3.5. MARINE BIRDS

Major groupings of marine birds that occur on NAVBASE Kitsap Bangor include shorebirds, wading birds, marine waterfowl, raptors, and seabirds (Table 3.5–1), which use the waters in and around the LWI and SPE project sites. Marine birds use manmade structures on the marine waterfront and trees along the shoreline for perching, resting, and (for a few species) nesting, but in general the focus is on marine habitats and food resources. Marine bird species may also use upland areas, as discussed in Section 3.6. Marbled murrelets are the only ESA-listed bird (Table 3.5–2), present in the marine environment on NAVBASE Kitsap Bangor.

3.5.1. Affected Environment

3.5.1.1. EXISTING CONDITIONS

Shorebirds and marine waterfowl are most abundant along the Bangor waterfront during the winter months and migration periods (Table 3.5–1). However, several species such as killdeer, spotted sandpiper (shorebirds), great blue heron, Canada geese, and dabbling duck species (waterfowl) are present year round. In particular, the shallow waters at the outfall of Devil's Hole near the south LWI project site are frequented by these species. Seabirds (certain gull and tern species) and diving-pursuit birds (such as cormorant species and pigeon guillemot) also occur year round. The marine environment on NAVBASE Kitsap Bangor (including the LWI project sites) provides habitat for foraging, loafing, social interaction, nesting, and brood rearing. Two fish-eating raptor species may be present near the LWI and SPE project sites: bald eagles are year-round residents and ospreys are summer residents on the Bangor waterfront. These species are discussed in Section 3.6.

Habitats near the LWI and SPE project sites that are used by marine birds include estuarine habitat, intertidal and subtidal zones of the nearshore marine, and marine deeper water habitat, as described below. Marine birds also use manmade structures, such as piers and piles associated with overwater structures including EHW-1.

3.5.1.1.1. MARINE BIRD HABITAT

ESTUARIES

Three locations along the Bangor waterfront have year-round freshwater output and are considered estuarine habitat: (1) outflows from Devil's Hole (the south LWI project site; 0.6 mile [1 kilometer] northeast of the SPE site), (2) outflows from Cattail Lake (approximately 1 mile [1.6 kilometers] north of the north LWI project site), and (3) outflows from Hunter's Marsh (approximately 1,200 feet [366 meters] from the north LWI project site). The productive nearshore habitat within estuaries and associated eelgrass beds that are commonly present in estuarine habitat provide foraging opportunities for marine waterfowl and seabirds that frequent the nearshore (Table 3.5–3). Food resources used by marine birds in estuarine habitat range from small schooling fish to invertebrates and marine vegetation (Johnson and O'Neil 2001).

Table 3.5–1. Marine Bird Groupings and Families at the Bangor Waterfront

Marine Bird Grouping	Marine Bird Families	Season(s) of Occurrence	Preferred Habitats	Preferred Prey
Shorebirds and Wading Birds	Plovers, sanderlings, dowitchers, sandpipers, yellowlegs, and phalaropes Great blue heron	• Killdeer: year round • Spotted sandpiper: summer • Phalaropes: during migration • Great blue heron: year round • All other species: winter and during spring and/or fall migration	• Shorebirds: Intertidal zone, mudflats, beaches • Great blue heron: shoreline, shallow marine and freshwater	• Shorebirds: marine worms, insect larvae, aquatic insects • Great blue heron: crustaceans, small fishes
Marine Waterfowl	Diving ducks (goldeneye, scoters, bufflehead), mergansers, grebes, loons, dabbling ducks (mallard, wigeon), and geese	• Canada goose, red-necked and hooded mergansers, and some dabbling ducks: year round • Surf and white-winged scoters: winter and in non-breeding flocks during summer • All other species: winter and/or during migration (spring and/or fall migration)	• Canada goose, mergansers, dabbling ducks: marine and freshwater shorelines, eelgrass beds, and shallow water • Scoters, goldeneyes: marine nearshore and deeper water, near piles • Grebes, loons: marine nearshore and deeper water	• Canada goose: vegetation • Mergansers: small fishes • Dabbling ducks: marine and freshwater vegetation, freshwater and marine larvae, aquatic and terrestrial insects • Scoters, goldeneyes: molluscs, barnacles, crustaceans, other invertebrates, small fishes • Grebes, loons: small fishes
Seabirds	Pursuit divers: auklets, murres, murrelets, guillemots, and cormorants Surface feeders: gulls and terns	• Gulls: glaucous-winged gulls: year round; Ring-billed gull: year round; mew gull: winter, migrant; Bonaparte's gull: fall and spring migrant; other species: winter • Terns: Caspian terns: summer; common tern: fall migrant • All other species: year round	• Pursuit divers: marine nearshore and deeper water • Surface feeders (gulls, terns): shoreline, marine nearshore, and deeper water	• Pursuit divers: small fishes, invertebrates, zooplankton • Surface feeders: small fishes, molluscs, crustaceans, garbage, carrion

Sources: Smith et al. 1997; Opperman 2003; Larsen et al. 2004; Wahl et al. 2005; WDFW 2005

Table 3.5–2. Federally Listed Threatened Marine Bird Species in Hood Canal

Wildlife	Federal Listing	Critical Habitat	Critical Habitat at Base
Marbled murrelet	Threatened *57 FR 45328,* *October 1, 1992*	Designated *61 FR 26256* *May 24, 1996* Proposed revision *71 FR 53838* *September 12, 2006*	No; closest critical habitat is forest lands west and south from Dabob Bay

FR = Federal Register

Table 3.5–3. Marine Habitats Used by Marine Birds in Hood Canal

Habitat Type		Habitat Values	Characteristic Species
Estuaries		Estuarine habitat has value for foraging, loafing, social interaction, and brood-rearing activities for a variety of marine waterfowl and seabirds.	Killdeer, sandpiper species, glaucous-winged gull, other gull species, raptors, great blue heron
Nearshore Marine	**Intertidal Zone**	Intertidal habitat has value for foraging activities of shorebirds and gulls, in addition to nesting habitat for breeding shorebirds (killdeer).	
	Subtidal Zone	Subtidal habitat has value for foraging, loafing, social interaction, and brood-rearing activities for a variety of marine waterfowl and seabirds.	Common merganser, Barrow's goldeneye, common goldeneye, American wigeon, surf scoter, white-winged scoter, bufflehead, various grebes, loons, cormorants, pigeon guillemot, marbled murrelet, Canada goose, glaucous-winged gull, raptors, and mallard
Marine Deeper Water		Deeper water habitat has value for foraging, loafing, and social interactions of marine waterfowl and seabirds.	Surf scoter, white-winged scoter, Barrow's goldeneye, common goldeneye, double-crested and pelagic cormorants, pigeon guillemot, marbled murrelet, and glaucous-winged gull
Manmade Structures		Manmade structures have value for roosting activities of select seabirds, and foraging of marine waterfowl and seabirds on the underwater piles of structures.	*Roosting:* Glaucous-winged gull, other gull species, pigeon guillemot, and double-crested and pelagic cormorants, great blue heron *Foraging:* Pigeon guillemot, scoters, goldeneyes, and grebes

Sources: Johnson and O'Neil 2001; Agness and Tannenbaum 2009b

NEARSHORE MARINE HABITAT

INTERTIDAL ZONE

The intertidal zone near the LWI and SPE project sites provides food resources for a variety of shorebirds as well as gulls (Table 3.5–3). The amount of intertidal habitat available varies throughout the day with tidal fluctuation. Food sources from intertidal mudflats occur in the

upper intertidal zone, and food sources from shellfish and invertebrates occur in the intermediate intertidal zone. Food resources for shorebirds include molluscs, crustaceans, amphipods, worms, and aquatic insects, among other resources.

SUBTIDAL ZONE

Marine waterfowl and seabirds use the subtidal zone of nearshore marine habitat for foraging, loafing (resting on water), social interaction, and potentially for brood-rearing (Table 3.5–3). Food resources for marine birds in the nearshore marine habitat include small fish (e.g., juvenile salmonids, Pacific sand lance, and Pacific herring), crustaceans, molluscs, amphipods, aquatic insects, aquatic invertebrates, and plant material such as eelgrass (Johnson and O'Neil 2001).

MARINE DEEPER WATER HABITAT

Marine deeper water habitat at and near the LWI and SPE project sites is used by marine waterfowl and seabirds for foraging, loafing, and social interaction (Table 3.5–3). Food resources in this habitat primarily include small schooling fish, which are distributed spatially and temporally across deeper water habitat (Hunt 1995). Marine waterfowl can also occur in deeper waters; however, for some species of marine waterfowl, food resources such as plant material and aquatic insects can be more plentiful in the nearshore environment. Fewer marine bird species use deeper marine habitat in the summer than in the winter (Johnson and O'Neil 2001).

