound, it can be assumed that they rarely pass through the area. Unlike harbor porpoise which are resident in Puget Sound year round, Dall's porpoise are only present from winter through to spring. Regardless, there is overlap in time between the construction schedule and their timing in the area, thus there is potential for all vibratory pile activities to occur when they are present.

Harbor porpoise and Dall's porpoise are rare in the area of potential effects but may occur once each year of construction. Average pod size for harbor porpoise has been reported to be nine individuals (Langseth 2011) and up to 1.3 individuals for Dall's porpoise (Heide-Jørgensen et al. 1992). Therefore, it can be assumed that a maximum estimate of nine harbor porpoises and two Dall's porpoises can be potentially exposed to noise disturbance from vibratory pile installation and/or removal each day such activity occurs. Unlike pinnipeds with haul-outs in the area, it is expected that cetaceans such as porpoises would only be present in the area as transients and not incur more than one "take" event; however, this cannot be assumed. Therefore, the total number of days vibratory pile installation and/or removal is scheduled to occur each calendar year will be used as the multiplier for the maximum estimated number of individuals expected to be in the area of potential effects, with the sum providing the estimated "take" for these species per year. Based on data presented in Tables 1, 3, 4, and 5, and quantified demographic estimates for these species, the maximum estimate of "take" each year and per day for each year have been calculated and are summarized in Tables 13 and 14.

TABLE 13. ESTIMATED "TAKE" FOR HARBOR PORPOISE

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	162	9
2014	26.2	236	9
2015	26.2	236	9
2016	25.8	232	9
2017	0.5	5	5

TABLE 14. ESTIMATED "TAKE" FOR DALL'S PORPOISE

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	36	2
2014	26.2	53	2
2015	26.2	53	2
2016	25.8	52	2
2017	0.5	1	1

Both harbor porpoise and Dall's porpoise are rare in the area of potential effects. Few anecdotal observations have been made of these two species, suggesting that estimated "take" estimates may be somewhat accurate. Although annual "take" estimates are moderate, they are all for Level B harassment (behavioral only) and no Level A harassment (injury) is anticipated to occur. They also denote "take" to the same individuals each day and do not represent a total number of individuals that incur "take" episodes. Because these are maximum estimates, many fewer "take" events are actually anticipated for these species. If individuals incur "take" more than once it can be assumed that they are not incurring significant impacts. Furthermore, the majority of these animals likely already stay well away from the Seattle downtown waterfront due to the high level of background noise and disturbance in the area. As few if any, individuals use the area of potential effects relative to the greater Puget Sound population; any effects due to the EBSP are not anticipated to be substantial.

Monitoring would occur each day of pile-related activities as described in Section 14 to survey for the presence of all marine mammals in the area of potential effects and document behavior and movements. It is intended to ensure no injury is incurred by any individual and disturbance is minimized to the extent possible.

9.5 KILLER WHALE

Based on reports from 1990 to 2008, the greatest number of unique killer whale sighting-days in the area of potential effects are for southern resident killer whales passing west of Alki Point; a pattern likely due to the high level of human disturbance or highly degraded habitat features currently found

within the area of potential effects. Of the pods that compose this DPS, J Pod, with an estimated 26 members, is the most likely to appear at any point during the year in the area of potential effects. An analysis of 2011 sightings described a liberal estimated 93 sightings of southern resident killer whales in or near the area of potential effects. During this same analysis period, 12 transient killer whales were also observed in or near the area of potential effects. The nature of this data makes it likely that several individuals were counted more than once as the observers were not coordinated and were generally untrained members of the general public. The majority of all sightings in this area were groups of killer whales moving through the main channel between Bainbridge Island and Elliott Bay and well away from the project area and likely out of the area of potential effects.

For purposes of this analysis, based on best available data, it is assumed that a maximum estimate of 105 killer whales can be potentially exposed to noise disturbance from pile-related activities each day; however, because killer whales tend to stay nearest to the open channel, it is likely that no more than half that number – 53 individuals – enters into the area of potential effects. Furthermore, killer whales socialize in pods but are frequently noted in or near the area of potential effects in groups much smaller than their corresponding pod size. Southern residents killer whales observed in the area typically travel in groups smaller than 26 individuals, or the estimated size of J Pod. Taking into account such observations, it is expected that no more than 26 individuals would be present in the area of potential effects each day of in-water construction. Unlike pinnipeds with haul-outs in the area, it is expected that cetaceans such as killer whales would only use the area as a movement corridor and not incur more than one "take" event per individual, however, this cannot be assumed. The total number of days pile activities are scheduled to occur each calendar year will be used as the multiplier for the maximum estimated number of individuals expected to be in the area of potential effects, with the sum providing the estimated "take" for this species per year. Based on data presented in Tables 1, 3, 4, and 5 and best available quantified demographic estimates for this species corrected by anecdotal observations, maximum estimates of "take" per year and per day due to construction related pile installation and removal noise were calculated and are summarized in Table 15.

TABLE 15. ESTIMATED "TAKE" FOR KILLER WHALES

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	465	26
2014	26.2	681	26
2015	26.2	681	26
2016	25.8	670	26
2017	0.5	26	26

Killer whales are perhaps the most obvious and easily anthropomorphized marine mammals in the area. Great public interest in these animals has resulted in occurrence data to be perhaps the most complete for any marine mammal in the area. However, calculated "take" estimates are anticipated to be substantially higher than actual "take" numbers as individuals would likely only pass through the area on occasion while following prey species (salmonids) or migrating. It is expected that killer whales would

not be present in or near the area of potential effects during the majority of all construction days. When present, it is anticipated that the maximum number would be less than 26.

Although some of the annual "take" estimates are moderately large, they are all for Level B harassment (behavioral only) and no Level A harassment (injury) is anticipated to occur. They also mostly represent "take" to the same individuals across consecutive days and do not represent a total number of individuals that incur "take" episodes. Because these are maximum expected estimates, many fewer "take" events are actually anticipated for this species. If individuals incur "take" more than once, it can be assumed that they are not in fact incurring significant effects since they remain in the area of potential effects. Furthermore, the majority of these animals likely already stay well away from the Seattle downtown waterfront due to the high level of existing background noise and disturbance. As few individuals use the area of potential effects relative to the greater Puget Sound population, any effects due to the EBSP are not anticipated to be substantial.

Monitoring would occur each day of pile-related activities as described in Section 14 to survey for the presence of all marine mammals in the area of potential effects and document behavior and movements. It is intended to ensure no injury is incurred by any individual and disturbance is minimized to the extent possible.

9.6 HUMPBACK WHALE

Humpbacks are only rare visitors to Puget Sound. In 1976 and 1978, two sightings were reported in Puget Sound and later, one sighting in 1986. There is evidence of increasing numbers in recent years. A rare encounter with one and possibly two humpbacks occurred in Hood Canal (well away from the area of potential effects) as recently as February 2012. No reports of humpback whales in the area of potential effects were noted during research for this document. Humpbacks are considered rare in the area of potential effects but are assumed to have the potential to occur at least once each year during the proposed EBSP. It is assumed that an occurrence would only consist of a single individual.

For purposes of this analysis, it is assumed that a maximum estimate of one humpback whale can be potentially exposed to noise disturbance from vibratory pile installation and/or removal each day this activity occurs. Unlike pinnipeds with haul-outs in the area, it is expected that cetaceans such as humpback whales would only use the area as a movement corridor and not incur more than one "take" event, however, this cannot be assumed. Therefore, the total number of days vibratory pile installation and/or removal is scheduled to occur each calendar year will be used as the multiplier for the maximum estimated number of individuals expected to be in the area of potential effects, with the sum providing the estimated "take" for this species per year. Based on data presented in Tables 1, 3, 4, and 5 and best available quantified demographic estimates for this species corrected by anecdotal observations, maximum estimates of "take" per year and per day due to construction related pile installation and removal noise were calculated and are summarized in Table 16.

TABLE 16. ESTIMATED "TAKE" FOR HUMPBACK WHALES

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	18	1
2014	26.2	27	1
2015	26.2	27	1
2016	25.8	26	1
2017	0.5	1	1

Humpback whales are only occasionally present in the area and would generally transiently come into Puget Sound on their migration along the coast. Estimated "take" estimates are anticipated to be somewhat accurate, although this species is not likely to be present every year.

Although some of the annual "take" estimates are moderately large, they are all for Level B harassment (behavioral only) and no Level A harassment (injury) is anticipated to occur. They also mostly represent "take" to the same individuals across consecutive days and do not represent a total number of individuals that incur "take" episodes. Because these are maximum expected estimates, many fewer "take" events are actually anticipated for this species. If individuals incur "take" more than once, it can be assumed that they are not in fact incurring significant effects since they remain in the area of potential effects. Furthermore, the majority of these animals likely already stay well away from the Seattle downtown waterfront due to the high level of existing background noise and disturbance. As few individuals use the area of potential effects relative to the greater Puget Sound population, any effects due to the EBSP are not anticipated to be substantial.

Monitoring would occur each day of pile-related activities as described in Section 14 to survey for the presence of all marine mammals in the area of potential effects and document behavior and movements. It is intended to ensure no injury is incurred by any individual and disturbance is minimized to the extent possible.