MANMADE STRUCTURES

Marine birds use buoys, piers, and piles on NAVBASE Kitsap Bangor as day roosts, perching sites, and nesting sites (Agness and Tannenbaum 2009b). Wharves along the waterfront such as EHW-1 provide underwater substrate for an assemblage of invertebrates such as molluscs, worms and crustaceans, and algal communities that attach to the wharf structures. For example, piles create structure for species typically found in shallower waters or benthic environments and, therefore, can attract marine bird species that forage on these types of prey (Table 3.5–3).

3.5.1.1.2. FEDERALLY ENDANGERED OR THREATENED BIRDS

MARBLED MURRELET

STATUS AND POPULATION

The marbled murrelet was listed in 1992 as threatened in California, Oregon, and Washington under the ESA (57 FR 45328) (Table 3.5–2). Primary causes of the species' decline include direct mortality from oil spills, by-catch in gillnet fisheries, and loss of nesting habitat (61 FR 26256). Critical habitat for nesting was designated for the marbled murrelet in 1996 (61 FR 26256) and was revised in 2011, but the revised critical habitat did not include military lands (76 FR 61599). NAVBASE Kitsap Bangor is not within designated marbled murrelet critical habitat (61 FR 26256; 71 FR 53838). Designated critical habitat closest to Hood Canal includes forestlands west and south from Dabob Bay, which is within flight distance of the Bangor waterfront (less than 52 miles [84 kilometers]) for breeding murrelets (61 FR 26256).

WDFW has initiated winter at-sea surveys in Washington inland marine waters including Hood Canal through a cooperative agreement with the Navy. The survey effort includes the Bangor shoreline, among other Hood Canal primary sampling units within Stratum 3[1], and is scheduled from 2012/2013 through 2016. The survey method uses a stratified sampling approach to derive density estimates within each stratum. The primary sampling unit in which the Bangor waterfront is located – PSU 39 – was surveyed from October 2013 – February 2014, with the following results expressed as the number of birds detected per kilometer transect length sampled (Table 3.5-4).

Table 3.5–4. 2013–2014 Marbled Murrelet Encounter Rates (PSU 39)

Replicate	Timing	Birds / km transect sampled
1	3 Oct 2013 – 1 Nov 2013	0.529
2	13 Nov 2013 – 17 Dec 2013	0.523
3	1 Jan 2014 – 14 Feb 2014	0.059
Average		0.37

Source: Pearson and Lance 2014
km = kilometer

The global model indicated an estimate of 186 individual birds for the Stratum encompassing NAVBASE Kitsap Bangor between October 2013 and February 2014 (Pearson and Lance 2014). The population estimate for Puget Sound and the Strait of Juan de Fuca in 2013 (Zone 1) was 4,395 birds (95 percent confidence interval = 2,275 – 6,740 birds) with a -3.88 percent (standard error = 1.73 percent) average annual rate of decline for the 2001–2013 period ($p = 0.0499$) (Pearson et al. 2014).

Marbled murrelets occur year round in Puget Sound and Hood Canal, although their flock size, density, and distribution vary by season (Nysewander et al. 2005; Falxa et al 2008). Observations of marbled murrelets on NAVBASE Kitsap Bangor have been documented since 2007. Marbled murrelets were observed opportunistically during the course of shoreline fish and sediment surveys conducted in spring/summer 2007 and during systematic at-sea surveys of marine birds and mammals conducted in summer 2008 and winter/spring 2009–2010 (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). These observations included eight sightings of marbled murrelet pairs during April and May 2007, and seven sightings of pairs and individuals in November 2009 and April 2010. An individual in juvenile plumage was observed under EHW-1 in September 2008.

The Navy conducted marbled murrelet monitoring in January 2009 during the installation of five steel piles near the southern end of the Bangor waterfront (Navy 2009b). During each of the five pile driving days, one to eight marbled murrelets were frequently observed within 3,280 feet

[1] The Stratum 3 designation is specific to the studies being conducted in cooperation with the Navy; the area in which NAVBASE Kitsap Bangor is located for overall population estimate studies (reference Falxa et al. 2014) is Stratum 2.

(1,000 meters) of pile driving, and intermittent sightings of 12 to 31 murrelets were recorded. No marbled murrelet sightings occurred within the potential injury zone for underwater pile driving noise. Only the September 2008 sighting was in proximity to existing pier structures; other sightings were in nearshore and deeper waters greater than 1,800 feet (549 meters) from any shoreline structure. Marbled murrelet surveys conducted during the TPP (late September to late October 2011) did not detect any murrelets within or in close proximity to the WRA (including the EHW-2 project area), although murrelets were detected elsewhere in Hood Canal (Hart Crowser and HDR 2012). One marbled murrelet was detected in nearshore waters in the vicinity of the north LWI project site (Tannenbaum et al. 2009b). No marbled murrelet observations have been reported in the vicinity of the south LWI project site. Marbled murrelets have been detected occasionally in deeper water in the vicinity of the SPE project site (Navy 2009b; Tannenbaum et al. 2011b).

During the most recent monitoring effort at the NAVBASE Kitsap, Bangor waterfront (July 16, 2013, to February 15, 2014) in support of EHW-2 construction, no marbled murrelets were observed (Pearson and Lance 2014). Collectively, monitoring observations at NAVBASE Kitsap, Bangor suggest that the WRA is not commonly utilized by murrelets or other diving seabirds. This may be due in part to the high levels of disturbance associated with the EHW-2 construction activity, coupled with the already high levels of noise and vessel traffic in the WRA that are part of routine Navy security and operational activities, some of which occur 24 hours a day (e.g., security boat traffic). Agness et al. (2008) similarly concluded that vessel traffic caused significant declines in nearshore densities of Kittlitz's murrelets, a species closely related to marbled murrelets, in Glacier Bay, Alaska. In contrast, noise and disturbance levels outside of the WRA in portions of Hood Canal and Dabob Bay are generally lower, and both marbled murrelets and diving seabirds appear to be much more common based on observations during the TPP when observers monitored baseline bird populations in these areas (Hart Crowser and HDR 2012).

BEHAVIOR AND ECOLOGY

Murrelets use the marine environment in Hood Canal for courtship, loafing, and foraging (USFWS 2010). In this area, nesting is asynchronous between late April and early September (McShane et al. 2004). During the breeding season, this species tends to forage in well-defined areas along the shoreline in relatively shallow marine waters (Strachan et al. 1995). Murrelets typically forage in pairs during the summer, with single birds occurring less often (Strachan et al. 1995). During the pre-basic (post-breeding season) molt, which occurs from July through November, murrelets are essentially flightless for up to two months (Nelson 1997) and must select foraging sites that provide adequate prey resources within swimming distance (Carter 1984; Carter and Stein 1995). During the non-breeding season, which occurs from September through April, murrelets typically disperse and are found farther from shore (Strachan et al. 1995). The winter flock size averages four birds (USFWS 2010). Murrelets forage at all times of the day and in some cases at night (Strachan et al. 1995). Prey species in Washington coastal and inland waters have not been well documented, but include sand lance, anchovy, immature Pacific herring, shiner perch, and small crustaceans (especially euphausiids) (review by Burkett 1995). Invertebrates are a primary prey source in the non-breeding season, whereas fish are a source year round.

Marbled murrelets nest solitarily in trees with features typical of coniferous old-growth (stand age from 200 to 250 years old trees with multi-layered canopy). Although old-growth forest is the preferred habitat for nesting, this species also is known to nest in mature second-growth forest with trees as young as 180 years old (Hamer and Nelson 1995). WDFW Priority Habitat Species maps do not indicate the presence of marbled murrelet nests in the upland areas including and adjacent to NAVBASE Kitsap Bangor (WDFW 2010b). Although forest stand inventories on NAVBASE Kitsap Bangor indicate that stands are typically less than 110 years old, some relict old-growth trees can be found near Devil's Hole, and a small old-growth stand has been located at the northern portion of the base (International Forestry Consultants 2001; Jones 2010a, personal communication).

3.5.1.1.3. OTHER MARINE BIRDS

The following discussion provides an overview of the marine bird groupings that occur in the vicinity of the LWI project site, including marine bird families, relative occurrence, habitat requirements, and food resources. Section 3.5.1.1.2 provides information on endangered, threatened, and protected species that occur near the project site. Appendix A provides a complete listing of all birds known or expected to occur on NAVBASE Kitsap Bangor and includes information on seasons of occurrence.

MIGRATORY BIRDS

Most of the marine bird species occurring near the LWI and SPE project sites are present during spring and fall migration or the winter months, including marine waterfowl and seabirds (Appendix A). Six species recognized by USFWS as species of concern could occur in the project area, including the Caspian tern, yellow-billed loon, pelagic cormorant, western grebe, lesser yellowlegs, and short-billed dowitcher (USFWS 2008). (See Appendix A for more information on these species.) Of these species, pelagic cormorants have been documented from Christmas bird counts (Kitsap Audubon Society 2008) and summer surveys (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). The species does not breed in the vicinity.