9.7 GRAY WHALE

Gray whales are observed in Washington inland waters regularly between the months of January and September with peaks between March and May. Gray whale sightings are typically reported in February through May and include an observation of a gray whale off of Colman Dock ferry terminal at Pier 52 heading toward the East Waterway in March 2010. Three gray whales were observed in the area of potential effects during 2011 (Whale Museum 2011).

For purposes of this analysis, it is assumed that a maximum estimate of five gray whales can be potentially exposed to noise disturbance from vibratory pile installation and/or removal each day it occurs. Unlike pinnipeds with haul-outs in the area, it is expected that cetaceans such as gray whales would only use the area as a movement corridor and not incur more than one "take" event, however, this cannot be assumed. Therefore, the total number of days vibratory pile installation and/or removal is scheduled to occur each calendar year will be used as the multiplier for the maximum estimated number

of individuals expected to be in the area of potential effects, with the sum providing the estimated "take" for this species per year. Based on data presented in Tables 1, 3, 4, and 5 and best available quantified demographic estimates for this species corrected by anecdotal observations, maximum estimates of "take" per year and per day due to construction related pile installation and removal noise were calculated and are summarized in Table 17.

TABLE 17. ESTIMATED "TAKE" FOR GRAY WHALES

Calendar Year	Estimated No. of Vibratory Pile Installation/Removal Days	Estimated Maximum No. of "Take" per Year	Estimated Maximum No. of "Take" per Day
2013	17.9	90	5
2014	26.2	131	5
2015	26.2	131	5
2016	25.8	129	5
2017	0.5	3	3

Gray whales are rare in the area and would generally move through on migration with some lingering to feed. Estimated "take" estimates are likely to be somewhat accurate, although this species is not likely to be present every year.

Although some of the annual "take" estimates are moderately large, they are all for Level B harassment (behavioral only) and no Level A harassment (injury) is anticipated to occur. They also mostly represent "take" to the same individuals across consecutive days and do not represent a total number of individuals that incur "take" episodes. Because these are maximum expected estimates, many fewer "take" events are actually anticipated for this species. If individuals incur "take" more than once, it can be assumed that they are not in fact incurring significant effects since they remain in the area of potential effects. Furthermore, the majority of these animals likely already stay well away from the Seattle downtown waterfront due to the high level of existing background noise and disturbance. As few individuals use the area of potential effects relative to the greater Puget Sound population, any effects due to the EBSP are not anticipated to be substantial.

Monitoring would occur each day of pile-related activities as described in Section 14 to survey for the presence of all marine mammals in the area of potential effects and document behavior and movements. It is intended to ensure no injury is incurred by any individual and disturbance is minimized to the extent possible.

SECTION 10. ANTICIPATED EFFECT ON SUBSISTENCE

Historically, Pacific Northwest treaty Indian tribes were known to utilize several species of marine mammals including, but not limited to: harbor seals, Steller sea lions, northern fur seals, gray whales, and humpback whales. More recently, several Pacific Northwest treaty Indian tribes have promulgated tribal regulations allowing tribal members to exercise treaty rights for subsistence harvest of harbor seals and California sea lions (Caretta et al. 2007). The Makah Indian Tribe (Makah) has specifically passed hunting regulations for gray whales, however, the directed take of marine mammals (not just gray whales) for ceremonial and/or subsistence purposes was enjoined by the Ninth Circuit Court of Appeals in a ruling against the Makah in 2002, 2003, and 2004 (NMFS 2007). The issues surrounding the Makah gray whale hunt (in addition to the hunt for marine mammals in general) is currently in litigation or not yet clarified in recent court decisions. These issues also require National Environmental Policy Act (NEPA) and MMPA compliance, which has not yet been completed. Presently, there are no known active ceremonial and/or subsistence hunts for marine mammals in Puget Sound or the San Juan Islands with the following exceptions:

- Tribes along the Pacific coast are most likely to still have regulations in place allowing a small number of directed take for subsistence purposes. It is unlikely that those regulations have been exercised in recent years, but they are likely still on the books. The Pacific Coast is separated by land and water bodies from the study area.
- Many tribes in Puget Sound and along the Pacific Coast have an additional current regulation that allows their fishermen to protect their life, gear, and catch from seals and California sea lions by lethal means. These rare takes are reported annually to NOAA/NMFS by each tribe.

There have been only a few reported takes of harbor seals from directed tribal subsistence hunts (Caretta et al. 2007). It is possible that a few seals have been taken in directed hunts because tribal fishers use seals caught incidental to fishing operations in the northern Washington marine set gillnet and Washington Puget Sound Region treaty salmon gillnet fisheries for their subsistence needs before undertaking a ceremonial or subsistence hunt (Caretta et al. 2007). From communications with the tribes, the NOAA/NMFS Northwest Regional Office believes that zero to five harbor seals from this stock (the Washington Inland Waters Stock) may be taken annually in Puget Sound-directed subsistence harvests (Caretta et al. 2007). The location of the hunted animals or hunting areas is not currently known.