SHOREBIRDS AND WADING BIRDS

Shorebirds occurring at or near the LWI and SPE project sites are mainly present during winter and/or migration periods, depending on species life history (Table 3.5–1). Exceptions include killdeer, which are present year round, and spotted sandpiper, a summer resident and potential breeder on NAVBASE Kitsap Bangor. Shorebirds primarily rely on resources on NAVBASE Kitsap Bangor for foraging during the non-breeding season when over-wintering or as a stopover during spring and fall migrations (for species such as phalaropes) (Buchanan 2004). Both killdeer and spotted sandpiper nest close to water (Opperman 2003) and may nest on the shoreline near the project sites. Shorebirds focus on intertidal habitat for all foraging activities (Johnson and O'Neil 2001). Many shorebird species (e.g., plovers, sanderlings, sandpipers, and dowitchers) forage in intertidal mudflats or on beaches near the shoreline for polychaete and oligochaete worms, insect larvae, and aquatic insects (Buchanan 2004). Other food sources for shorebirds include amphipods, copepods, crustaceans, and molluscs. Shorebirds rest or sleep (roost) in a variety of location-dependent habitats. Some roosting habitats used by shorebirds include salt flats adjacent to intertidal foraging areas, higher elevation sand beaches, fields, or grassy areas near intertidal foraging areas. Roost sites occasionally include piles, log rafts,

floating docks, or other floating structures when natural roost sites are limited (Buchanan 2004). Shorebird detections were infrequent during at-sea surveys of the Bangor waterfront, with the exception of flocks of dunlin and western sandpiper that used sections of the PSB in deeper water as resting sites during winter months in 2010 (Tannenbaum et al. 2011b).

Great blue herons are wading birds that forage on fish, amphibians, and aquatic invertebrates in wetlands, streams, and marine shorelines in Washington (Quinn and Milner 2004). They are year-round residents in low-elevation areas of western Washington, breeding in colonies (rookeries) that are typically located near a body of water. Great blue herons are observed foraging, resting, and flying along the Bangor shoreline throughout the year (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b). In 2008, three new nests were constructed on a lightning tower at EHW-1, at least two of which had chicks during summer 2008 marine wildlife surveys (Tannenbaum et al. 2009b). The tower does not appear to have been used by nesting great blue herons since 2008. A great blue heron rookery with 10 nests was discovered in mid-April 2013 in the vicinity of the proposed SPE parking lot, but the nests were abandoned by the end of May. Since the site was abandoned early in the season it would not warrant protection under the Navy's management criteria for heron nesting sites on NAVBASE Kitsap Bangor.

MARINE WATERFOWL

Most marine waterfowl species only occur at the Bangor waterfront during the winter and migrate north for their breeding season. However, common and hooded mergansers, Canada geese, and some dabbling duck species (mallard, gadwall, and northern shoveler) can be found near the LWI project sites year round. Of these species, only Canada geese and merganser have been sighted regularly during summer months (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b). Surf and white-winged scoters primarily occur in winter, but also can occur in summer (Opperman 2003; Tannenbaum et al. 2011b), although sightings are less common during summer months (Agness and Tannenbaum 2009b). Marine waterfowl primarily forage in the nearshore environment, including near manmade structures (such as EHW-1), but are also found in deeper marine waters (Agness and Tannenbaum 2009b). The primary food resources of marine waterfowl include molluscs, crustaceans, and plant material. Other secondary food sources of marine waterfowl in the nearshore area of the LWI project sites are aquatic larvae and invertebrates. In the Puget Sound region, eelgrass beds are important foraging zones for dabbling ducks (American wigeon and mallard) (Lovvorn and Baldwin 1996). Mergansers, such as the common merganser, nest close to water in rock crevices, tree cavities, or under tree roots (Opperman 2003) and may nest along the shoreline habitat near the LWI project sites during summer. Marine waterfowl also rest on shore and in the intertidal zone (Agness and Tannenbaum 2009b). Summer surveys of marine waterfowl on the Bangor shoreline did not reveal any evidence of local breeding, that is, nest sites or chicks (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b).

SEABIRDS

Two primary groupings of seabirds occur near the LWI project sites: surface-feeding and pursuit-diving. In addition, the parasitic jaeger is a predatory seabird that may occur in the vicinity of NAVBASE Kitsap Bangor during fall migration (late September to early October) in pursuit of small birds such as common terns, which are also in migration during this time

(Opperman 2003). Depending on individual species life history, surface-feeding seabirds may be present in the vicinity of NAVBASE Kitsap Bangor during different seasons. Glaucous-winged gulls occur year round (Hayward and Verbeek 2008), but other gull species only occur during part of the year (Table 3.5–1 and Appendix A). Glaucous-winged gulls breed at established colonies, with the closest colony to the LWI project site located approximately 30 miles (48 kilometers) to the northwest at Protection Island (Hayward and Verbeek 2008). Caspian terns disperse from nesting colonies after the breeding season ends in June or July and may occur in the vicinity of the LWI project sites from April to August. Gulls and terns in the vicinity forage on small schooling fish (e.g., Pacific herring, Pacific sand lance, and juvenile salmonids), which are visible from the water surface in the nearshore marine and deeper water habitats. Additional forage resources taken opportunistically by gulls include objects gleaned at the water surface, garbage on shore or inland, scavenged carrion, and small birds and eggs. Gulls can also forage in the intertidal zone; for example, gulls can feed on molluscs by dropping a mollusc from the air to break the shell on the beach or other hard surface, such as EHW-1.

Pursuit-diving seabirds can occur year round in the vicinity of the LWI project sites; however, numbers of some species are greater during winter months (e.g., pelagic cormorant, common murre, and pigeon guillemot). Cormorants such as the double-crested cormorant nest in colonies along the outer coast of Washington; however, non-breeding double-crested cormorants are found year round on NAVBASE Kitsap Bangor, and pelagic cormorants are also occasionally present. Cormorants typically roost on buoys and other structures at the waterfront in groups of 10 or more individuals, the majority of which are juveniles (Agness and Tannenbaum 2009b; Tannenbaum et al. 2009b, 2011b).

With the exception of the pigeon guillemot, seabirds such as the common murre and rhinoceros auklet do not nest near the Bangor waterfront (Wilson and Manuwal 1986; Ainley et al. 2002; Agness and Tannenbaum 2009b). Non-breeding common murres can occur year round. In general, however, common murres are most abundant in inland waters of Washington during the winter (Johnson and O'Neil 2001), whereas rhinoceros auklets are more common during the summer (Johnson and O'Neil 2001; Opperman 2003). Pigeon guillemots were frequently observed during spring/summer surveys of the NAVBASE Kitsap shoreline and infrequently in winter. Common murres and rhinoceros auklets were not detected during these surveys.

Pursuit-diving seabirds are found in nearshore and marine deeper waters near the project site, where they dive to capture prey underwater. These seabirds are also found near manmade structures, such as EHW-1, where algal and invertebrate communities (which provide additional forage resources) have become established on underwater piles. Primary forage resources of these seabirds include small schooling fish and other nearshore fish, such as Pacific sand lance and Pacific herring (Vermeer et al. 1987). The pigeon guillemot forages opportunistically on a more general diet of epibenthic fish and invertebrates compared to some other pursuit-divers, such as the common murre (Vermeer et al. 1987). Additional forage resources of pursuit-diving marine birds include zooplankton and aquatic invertebrates.

Marine Birds at the LWI and SPE Project Sites

Great blue herons have been observed at the outlet of Devil's Hole in the vicinity of the south LWI project site and have been detected in smaller numbers in the vicinity of the north LWI and

SPE project sites. Several heron pairs have nested on a lightning tower at EHW near the north LWI project site in the past (2008), but this is not a recurring rookery location (Tannenbaum et al. 2009b, 2011b). No shorebird concentrations have been detected in the vicinity of the LWI project sites.

Most marine waterfowl species tend to concentrate in the vicinity of manmade structures on the Bangor waterfront, including EHW-1 near the north LWI project site (Tannenbaum et al. 2009b, 2011b). The most abundant marine waterfowl species detected near the project site include Barrow's goldeneye, surf scoter, and bufflehead. The south LWI project site appears to have fewer occurrences of marine waterfowl, with the exception of American wigeon.

Merganser species and Barrow's goldeneye are the most abundant species that congregate in the vicinity of the Service Pier, and pigeon guillemots and various gull species congregate in the vicinity of the north LWI and SPE proposed project sites (Tannenbaum et al. 2009b, 2011b).