No effects to the availability of the species or stock to the Pacific Northwest treaty tribes are expected as a result of the EBSP.

Current estimates of annual subsistence take of pinnipeds are zero to two animals per year (Caretta et al. 2007). No effects to the availability of the species or stock to the Pacific Northwest treaty tribes are expected as a result of the EBSP.

The Makah ceased whaling in the 1920s after commercial whaling decimated the Eastern North Pacific gray whale population (NMFS 2007). On June 16, 1994, gray whales were removed from the endangered species list after a determination that the population has "…recovered to near its estimated original

population size and is neither in danger of extinction throughout all or a significant portion of its range, nor likely to again become endangered within the foreseeable future throughout all or a significant portion of its range" (59 FR 31094). On May 5, 1995 the Makah formally notified the U.S. Government of their interest in resuming treaty ceremonial and subsistence harvest of gray whales, asking the Department of Commerce to represent them in seeking approval from the International Whaling Commission (IWC) for an annual quota (NMFS 2007). On October 18, 1997, the IWC approved an aboriginal subsistence quota of 620 gray whales (with an annual cap of 140) for the Russian Chukotka people and the Makah (Angliss and Outlaw 2005; NMFS 2007). On May 17, 1999, the Makah hunted, struck, and landed 1 gray whale (NMFS 2005). On December 20, 2002, the Ninth Circuit Court of Appeals ruled that an Environmental Impact Statement (EIS) should have been prepared and that the Makah must comply with the process prescribed in the MMPA for authorizing take of marine mammals otherwise prohibited by a moratorium (NMFS 2007). This was further upheld at rulings in 2003 and 2004 (NMFS 2007).

At the most recent meetings of the IWC (59th Annual Meeting in Anchorage, Alaska from May 28 to 31, 2007), an aboriginal subsistence quota for gray whales was again approved for natives in Russia and 20 whales or four per year for five years for the Makah, but under the Ninth Circuit Court ruling the Makah must first obtain a waiver of the MMPA take moratorium before harvesting under their IWC quota. NOAA/NMFS is currently finalizing an EIS to examine the alternatives for a decision to approve or deny such a waiver (FR 73, 33814).

Gray whales migrate north and south along the coast of Washington and there is a regular group of gray whales that enter the Puget Sound waters (specifically Saratoga passage on the eastern side of Whidbey Island) to feed during early spring and summer (March through May/June).

Should the Makah tribe resume hunting gray whales, this hunt would occur along the outer coast of Washington. Therefore, the proposed activities would not directly interfere with or affect the hunt. No effects to the availability of the species or stock to the Pacific Northwest treaty tribes are expected as a result of the EBSP.

SECTION 11. ANTICIPATED EFFECT ON HABITAT

The EBSP could potentially affect habitat and the overall Elliott Bay ecosystem via effects to water quality, marine mammal prey species, and passage obstructions. There are no passage obstructions present in the area of potential effects and any negative effects would be temporary in nature and would not result in long-term effects to habitat.

Water Quality: The types of water quality effects from the EBSP include the generation of short-term turbidity or resuspension of contaminated sediments during pile removal, pile driving, riprap removal, and placement of substrates for the creation of habitat features. These effects would be minimized by the use of silt curtains or other BMPs, including particularly, the installation of the temporary containment wall. The Washington State Department of Ecology will require that water quality standards are met throughout the construction duration; thus no adverse effects are expected to marine mammals and only minor short-term disturbance would occur to their prey species such as salmonids and marine invertebrates. The short-term changes in turbidity affect only a small proportion of the available habitat in the Puget Sound (i.e., within 100 feet of the existing seawall).

The provision of stormwater treatment devices would result in long-term water quality improvements by reducing pollutant loading into Elliott Bay. Juvenile salmonids, rockfish, surf smelt, sand lance, and Pacific herring as well as invertebrates such as crustaceans and polychaetes could potentially be affected by stormwater discharges. An analysis of stormwater discharges and plumes conducted for the EBSP indicates that no toxicity is predicted for any of the species of interest. Some limited behavioral effects from copper and zinc may be exhibited from stormwater inputs of these elements in close proximity to the outfalls, but these effects will be reduced as compared to existing conditions.

Effects to Prey Species: Prey species for the various marine mammals discussed in this document include marine invertebrates and fish species. Short-term effects would occur to marine invertebrates immediately along the existing seawall during construction. The installation of the temporary containment wall would necessitate the removal of riprap that hosts various invertebrate and macroalgae species and invertebrates present behind the temporary containment wall could experience mortality or decreased growth during the 1 season of construction occurring at each location. This effect is expected to be minor and short-term on the overall population of marine invertebrates in Elliott Bay. Construction will also have temporary effects on salmonids and other fish species in the project area due to disturbance, turbidity, noise, and the potential resuspension of contaminants. All in-water work will occur during the designated in-water work window to avoid and minimize effects on juvenile salmonids. Additionally, marine resident fish species are only present in limited numbers along the seawall during the work season and primarily occur during the summer months when work would not be occurring (Anchor QEA 2012). Prey species are expected to incur a long-term benefit from the proposed habitat enhancements; these enhancements would improve primary and secondary productivity and migratory habitat for salmonids.

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SECTION 12. CONSERVATION MEASURES

Several conservation measures are proposed for mitigating effects on marine mammals from the proposed EBSP. In general, a protocol is proposed to monitor for marine mammals in the area of potential effects during periods of active construction and/or pile installation. Acoustic monitoring will occur concurrent with in-water construction to evaluate, in real time, sound production from construction activities. Employing sound attenuation measures and timing construction to periods of lowest potential use of the area of potential effects by marine mammals will be used if applicable. Details for all conservation measures are provided in Section 14.

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SECTION 13.
ARCTIC SUBSISTENCE USES, PLAN OF COOPERATION

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

The proposed activities would take place in Seattle, Washington, in Elliott Bay. No activities would take place in or near a traditional Arctic subsistence hunting area.

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SECTION 14.
CONSERVATION AND MITIGATION MEASURES – MONITORING AND REPORTING PLAN

The following conservation measures would be employed for the duration of the proposed project. Proposed conservation measures are intended to avoid and 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, prior projects in Puget Sound.

Each conservation measure would be included in either the Contract Plans and Specifications document or a specified action to be conducted by SDOT for permit compliance.

Existing SDOT policy and construction administration practice requires an SDOT inspector to be present on site at all time during construction activities to ensure contract compliance. The inspector and the contractor would 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 proposed monitoring and reporting plan includes a construction monitoring protocol as well as guidelines for construction activities associated to pile installation and removal. Construction monitoring would occur through observing construction activities and the surrounding marine environment for signs of marine mammals and/or potential threats to marine mammals, as well as surveying underwater noise produced by in-water pile-related activities. Observations accrued through the proposed monitoring and reporting plan will provide data and other formal information for scientific study. Implicit in this monitoring and reporting plan is retaining enough flexibility to allow proper protection of marine mammal species from unforeseen events.

Construction Monitoring Protocol: Monitoring of in-water pile-related construction would consist primarily of land-based observations with boat-based observations also being employed during specific construction activities. Land-based observations would function to monitor the nearshore environment immediately surrounding active construction for signs of marine mammals in and out of an exclusion zone established around each in-water pile-related activity (the exclusion zone is discussed further below). Boat-based observations, when employed, would monitor areas of open water likely exposed to vibratory pile-related noise.

Exclusion Zone: An exclusion zone will be established at a radius of 200 feet waterward of each steel sheet pile source and 50 feet waterward of each concrete piling point source and would be marked with a temporary buoy. This exclusion zone is intended to provide a physical threshold for a stop-work order for in-water pile-related activities if a marine mammal nears the work area. If a stop-work order is required to be issued, the marine mammal(s) will be closely observed and NOAA/NMFS will be contacted for consultation. A full discussion on triggers of stop-work orders is provided below. Any marine mammal, however, will be observed closely if they near the work area and every precaution will be taken to ensure they are not harmed. If the size and/or shape of this proposed exclusion zone is

determined to not be appropriately effective in protecting marine mammal species, additional consultation with NOAA/NMFS will be initiated and new monitoring boundaries will be determined and implemented.

Land-Based Observations: At the start of in-water pile-related construction each day, a minimum of one qualified marine mammal observer (observer) would be staged on land (or adjacent pier) near the location of in-water activities to document any marine mammal that approaches the 200 foot exclusion zone. The distance and/or position of the observer relative to the site of pile-related activities is yet to be determined; however, it would be continually optimized to maintain an unobstructed view of the construction site and surrounding marine areas (Figure 7). Additional land-based observers would be deployed if needed to ensure the construction area is adequately monitored. Land-based monitoring will occur throughout each day of active pile-related activities. .