3.5.1.2. MARINE BIRD HEARING AND VOCALIZATION

Diving birds (e.g., loons, pelicans, some ducks, terns, and cormorants) may not hear well under water, compared to other (non-avian) terrestrial species, based on adaptations that protect their ears from pressure changes (Dooling and Therrien 2012). Common murres (*Uria aalge*) were deterred from gillnets by acoustic transmitters emitting 1.5 kHz pings at 120 dB re 1 µPa; however, there was no significant reduction in rhinoceros auklet (*Cerorhinca monocerata*) bycatch in the same nets (Melvin et al. 1999). Stemp (1985) found no effect of seismic survey activity on the distribution and abundance of seabirds, and Parsons (in Stemp 1985) reported that shearwaters with their heads underwater were observed within 100 feet (30 meters) of seismic sources (impulsive sounds) and did not respond[2].

Data relevant to the auditory capabilities of bird species are either from studies of vocalizations or audiometric recordings done in-air. These data generally suggest that birds hear best at frequencies between about 1 and 5 kHz, with the most sensitive frequency in the range of 2 to 3 kHz (Dooling 1980, 1982, 2002; review in Dooling and Popper 2007). In-air data for marine birds is limited but generally matches that reported for other bird species. For instance, Woehler (2002) presented data on the hearing capabilities of six penguin species based on their vocalization behavior. The frequency range for all species was between 400 and 8,000 Hz. The upper limit of in-air hearing in all birds is generally limited to the mid-frequency bandwidth due to the anatomical morphology of their middle ear. Saunders et al. (2000) determined that the presence of a single columella rather than the three ear bones found in mammals generally limits hearing in most avian species to a maximum of approximately 10 kHz. No auditory information exists for the marbled murrelet; however, murrelet vocalizations have been recorded for adults and nestlings, with adult calls ranging from approximately 4 to 7 kHz and nestling begging calls from 2 to 11 kHz (Nelson 1997).

[2] Effects of seismic survey underwater sound cannot be compared directly to effects of pile driving, particularly in shallow waters where sound propagation differs from that in deeper waters generally studied in seismic surveys.

3.5.1.3. CURRENT REQUIREMENTS AND PRACTICES

ENDANGERED SPECIES ACT

The ESA is discussed under the fish resource, Section 3.3.1.4.1.

MIGRATORY BIRD TREATY ACT

The MBTA (16 USC 703 et seq.) and EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, protect migratory birds from harm, except as permitted by USFWS for purposes such as banding, scientific collecting, taxidermy, falconry, depredation control, and other regulated activities such as game bird hunting. Harm includes actions that "result in pursuit, hunting, taking, capture, killing, possession, or transportation of any migratory bird, bird part, nest, or egg thereof."

3.5.2. Environmental Consequences

3.5.2.1. APPROACH TO ANALYSIS

The evaluation of impacts on marine birds considers the importance of the resource (i.e., legal, recreational, ecological, or scientific); the proportion of the resource affected relative to its occurrence in the region; the particular sensitivity of the resource to project activities; and the duration of environmental impacts or disruption.

The primary impacts on marine birds from construction of the LWI and SPE would be associated with water quality changes (turbidity) in nearshore habitats, noise associated with impact and vibratory pile driving, construction vessel traffic, visual disturbance, and changes in prey availability. In particular, pile driving noise during the construction period has the potential to disrupt marine bird nesting, foraging, and resting in the vicinity of the LWI and SPE. The range to effect for construction noise for each Alternative is described in the following sections. Other impacts on marine birds, such as changes in prey availability, are anticipated to be highly localized to the construction area.

3.5.2.2. LWI PROJECT ALTERNATIVES

3.5.2.2.1. LWI ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine birds in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine birds.

3.5.2.2.2. LWI ALTERNATIVE 2: PILE-SUPPORTED PIER

Construction of the LWI under this Alternative has the potential to impact marine birds primarily through underwater and airborne noise generated by pile driving, visual disturbance due to construction activity and vessels, and temporary localized effects within the construction area on prey availability.

CONSTRUCTION OF LWI ALTERNATIVE 2

The primary impacts on marine birds from construction of LWI Alternative 2 would be associated with temporary water quality changes (turbidity) in nearshore habitats, noise associated with pile driving and other construction equipment, temporarily increased construction vessel traffic and intermittent changes in prey availability (benthic community and forage fish), and visual disturbance from the presence of construction workers and equipment during the in-water construction period.

WATER QUALITY

Construction of the LWI would temporarily resuspend sediments into the water in the project area due to installation of piles and steel plate anchors for the mesh barrier, anchoring of barges and tugs, relocation of PSB buoys, and work vessel movements, as discussed in Section 3.1.2.2.2. Water quality would be impacted because bottom sediments would be temporarily resuspended and spread up to approximately 130 feet (40 meters), as described in Section 3.1.2.2.2.

A maximum of 13.1 acres (5.3 hectares) of benthic habitat may be temporarily disturbed within the construction footprint. Resuspended sediments would increase turbidity periodically during in-water construction activities, but turbidity is expected to be localized within the construction zone and temporary during the course of project construction. Metals and organic contaminants that may be present in sediments could also become suspended in the water column in the construction impact zone, but these contaminants are within the sediment quality guidelines listed in Section 3.1.1.1.3. Water quality could also be impacted by stormwater discharges (contaminant loading), and spills (contaminant releases). However, construction-period conditions are not expected to exceed water quality standards, and mitigation measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C).

Bird species that prey on fish and benthic organisms may be impacted if resuspended sediments obscure their prey. However, increased turbidity would be limited to the area immediately around driven piles. BMPs and current practices would be implemented to minimize impacts on water quality, such as deploying an oil boom if a spill were to occur, and implementing procedures to remove contaminants (Appendix C). Marine birds would be unlikely to enter the contained area during periods of construction activity due to the pile driving noise, vessel movement, and human presence during the in-water construction window. Some birds may enter the area during breaks in activity, when turbidity due to pile driving would be low. Therefore, impacts on marine birds due to changes in water quality during construction are expected to be minor.

VESSEL TRAFFIC

Vessel movements have the potential to affect marine birds by visual or physical disturbance, or noise (review in Piatt et al. 2007). Responses to disturbance also vary with environmental factors such as habitat types, tides, time of day, and weather (review in Agness 2006). Responses to vessel disturbance are species-specific, and it is likely that both airborne and underwater noise and visual presence of vessels play a role in prompting reactions from marine birds. The probability and significance of vessel and marine bird interactions is dependent on

several factors including numbers, types, and speeds of vessels; duration and spatial extent of activities; and the presence/absence and density of marine birds. In general, large, loud, or fast boats appear to have greater impacts than smaller, quieter boats (Piatt et al. 2007).

Behavioral changes in response to vessel presence can include avoidance reactions, alarm/startle responses, temporary abandonment of resting sites, and other behavioral and stress-related changes, such as altered swimming speed, flight, diving, altered direction of travel, and changes in feeding activity, vocalizations, and resting behavior. For example, studies of vessel disturbance and murrelet species (including marbled murrelet) in Alaska, British Columbia, and Washington showed that murrelet counts were negatively correlated with vessel traffic, fewer birds made foraging dives, more birds made avoidance dives, and more birds flew off the water compared to undisturbed focal groups (Kuletz 1996; Speckman et al. 2004; Agness 2006; unpublished data reviewed in Piatt et al. 2007). Boat distance and speed had an effect on reactions by marbled murrelets (review in Piatt et al. 2007). On average, murrelets reacted (by diving or flying) to approaching boats at 130 feet (40 meters) when boat speed was greater than 16 knots, but flushed on average at 92 feet (28 meters) when boat speed was less than 7 knots.

Marine birds on NAVBASE Kitsap Bangor encounter vessel traffic associated with daily operations, maintenance, and security monitoring along the waterfront. During construction of the LWI, several additional vessels would operate in the project area, including one pile driving barge with a crane, one supply barge, one tug boat, and work skiffs. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 80 days during one in-water work season). Sixteen total round trips of barges are expected for the duration of the project (Table 2–1). At any given time, there would be no more than two tugs and six smaller boats, plus barges, present in the construction area. The powered vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Tugs would be employed primarily to bring barges to and from the project area and to position them, which generally involves low speeds. Small boats used to ferry personnel or for monitoring would likewise be operating at slow speeds.

The increased boat traffic associated with in-water construction activities may displace some marine birds if they are in the LWI construction area. As described in Section 3.5.1.1, seabirds and waterfowl would be most abundant types of birds in the project area during the in-water work period, but the effect on breeding marine birds would be negligible because most species do not breed in the vicinity of the project area. Most marine bird species that occur along the Bangor waterfront appear to have habituated to high levels of vessel traffic, based on surveys of developed areas such as Delta Pier, Marginal Pier, and the Service Pier (Tannenbaum et al. 2009b, 2011b). Thus, although some individuals may be disturbed by increased construction-period vessel traffic in the project area, overall impacts would be temporary and intermittent.