Boat-Based Observations: Additional observers (a minimum of two individuals) would also be positioned on a boat offshore in order to monitor open water within the area of potential effects during vibratory pile-related activities or any other construction activities that may pose a threat to marine mammals moving through this area. Although details of the boat-based monitoring have not yet been determined, it can be assumed the observers would have no other responsibilities while on the boat, the vessel crew would consist of a craft master and two observers–although all three would participate in scanning for marine mammals, one observer would be dedicated to the port side of the vessel and the other observer was responsible for the starboard side, and the observers would also be responsible for recording the GPS coordinates of all sightings and logging the information onto datasheets. Observers will use naked eye and wide-angle binoculars with reticles to scan the area from dead ahead to dead astern. The boat would be a small range craft and would travel at low speeds that would optimize monitoring quality and minimize the potential for boat-strikes with marine mammals. During each boat-based survey, the boat will move along a figure-eight path starting near the area of construction and move into open water towards Bainbridge Island and back (see Figure 7); a route intended to allow all areas of open water within the area of potential effects to be visible at some time during each boat survey. It is also assumed that for each day boat-based monitoring is conducted, the observers would be deployed two to three times during active construction. Additional boat-based observers (on the same or multiple boats) could be deployed if deemed necessary. It is anticipated that boat-based observations would need to be employed several days during each construction season according to the construction schedule, but not on a daily basis (estimated at this time to occur each day for the first three days of pile driving, then every third day thereafter, unless land based monitors request additional boat surveys based on more marine mammal presence than expected).

Figure 7. Proposed Monitoring Routes/Locations

General Observation Details: Each observer would work, on average, eight hours per day and would be relieved by a fresh observer if pile driving occurs over a longer day (i.e., 12 or 16 hours). The number of observers would be increased and/or positions would be changed to ensure full visibility of the area of potential effects to provide early sighting of any marine mammal that enters the area. Coordination between construction contractors and observers would occur, at a minimum, each day or frequently enough to ensure an appropriate monitoring plan is ready prior to the start of construction each morning. All observations would initiate at least 30 minutes prior to the commencement of all in-water pile-related activities and continue at all times during active construction. Equipment necessary to facilitate accurate monitoring will always be available and provided to the observers if needed.

All sightings of marine mammals will be documented by observers on a NOAA/NMFS-approved marine mammal sighting form (described below). If a marine mammal is sighted within the area of potential effects during in-water pile driving, a "take" will be recorded for each individual present. The observer will be contractually required to keep an accurate "take" count of marine mammals sighted within the area of potential effects, document the "take(s)" on the sighting form, and notify the construction contractor if any marine mammal appears to have the potential to be harmed.

Each observer will receive training in the detection, identification, and distance estimation of marine mammal species; be equipped with binoculars and other necessary viewing gear; and be stationed at a location that provides optimal sight range. The observers will have no other construction-related responsibilities while monitoring. A comprehensive marine mammal monitoring plan (plan) will be prepared for NOAA/NMFS review and approval prior to the start of in-water work. The plan will contain all the contractual and permit requirements and will describe the procedures the construction subcontractor will implement to comply with the conditions of the requested take permit and other applicable permits. Conformance with the plan will be discussed at weekly construction meetings to ensure that the procedures are working and to identify and implement any revisions necessary to tailor procedures to the specifics of ongoing construction. Observers will understand the permit requirements and will be diligent in ensuring that the area of potential effects will be monitored according to the conditions of the requested permit. Observers will implement quality checks to ensure communications with the construction subcontractors and other observers is always readily available.

Marine Mammal Sighting Form: The sighting form has not been fully developed to date; however, it will capture all necessary details deemed important by NOAA/NMFS. At a minimum, the NOAA/NMFS-approved sighting form would record the following information:

- Date of observation period, monitoring type (land-based/boat-based), observer name and location, climate and weather conditions, and tidal conditions;
- Environmental conditions that could confound marine mammal detections and when the time and location they occurred;
- Level of human disturbance independent of the associated construction, when they occurred and location;
- For each marine mammal sighting – the time of initial sighting and duration to the end of the sighting period;
- Observed species, number, group composition (i.e., age and color class), distance to pile-related activities, and behavior (e.g., group cohesiveness, direction of travel, etc.) of animals throughout duration of sighting;
- Discrete behavioral reactions, if apparent;
- Initial and final sighting locations marked on a grid map;
- Pile-related activities taking place during each sighting and if or why a work shutdown was or was not triggered; and
- The number of take(s) (by species) of marine mammals (i.e., individuals observed to enter the area of potential effects), their locations, and behavior.

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

Protocol for Triggering an In-Water Pile-Related Stop-Work Order: When a marine mammal is sighted approaching the work area, the observer will immediately notify the construction personnel operating the pile-related equipment of the direction of travel and distance relative to the exclusion zone. An in-

water pile-related stop-work order would be immediately triggered if an observer documents a marine mammal displaying clear signs of stress or distress such as difficulty swimming, breathing, or other disoriented behaviors near or within the 200 foot exclusion zone.