PREY AVAILABILITY

The prey base for marine waterfowl includes vegetation, molluscs, and crustaceans and for seabirds includes juvenile salmonids, forage fish, and invertebrates. As described in Section 3.3.1.1, fish species and groups that occur in the LWI project area include forage fish (Pacific sand lance, surf smelt, Pacific herring) and juvenile salmonids (juvenile Chinook

salmon, coho salmon, and steelhead; and cutthroat trout) (Bhuthimethee et al. 2009). As described in Section 3.2.1.1, a number of benthic invertebrate species are abundant and diverse at the LWI project sites. These nearshore resources offer suitable prey for most of the marine birds that have been documented in Hood Canal and the Bangor waterfront, but available information is not sufficiently detailed to support a comparison of these sites with other known or potential foraging sites in inland waters.

Some of the prey species, including forage fish and juvenile salmonids have been identified in beach seine surveys (SAIC 2006; Bhuthimethee et al. 2009) and are particularly vulnerable to project impacts because they migrate, feed, shelter, or spawn in the nearshore environment. The greatest impacts on prey species during construction would result from nearshore benthic habitat displacement, resuspension of sediments, localized turbidity within the construction zone, creation of physical barriers to fish migration in nearshore waters, and behavioral disturbance due to pile driving noise. Anchoring of construction barges, propeller wash, pile driving, and installation of anchor plates could locally displace or disturb nearshore benthic habitats and increase turbidity. All of these actions may indirectly impact marine birds by reducing their invertebrate and vertebrate prey base, as discussed in detail in Sections 3.2.2.2.2 and 3.3.2.2.2, respectively. Construction of the pile-supported pier may temporarily reduce biological productivity and quality of benthic habitat used by prey species. Potential construction impacts on benthic habitats would be proportional to the size of the construction zone (up to 100 feet [30 meters] of the proposed LWI structures). Construction of LWI Alternative 2 may potentially displace or disturb up to 13.1 acres (5.3 hectares) of benthic habitat used by invertebrate prey species. Potential impacts to forage fish from underwater noise are detailed in Section 3.3.

VISUAL DISTURBANCE

Visual disturbance would also impact use of the construction area by marine bird species, which have variable levels of tolerance for disturbance. Species including bald eagles, osprey, and great blue herons that are intolerant of visual disturbance while foraging may be impacted during construction at shoreline foraging areas in the vicinity (Watson and Pierce 1998; Quinn and Milner 2004; Eissinger 2007). Birds that depart during construction activities may return to the area following a decrease in activity, such as evening or early morning hours before work commences and when activities are completed. Due to the large size of the Bangor waterfront area and the surrounding Hood Canal, alternative foraging and resting areas are present that would minimize the potential effects of visual disturbance during construction.

CONSTRUCTION AND PILE DRIVING NOISE

The following analysis of underwater noise under LWI Alternative 2 focuses on criteria and guidelines used by the USFWS to determine effects on the ESA-listed marbled murrelet. The analysis estimates the areas that would be encompassed by these criteria based on pile driving noise source levels and propagation of sound through the project area.

Average underwater noise levels measured along the Bangor waterfront are elevated over ambient conditions at undeveloped sites due to waterfront operations, but are within the minimum and maximum range of measurements taken at similar environments within Puget Sound (see Appendix D). In 2009, the average broadband ambient underwater noise levels were measured at 114 dB re 1 µPa between 100 Hz and 20 kHz (Slater 2009). Peak spectral noise

from industrial activity was noted below the 300 Hz frequency, with maximum levels of 110 dB re 1 µPa noted in the 125 Hz band. In the 300 Hz to 5 kHz range, average levels ranged between 83 and 99 dB re 1 µPa. Wind-driven wave noise dominated the background noise environment at approximately 5 kHz and above, and ambient noise levels flattened above 10 kHz. Underwater ambient noise measurements taken at EHW-1 (approximately 1,500 feet [450 meters] from the north LWI and 5,900 feet [1,800 meters] from the south LWI) during the TPP project in 2011 ranged from 112.4 dB re 1 µPa RMS between 50 Hz and 20 kHz at mid depth to 114.3 dB at deep depth (Illingworth & Rodkin 2012).

Increased vessel activity and barge-mounted construction equipment such as cranes and generators would temporarily elevate underwater noise levels in the project vicinity. Noise from tugs associated with barge movement would produce intermittent noise levels of approximately 142 dB re 1 µPa at 33 feet (10 meters). These noise levels are typical of an industrial waterfront where tugs, barges, and other vessels are in operation, and consistent with noise levels experienced daily by marine birds under existing conditions in the vicinity of the Bangor waterfront.

Under LWI Alternative 2, up to 54 24-inch (60-centimeter) steel pipe piles would be driven at the north site location, and 202 24-inch steel pipe piles (120 of which would be installed temporarily) would be driven at the south site. An additional 15 36-inch (90-centimeter) piles (abutment piles) and 5 24-inch piles (abutment stair piles) would be driven on shore (in the dry) at the north site, and 16 36-inch piles and 5 24-inch piles would be driven on shore at the south site. Piles would be installed primarily with a vibratory driver, with additional proofing of piles by an impact hammer only if needed. Driving would occur over a maximum of 80 days between July 15 and January 15 during the first year of construction.

Details on selection of proxy source levels for acoustic modeling and sound transmission loss calculations are presented in Appendix D, as is a discussion of the use of a bubble curtain to attenuate noise from impact driving of steel piles. Source levels used to estimate the ranges to effect for marbled murrelets are detailed in Table 3.5-5.

Sound from impact pile driving may be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven pile to receiver location). Intervening land masses would block sound propagation outside of the pathways.

The USFWS identified threshold criteria for marbled murrelets for determining injury exposure to underwater pile driving noise as 208 dB SEL re 1 μPa^2-sec for barotrauma injury and 202 dB SEL re 1 μPa^2-sec for auditory injury (Table 3.5-6). Since the criterion for auditory injury was the lower of the two thresholds, it is used to assess injurious impacts on the marbled murrelet from impact pile driving.

In estimating the potential effects to marbled murrelets from noise generated by impact proofing, the acoustic model assumes 200 strikes per pile with up to 10 piles being proofed per day for the cumulative range to effect. However, the actual number of piles being driven in a given day, and the number of strikes per pile, may be significantly lower than what was modeled.

Table 3.5–5. Source Levels (unattenuated) for Impact Proofing and Vibratory Pile Driving - LWI Alternative 2

Underwater		
Pile Size / Type	**dB SEL re: 1 µPa^2 sec @ 33 feet (10 meters)**	
24-inch (60-centimeter) steel pipe	181	
Airborne		
Pile Size / Type	**dBA RMS re: 20 µPa @ 50 feet (15 meters)**	
	Impact	Vibratory
24-inch steel pipe	100	89
36-inch (90-centimeter) steel pipe	100	96

dB=decibel; re 1 µPa = referenced at 1 micropascal; sec = second; SEL= sound exposure level

Table 3.5–6. Calculated Ranges to Effect - LWI Alternative 2

	Underwater Noise		Airborne Noise
	Barotrauma Injury 208 dB SEL[1]	**Auditory Injury 202 dB SEL[1]**	**Masking**
Distance to Threshold	24 ft (7 m)	61 ft (19 m)	138 ft (42 m)
Area Encompassed by Threshold[2]	1,836 sq ft (171 sq m)	11,690 sq ft (1,134 sq m)	59,829 sq ft (5,512 sq m)

dB=decibel; ft = feet; m = meter; µPa = micropascal; SEL= sound exposure level (re 1 µPa^2-sec); sq ft = square feet; sq m = square meter

1. All SEL values assume 2,000 strikes per day. Bubble curtain assumed to achieve an 8 dB reduction in sound pressure levels (or SPLs).
2. Areas encompassed by threshold are the same for the north and south LWI sites

Further, when the model applies the 208 or 202 dB re 1 µPa^{2}sec SEL injury thresholds it assumes marbled murrelets are remaining underwater within the range to effect during the entirety of active impact proofing. In other words, an individual bird would have to be underwater constantly within the calculated range during all impact proofing, with the maximum number of piles installed, and all piles requiring proofing with the maximum number of strikes, in order to accumulate energy from every impact strike. Because these assumptions are physiologically impossible for marbled murrelets, and represent an extreme worst-case scenario regarding pile driving methods and numbers, the practical range to effect would be significantly smaller than those listed in Table 3.5-6 and illustrated in Figure 3.5-1.

Marbled murrelets are unlikely to be injured by pile driving noise at these short distances because the high level of human activity and vessel traffic would cause them to avoid the immediate construction area. Further, impact proofing would be halted if a marbled murrelet is observed within 61 feet (19 meters) of the pile being driven (Appendix C). All pile driving would begin 2 hours after sunrise and cease 2 hours before sunset to minimize effects on foraging marbled murrelets during the nesting season.