The proposed monitoring protocol establishes that if a marine mammal directly approaches or enters into the exclusion zone, all construction personnel associated to ongoing in-water pile-related activities in the immediate area will be alerted of the situation and work may be stopped until the individual has moved out of the exclusion zone and/or is determined to not be at any risk of injury or harm (i.e., shows no signs of stress). Although the exclusion zone will be used as a physical threshold to provide a protective buffer for marine mammals from construction activities, behavioral differences across species prevents a universal stop-work order threshold to be defined. Pinnipeds, particularly harbor seals and California sea lions are known to be comfortable with anthropomorphic activities and are occasionally attracted into areas of in-water work. These species are also commonly found in shallow water within the range of depth of the in-water work area of the proposed project. In contrast, cetaceans typically do not exhibit these behaviors and would not likely occur in shallow waters or near in-water construction unless they are already sick or injured. A stop-work order would not be issued for pinnipeds near or in the exclusion zone unless they exhibit stress behavior or are at risk of injury from construction activities (i.e., threat of entanglement or trauma from being physically struck by construction-related materials, from trauma caused by potentially damaging construction noise, etc.). A stop-work order would be issued for cetaceans if any individual approaches near to or reaches the exclusion zone regardless of behavior. Any marine mammal, however, will be observed closely if they near the work area and every precaution will be taken to insure they are not harmed by any construction-related activity. All marine mammal observations will be documented in detail and best scientific judgment will be expected to be employed conservatively during decision making by observers.

Additionally, the total daily number of “take” will be monitored and updated throughout each working day. If the total number of “take” is equaled or surpassed at any point prior to the completion of in-water pile-related activities, NOAA/NMFS will be notified immediately of the potential to exceed the approved number of “take” and will be consulted for further guidance. If the total number of “take” has been reached or exceeded, any additional observation of a previously unaccounted for marine mammal in the area of potential effects would trigger a stop-work order of in-water work. This protocol applies to both ESA-listed and non-ESA-listed species. Additional protections would apply to all listed species found in the area of potential effects (and/or action area) under the ESA.

Acoustic Monitoring: Acoustic monitoring will also be conducted during pile-related in-water work. The purpose of the monitoring will be to identify or confirm noise levels for pile-related work during in-water construction, as described in the interim NOAA/NMFS guidance (NOAA/NMFS 2010b). Collection of most of the acoustic data will be accomplished aboard a drifting boat to reduce the effect of flow noise. All acoustical recordings will be conducted 1 meter below the water surface and 1 meter above the sea floor. It is expected that the noise survey will confirm the findings of previous studies relative to noise levels generated from steel and concrete pile driving. A number of background noise recordings (in the absence of pile driving) will also be made during the study to provide a baseline background noise profile. Tides and wind are influential factors in creating high ambient noise levels, with vessels

increasing underwater ambient sound. The results and conclusions of the study will be summarized and presented to NOAA/NMFS with recommendations on any modifications to this proposed plan.

Underwater hydrophones and an airborne microphone will be used. 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 (NIST) standards and will be re-checked at the start of each day.

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 pile and five concrete piles will be monitored. The hydrophones will provide a continuous recording of the pile-related activities. The data will be analyzed after completion of the acoustic monitoring.

- Prior to monitoring, water depth measurements will be made to ensure that when taking tidal changes into consideration hydrophones will not drag on the bottom. One hydrophone will be placed at approximately mid-depth and the other at a position closer to the bottom (70 to 85 percent of the water depth). Because the hydrophones may be supported from a floating platform (i.e., barge), the depth with respect to the bottom may vary due to tidal changes and current effects.
- The hydrophone systems will be deployed so as to maintain a constant distance of approximately 10 meters from the pile.
- 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.

Appropriate measures will be taken to eliminate strumming of the hydroacoustic cable in the current and minimize flow noise over the hydrophones. There will be a direct line of acoustic transmission through the water column between the pile and the hydrophones in all cases, without any interposing structures, including other piles. At least one stationary land-based microphone will be deployed to record airborne sound levels produced during pile installation and removal. The microphone will measure far-field airborne sounds. A sound level meter with microphone will be located in the near-field if logistical and security constraints permit to make near-field source level measurements. Near-field measurements will not be continuous and will be used to identify which sources of noise are making significant contributions to the overall noise levels measured at the shoreline microphones. Specific locations will be determined by ease of access (terrain restrictions and presence of a road) and security permission. The microphone will be calibrated at the beginning of each day of monitoring activity.

To empirically verify the modeled behavioral disturbance zones, underwater and airborne acoustic monitoring will occur for five steel sheet pile and five concrete piles during the duration 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. Underwater and airborne sound pressure levels will be recorded continuously during pile related activities. Data will be downloaded periodically (i.e., daily or on another appropriate schedule) and will be analyzed after the completion of the acoustic monitoring period for this project

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

- 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 NOAA-NMFS Guidance Document.
- 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 estimated in this LoA Request. In the event noise does surpass estimated levels for extended periods of time, construction would be stopped and NOAA-NMFS will be contacted to discuss the cause and potential solutions.

Scientific Marine Mammal Monitoring Program: Scientific marine mammal monitoring will likely be mostly opportunistic and provided by a combination of construction monitoring observations and acoustic monitoring. All data acquired during the monitoring of in-water pile-related construction including marine mammal species observed; behaviors; sighting locations; noise levels; and/or reactions to construction activities, if observed, will be made available to agencies and/or professional researchers. Scientific monitoring would primarily target documenting the frequency of occurrence that marine mammals are present in the area of potential effects, habitat use, behavior, direction of travel, and group composition, and observed reactions or changes in behavior of marine mammals in response to in-water activities occurring at the time of sighting. Copies of sighing forms, acoustic data, or other digital data would be made available.

General Construction Guidance and Protocols: All SDOT construction will be performed in accordance with the established standards. SDOT activities are subject to 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.

- The contractor shall be responsible for the preparation of a Spill Prevention, Control, and Countermeasures (SPCC) plan to be used for the duration of the project. The plan shall be submitted to the project engineer prior to the commencement of any construction

activities. A copy of the plan with any updates would be maintained at the work site by the contractor.

  - The SPCC shall outline BMPs, responsive actions in the event of a spill or release, and identify notification and reporting procedures. The SPCC shall also outline contractor management elements such as personnel responsibilities, project site security, site inspections, and training.
  - The SPCC would outline what measures shall be taken by the contractor to prevent the release or spread of hazardous materials, either found on site and encountered during construction but not identified in contract documents, or any hazardous materials that the contractor stores, uses, or generates on the construction site during construction activities. These items include, but are not limited to gasoline, oils, and chemicals.
  - The contractor shall maintain, at the job site, the applicable spill response equipment and material designated in the SPCC plan.

- The contractor shall regularly check fuel hoses, oil drums, oil or fuel transfers valves, fittings, etc. for leaks, and shall maintain and store materials properly to prevent spills.

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 and all construction equipment would have noise control devices no less effective than those provided on the original equipment.

Sound Attenuation Measures: Specific to pile installation, 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 consolidated sediments 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 driven behind the temporary containment wall that would function to partially attenuate pile driving noise. Estimated noise-reduction values are not readily available for this attenuation type; however, it has been shown that use of cofferdams, which is analogous to the temporary containment wall, is more effective at reducing noise than not employing one at all (CALTRANS 2009). Other measures would also be used as appropriate per the NOAA/NMFS and USFWS Impact Pile Driving Sound Attenuation Specifications.
- **Additional attenuation**: Other attenuation measures such as the use of a cushioning block may be employed as necessary to reduce sound levels (note; currently bubble curtains have not proposed due to the potential for resuspension of contaminated materials and/or existing sediment caps). Cushioning blocks used between a hammer and pile (during impact pile installation) can reduce noise up to 26 dB (CALTRANS 2009) and would be used during all impact pile installation activities. In the event where noise generation is shown to exceed levels calculated in this LoA Request (from acoustic monitoring), the implementation of

additional attenuation devices would be reevaluated, and discussions with NOAA-NMFS will be instigated in order to pursue a better strategy that would more effectively attenuate noise propagation in the marine environment.

Timing Windows: Timing restrictions would be used to avoid in-water work, when feasible, when ESA-listed species are most likely to be present in the area of potential effects. SDOT would 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.

Modified Underwater Noise Mitigation Measures: Although marine mammals would be mostly protected from Level A harassment by the use of attenuation measures and employing observers, these protection measures may not be completely effective at all times. Therefore, two other mitigation measures have been proposed to further reduce potential effects; using a 'soft-start' technique and establishing an exclusion zone around active in-water pile activities.

- **Soft Start Technique**: A 'soft-start' technique would be used at the beginning of each day's in-water pile installation or removal activities or if pile-related activities have ceased for more than 1 hour. This technique would allow any marine mammal that may be in the immediate area to leave before pile driving reaches full energy. The 'soft-start' 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. For impact pile installation, contractors would be required to provide an initial set of three strikes from the impact hammer at 40 percent energy, followed by a 1-minute waiting period, then two subsequent three strike sets.

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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 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 as well. 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 their 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/NMFS.

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.

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