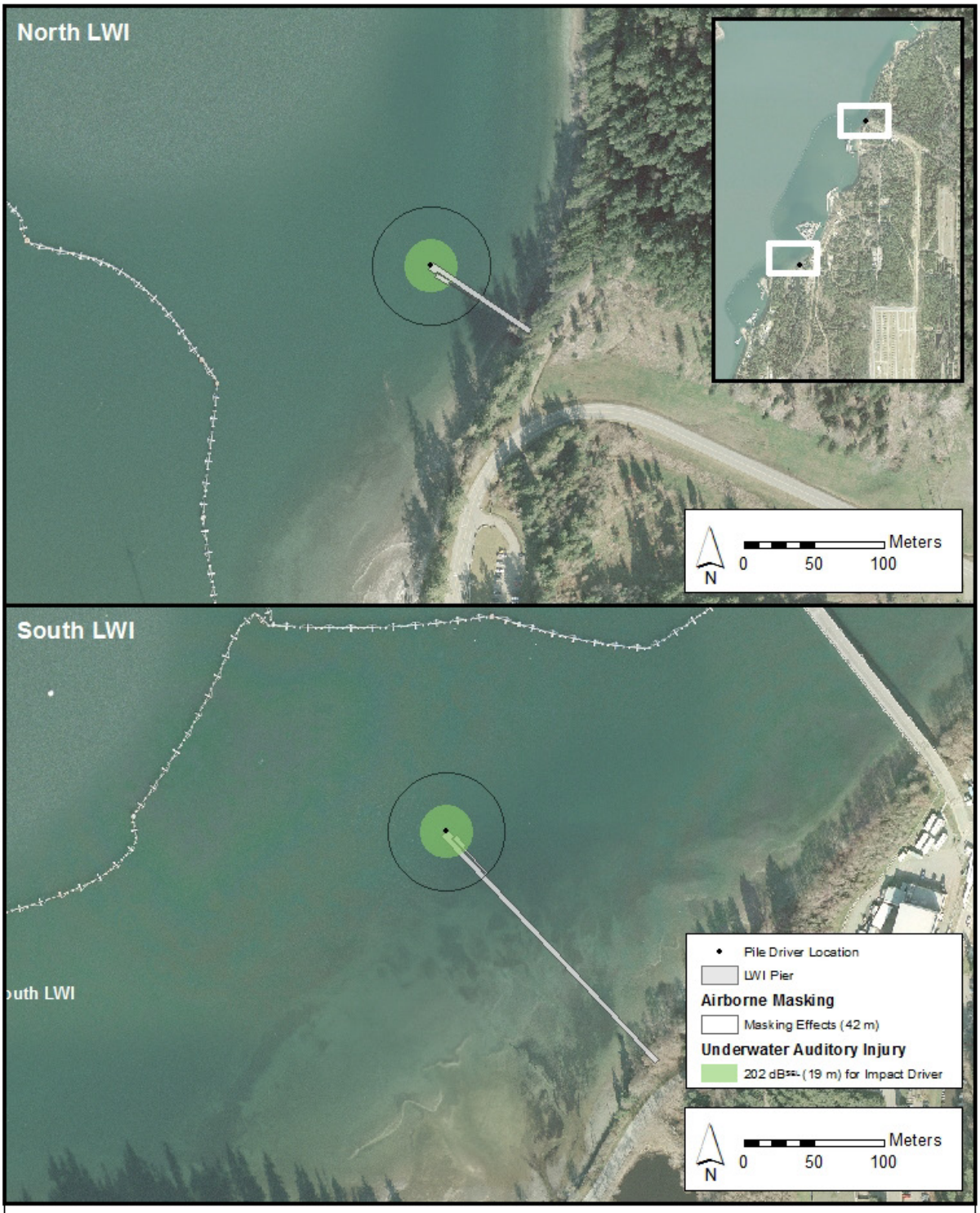

Figure 3.5-1. Representative View of Affected Areas for Marbeled Murrelet due to Underwater and Airborne Pile Driving Noise during Construction of LWI Alternative 2

PHYSIOLOGICAL AND BEHAVIORAL IMPACTS OF NOISE

PHYSIOLOGICAL EFFECTS

Temporary changes in physiology (e.g., stress, reproductive hormone levels) (Blickley et al. 2012; Sanyal et al. 2013) and behavior (e.g., avoidance, foraging, vocalization, attention) (Shen 1983; Bowles 1995) may occur, but are expected to be temporary and consistent with those experienced during exposure to other natural and anthropogenic stressors in an area with a high level of activity such as Hood Canal. Research suggests that bird populations in urban environments can rebound very shortly after even large-scale, extremely noisy events (Payne et al. 2012). During construction of the offshore wind farm Egmond aan Zee in the Netherlands, observers reported that birds (mainly gulls and terns) passing by the activity area did not show a noticeable reaction to pile driving noise (Leopold and Camphuysen 2009). Further, potential for these effects is expected to decrease rapidly with distance from the source of the noise, particularly if topography or vegetation attenuates the signal (WSDOT 2014).

The source levels for airborne noise from pile driving (Table 3.5-5) would be well below those known to cause injury to birds in laboratory situations. Studies of captive birds indicate that long-term exposure to high levels (≥ 93 dBA) of non-impulsive noise (e.g., vibratory pile driving) or to multiple impulses over 125 dBA can cause temporary threshold shifts (Dooling and Popper 2007). However, birds may recover auditory function even after repeated exposure to elevated sound levels (Corwin and Cotanche 1988; Niemiec et al. 1994), and noise resulting from pile driving and other construction activities would be temporary and intermittent during the course of the day.

BEHAVIORAL EFFECTS

Behavioral responses to sound are highly variable and context-specific. For each potential behavioral change, the magnitude of the change ultimately determines the severity of the response. A number of factors may influence an animal's response to noise, including its previous experience; auditory sensitivity; biological and social status, including age and sex; and the behavioral state and activity at the time of exposure. Characteristics of the noise, such as duration and whether the sounds start suddenly or gradually, play a role in determining an animal's response. There is anecdotal evidence of underwater pile driving effects on marine birds. Construction-period monitoring at the Hood Canal Bridge, approximately 22 miles (35 kilometers) from NAVBASE Kitsap Bangor, described a pigeon guillemot that appeared to be distressed and initially unable to fly following underwater exposure to impact pile driving at a distance of approximately 225 feet (69 meters) (Entranco and Hamer Environmental 2005). Foraging marbled murrelets observed during the same project flushed at the onset of pile driving but eventually habituated to pile driving noise.

For birds in the immediate vicinity of the construction activities, behavioral responses to construction noise could include flushing, temporary interruptions of foraging or other behaviors, increased stress hormone levels, changes in vocalization patterns, or avoidance of the activity area (Wasser et al. 1997; Remage-Healey and Romero 2000, 2001; Romero and Remage-Healey 2000; Ronconi and St. Clair 2002; Weimerskirch et al. 2002; Penna and Zúñiga 2014). Energy expenditures due to avoidance of elevated sound pressure levels may increase. Conversely, if

small fish are killed or injured as a result of pile driving, foraging birds may be attracted to the work area to feed on them in spite of the noise levels (Cooper 1982). Even without the attractant of stunned or killed fish, birds could continue to forage close to the study area and be exposed to noise from pile driving and extraction. For example, monitoring work at the Hood Canal Bridge in Washington demonstrated that marbled murrelets would continue to dive and forage within 984 feet (300 meters) of active pile driving operations (Entranco and Hamer Environmental 2005), indicating that foraging birds may habituate to such noise.

The summer/fall, pre-basic molt condition (July to November), during which murrelets are essentially flightless, would overlap with the in-water construction season for the LWI. During the pre-basic molt period, marbled murrelets would be less able to withdraw quickly from the project area when suddenly exposed to sound at injury or disturbance levels and could dive underwater to avoid the disturbance. However, visual monitoring before the start of pile driving would minimize the likelihood of this occurring.

HABITUATION

Habituation is a response that occurs when an animal's reaction to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok et al. 2003/2004). Animals are most likely to habituate to sounds that are predictable and unvarying. The opposite process is sensitization—when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. Behavioral state or differences in individual tolerance levels may affect the type of response as well. For example, animals that are resting may show greater behavioral change in response to disturbing noise levels than animals that are highly motivated to remain in an area for feeding (Richardson et al. 1995; National Research Council 2003; Wartzok et al. 2003/2004). Indicators of disturbance may include sudden changes in the animal's behavior or avoidance of the affected area. Species occurring in the vicinity of the LWI project area may have habituated to noise (Brown et al. 2012) from year-round active military activities.

AIRBORNE NOISE

There are no criteria or guidelines for exposure of ESA-listed species such as marbled murrelet to injury from elevated airborne sound. Marine birds would potentially be disturbed by airborne noise associated with construction of the LWI under Alternative 2. Activities that would generate elevated noise levels could include excavation for the abutments, pile driving for the abutments, in-water pile driving, road construction, placement of armor rock, and other uses of heavy equipment. The highest airborne noise levels over water (100 dBA RMS re: 20 µPa at 50 feet [15 meters]) would be associated with impact proofing of steel piles (Table 3.5-5). Airborne noise from vibratory driving is estimated to be 96 dBA RMS re: 20 µPa at 50 feet (15 meters) from the pile being installed. The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013), which are within the frequency range detected by marine birds.

In addition to pile driving, other LWI construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.2). Construction equipment for the LWI project would include backhoes, bulldozers, loaders,

graders, trucks, and cranes. Activities that would generate elevated noise levels could include excavation for the abutments; construction of the pier deck and fence, and stairways; and road construction and other uses of heavy equipment. Average noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be intermittent.

MASKING

Another potential effect of airborne noise from impact pile driving may be masking of vocalizations (Vargas-Salinas and Amézquita 2014). Natural and artificial sounds can disrupt behavior by auditory masking, or interfering with an animal's ability to detect and interpret other relevant sounds, such as communication signals (Wartzok et al. 2003/2004). Masking occurs when both the signal and masking sound have similar frequencies and either overlap or occur very close to each other in time. A signal is very likely to be masked if the noise is within a certain "critical bandwidth" around the signal's frequency and its energy level is similar or higher (Holt et al. 2009). Additional factors influencing masking are the temporal structure of the noise and the behavioral and environmental context in which the signal is produced. Continuous noise is more likely to mask signals than intermittent noise of the same amplitude; quiet "gaps" in the intermittent noise allow detection of signals which may not be detectable during continuous noise (Brumm and Slabbekoorn 2005). Noise from pile driving could cause masking if it disrupts communication and other hearing-dependent behavior. The USFWS has developed criteria and guidelines for evaluating the exposure of marbled murrelets to non-injurious acoustic masking due to elevated airborne noise levels (USFWS 2013c). Airborne noise-related thresholds have not been established for other marine bird species that occur on the waterfront, such as scoter species, pigeon guillemots, goldeneye species, cormorants, and grebes.

Based on the finding of the Marbled Murrelet Hydroacoustic Science Panel II (SAIC 2012), which was tasked with evaluating non-injurious thresholds for pile driving noise, the USFWS determined that airborne acoustic masking due to impact pile driving may affect foraging marbled murrelets. Marbled murrelets typically perform foraging dives in pairs and are highly vocal when they are above the surface (Strachan et al. 1995). On the water's surface, birds typically stay within 100 feet (30 meters) of their partners during foraging bouts. This behavior is thought to play a role in foraging efficiency, and therefore airborne noise that masks their vocalizations has the potential to affect foraging success (Carter and Sealy 1990; Strachan et al. 1995).

Unlike other noise effects criteria and guidelines established for injury and behavioral disturbance, the distance from a pile driving source within which communications would be masked is dependent on ambient noise levels and therefore is site-specific. The expert science panel (SAIC 2012) developed methods to calculate masking distances for impact pile driving projects and applied the procedure to sample cases using ambient and pile driving source data from the TPP (Illingworth & Rodkin 2012) on the Bangor waterfront. Under typical conditions on the waterfront, the maximum distance within which pile driving noise for a 24-inch

(60-centimeter) steel pile is expected to compromise communication between foraging murrelets, assuming the birds are no more than 100 feet (30 meters) apart, would be 138 feet (42 meters) (Table 3.5-6). Acoustic monitoring during EHW-2 construction (Illingworth & Rodkin 2013) indicated that average airborne source levels during impact driving of 36-inch (90-centimeter) steel piles were the same as, and in some cases lower than, 24-inch (60-centimeter) steel piles. Therefore, the masking distance for 24-inch steel piles would pertain to all pile sizes installed under Alternative 2. Representative scenarios of areas encompassed by masking effects are shown in Figure 3.5–1. Similar to the depiction of underwater injury zones, the airborne effects zones would vary depending on the placement of pile driving rigs along the LWI alignments. The USFWS (2013c) has provided guidance on evaluating the significance of airborne masking effects for pile driving projects. "Typical" pile driving projects involve:

- Installation of 24-inch or 36-inch (60- or 90-centimeter) steel piles,
- Use of vibratory pile drivers,
- Use of impact pile drivers for proofing only, and
- Adherence to a 2-hour timing restriction (i.e., no pile driving 2 hours after sunrise and 2 hours before sunset during the breeding season).

Typical pile driving projects would not result in measurable effects on marbled murrelets because the use of impact hammers is intermittent and of short duration, the two-hour timing restriction protects murrelets during their most active foraging periods, and murrelet vocalizations are adapted to overcome the effects of ambient noise (USFWS 2013c). Other considerations in determining whether a project may be atypical would include the project timing, location, and number of piles. The calculated range in which masking could occur for marbled murrelets is listed in Table 3.5-6. The potential for masking effects due to pile driving would be minimized by implementing a marbled murrelet monitoring plan (Appendix C), which would provide for halting impact pile driving while murrelets are present within the masking zone for airborne noise. Masking effects cease immediately when the masking noise stops. .

No recently used nest sites are known from the project area that would be affected by airborne construction noise, including marbled murrelet nesting habitat and nests of marine bird species. Relative to size of available habitat, the area affected by airborne construction noise is negligible.

SUMMARY OF IMPACTS

Nearshore waters in the vicinity provide foraging habitat and prey species for marbled murrelets, and they have been observed in the area during the months of the proposed in-water construction window. They appear to be most abundant during the winter (USFWS 2010); that is, during the proposed in-water construction window for pile driving.

Marbled murrelets are expected to avoid the immediate vicinity of project activities because of construction activities. If individuals were to occur, they would be expected in very small numbers because they have never been observed regularly in the area. Murrelets occurring in the vicinity may have habituated to pile driving and other construction noise, and measurable effects of exposure to noise in this location are not anticipated.

Based on the conservative assumptions used in the sound propagation model to determine the distance to the injurious underwater noise thresholds, the low likelihood of occurrence in the project area, and the protective measures being implemented during construction (Appendix C), any impacts to marbled murrelets would be insignificant and discountable. Potential indirect effects such as temporary alterations to prey base (Section 3.3) would be minor, and no population-level impacts would occur, and the species' overall fitness would not be affected.

Therefore, the ESA effect determination for construction activities under LWI Alternative 2 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for murrelets.

Direct and indirect impacts on other bird species would be similar to those described for marbled murrelets. While it is likely that most marine birds would avoid the immediate vicinity of the construction site, especially while pile driving is taking place, it is possible that some individuals may habituate sufficiently to occur in the vicinity. Some mitigation measures designed to protect marbled murrelets (e.g., daily time restrictions for pile driving) would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise. Migratory marine birds are widespread throughout Puget Sound in winter months, but the area affected by the LWI would be limited and would not impact marine bird populations overall.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 2

PREY AVAILABILITY

LWI Alternative 2 would create a nearshore barrier to the movements of marine biota that would be 280 feet (85 meters) long at the north location and 730 feet (223 meters) long at the south location. Marine birds are highly mobile and their movements would not be significantly affected by the presence of the in-water barrier. The mesh would be a high visibility material that is not directly comparable to fishing nets but rather would be more like a semi-flexible grate with fairly wide partitions between the mesh openings. Therefore, diving birds would be expected to readily avoid the mesh and are unlikely to become entangled in it.

The LWI may indirectly affect marine birds by temporarily changing their prey base (primarily fish and invertebrates). The main impact of LWI Alternative 2 on the benthic organisms would be the permanent loss of nearshore habitat due to installation of steel piles and anchor plates. The LWIs and abutment stair landings would permanently displace approximately 0.14 acre (0.06 hectare) of nearshore soft-bottom benthic habitat at the north and south locations. The overwater structures would shade a small area of benthic habitat (approximately 0.0029 acre [0.0012 hectare] of full shading) (Section 3.2.2.2.2). However, shading impacts on biological productivity of sessile benthic invertebrates in this area would be minor due to its small size. A potential beneficial effect may occur by facilitating predation by marine birds. The piles and mesh would create a physical barrier to movements of juvenile salmonids and forage fish (Section 3.3.2.2.2) in the nearshore environment, causing them to hesitate at the mesh and/or migrate around the seaward ends of the piers. These fish may be more vulnerable to avian predators. Adult salmonids are less dependent on nearshore habitats than juveniles and are more mobile, but they may congregate at the seaward ends of the LWI, where they would be more exposed to avian (eagle or osprey) predation. Moreover, installation of additional piles for the

LWI pier would result in an increase in hard-surface benthic habitat for encrusting species, which has the potential to benefit waterfowl and seabirds that forage on these resources.

Prey populations would not be significantly impacted by the construction and future operation of Alternative 2. Operations impacts of the LWI would be limited to the small area including and adjacent to the structures. The Mitigation Action Plan (Appendix C) describes the marine habitat mitigation actions that the Navy would undertake as part of the Proposed Action. This habitat mitigation action would compensate for impacts of the Proposed Action to marine habitats and species.

NOISE AND VISUAL DISTURBANCE

Operation of the LWI may result in a minor increase in potential noise and visual disturbance from human activity and artificial light. Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine birds. Some marine bird species, such as pigeon guillemots, waterfowl species, and seabirds including gulls and cormorants, forage and loaf in marine waters and manmade structures at working piers and wharves on NAVBASE Kitsap Bangor (Agness and Tannenbaum 2009b). Because future operations of the LWI would not exceed existing levels, most individual marine birds are likely to habituate to the post-construction activity levels as they have to activity levels at other developed portions of the waterfront. Operation of the LWI would be unlikely to impact future use of the MSF pier by nesting pigeon guillemots because the north LWI is over one mile from the LWI (1.6 kilometers) away and noise levels attenuated by distance and physical features such as buildings and trees would be less than ambient noise at the MSF at this distance.

Maintenance of the LWI would include routine inspections, cleaning, repair, and replacement of facility components as required (not including pile replacement). These activities could affect marine birds through noise impacts. However, noise levels are not expected to be appreciably higher than existing levels elsewhere along the Bangor waterfront, to which marine birds appear to have habituated. Therefore, maintenance would have negligible impacts on marine birds.

Effects of long-term operations of the LWI on prey availability, noise, and visual disturbance are not expected to measurably affect marine bird behaviors, including resting, foraging, and breeding, on the Bangor waterfront.

Therefore, the ESA effect determination for operation of LWI Alternative 2 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

3.5.2.2.3. LWI ALTERNATIVE 3: PSB MODIFICATIONS (PREFERRED)

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, but there would not be a pile-supported pier as proposed under Alternative 2. As described in Chapter 2, no piles would be installed in the water, and nearshore barriers to movement of marine biota would be much less than under Alternative 2. LWI Alternative 3 would include the same concrete abutments described for LWI Alternative 2, as well as observation posts, such that marine birds could be exposed to airborne pile driving noise for these structures, all of which would be installed from the shoreline in the

dry. Long-term operations of the LWI under Alternative 3 would result in some potential indirect effects on prey species, although the consequences for marine bird populations are likely to be insignificant.

CONSTRUCTION OF LWI ALTERNATIVE 3

Marine birds are expected to avoid the construction areas because of increased vessel traffic and noise and human activity. General construction period impacts, including those to water quality, vessel traffic, prey availability, and construction noise, would be similar to LWI Alternative 2, but overall Alternative 3 would have fewer and shorter-duration impacts on marine birds. Additionally, Alternative 3 would require no in-water pile driving, thus eliminating the potential for marbled murrelets to be exposed to injurious noise levels.

The following sections describe how construction would affect the abundance and distribution of marine birds present or potentially on NAVBASE Kitsap Bangor, and compare the effects of LWI Alternative 3 with effects of LWI Alternative 2.

WATER QUALITY

Tug and barge operations and placement of PSB buoy anchors would resuspend contaminants that may be present in sediments and increase turbidity levels, as discussed in Section 3.1.2.2.3. A smaller seafloor area (up to 12.7 acres [5.2 hectares]) may be disturbed under LWI Alternative 3 compared to Alternative 2 (approximately 13.1 acres [5.3 hectares]). Similar to Alternative 2, water quality effects of Alternative 3, including seafloor disturbance, would be temporary and localized within the construction zone, and construction-period impacts are not expected to result in violations of water quality standards. Measures for the protection of marine water quality and the seafloor would be implemented to minimize impacts (Mitigation Action Plan, Appendix C).

Because suspended sediment and contaminant concentrations would be low and highly localized to the immediate construction area, no impacts on marine birds are expected due to changes in water quality during construction. Considering the wide distribution of marine birds in inland marine waters, water quality changes due to LWI Alternative 3 would be negligible.

VESSEL TRAFFIC

Vessel movements associated with construction of the LWI under Alternative 3 have the potential to impact marine birds directly by accidentally striking or disturbing individuals. Construction activity involving vessel traffic may occur over 12 months. However, because no in-water piles would be installed with Alternative 3, lower levels of vessel traffic including barge and tug trips would be required (3 total round trips for barges under Alternative 3 compared to 80 days of pile driving with 16 total round trips under Alternative 2). Thus, LWI Alternative 3 would result in lower overall disturbance levels for marine birds in the project vicinity and would likely displace them for shorter periods of time. The affected area for both alternatives would be limited to the project vicinity and inconsequential relative to the wide distribution of marine bird populations in inland waters.

PREY AVAILABILITY

Construction of Alternative 3 could displace and degrade benthic habitats and marine vegetation used by prey populations for foraging and refuge, and also potentially affect marine bird foraging success due to increased turbidity. Impacts of LWI construction on prey availability for fish-eating marine birds under Alternative 3 are described in Section 3.3 and impacts on benthic organisms are described in Section 3.2. The amount of foraging and refuge habitat supporting prey populations that would be lost or degraded during project construction would be smaller for Alternative 3 (12.7 acres [5.2 hectares]) than for Alternative 2 (13.1 acres [5.3 hectares]) (Table 3.2–8). Under Alternative 3, there would be reduced (relative to Alternative 2) barriers to fish movements in the nearshore because no pier/mesh barrier system would be installed with this alternative, and there would be no in-water pile driving and related disturbance of fish. Thus, adverse behavioral responses of fish populations to project construction would be reduced under Alternative 3. Under Alternative 3, less habitat for benthic organisms would be lost or degraded during construction because there would be no pile and mesh barrier installation.

While project construction may temporarily alter the prey base of marine birds that occur in the immediate project vicinity, in the overall context of the range occupied by marine bird populations in Hood Canal and inland marine waters, the area affected by Alternative 3 is too small to represent meaningful impacts on population numbers and distribution.

NOISE

As described in Section 2.1.1.3.3, Alternative 3 would require pile driving for the LWI abutments. A total of 15 36-inch (90-centimeter), 15 24-inch (60-centimeter), and up to 12 30-inch (76-centimeter) hollow steel piles would be driven at the north LWI site, all of which would be driven in the dry using a land-based pile driving rig. The same number of steel piles would be driven in the dry at the south LWI site, with the exception that 16, rather than 15, 36-inch piles would be installed. Piles would be driven using vibratory and impact drivers as required. Unlike the pile-supported pier under Alternative 2, no in-water pile driving would be required for Alternative 3, and the total number of driven piles would be substantially fewer (85 land-installed piles for Alternative 3 compared with 136 permanent in-water piles, 120 temporary in-water piles, and 41 land-installed piles for Alternative 2). Exposure of marine birds to pile driving noise would be limited to airborne noise impacts from Alternative 3, and the duration of the exposure would be substantially shorter. Up to 30 days of pile driving would be required for construction of Alternative 3 compared to 80 days of pile driving for Alternative 2.

Under LWI Alternative 3, the range in which potential masking may occur for marbled murrelets would be the same as LWI Alternative 2 (Table 3.5-6). Representative views of the areas encompassed by this range are shown in Figure 3.5–2 for the north and south LWI locations. The affected areas under Alternative 3 are limited to the nearshore zone, which is typically not frequented by foraging or resting marbled murrelets. Therefore, no murrelets are likely to be exposed to adverse airborne noise-related effects. Moreover, the Navy would actively avoid masking effects due to pile driving by implementing a marbled murrelet monitoring plan (Appendix C), which would provide for halting impact pile driving while murrelets are present within the masking zone for airborne noise. All pile driving would cease if a marbled murrelet were observed within or entering the masking zone for airborne pile driving.

Figure 3.5-2. Representative View of Affected Areas for Marbled Murrelet due to Airborne Pile Driving Noise during Construction of LWI Alternative 3

Airborne sound due to other construction equipment would be similar to the levels described for non-pile driving construction noise under Alternative 2. Average noise levels are expected range from 60 to 68 dBA, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of heavy construction equipment (excluding pile drivers) would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be intermittent.

As discussed above for Alternative 2 (Section 3.5.2.2.2), Alternative 3 would meet the characteristics of a "typical" pile driving project as defined by the USFWS (2013c) for the purposes of evaluating masking effects on marbled murrelets. Alternative 3 is not expected to have measurable effects on the species.

Therefore, the ESA effect determination for construction activities under LWI Alternative 3 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

OPERATION/LONG-TERM IMPACTS OF LWI ALTERNATIVE 3

LWI Alternative 3 would modify the existing PSB system to extend across the intertidal zone and attach to concrete abutments at the shoreline, and the pile-supported pier and in-water mesh proposed under Alternative 2 would not be constructed. Most of the habitat displacement under Alternative 3 would result from pontoons of the PSB repeatedly grounding and scouring in nearshore benthic habitat. Alternative 3 would permanently displace or disturb a smaller area of soft-bottom benthic habitat (0.06 acre [0.025 hectare]) than Alternative 2 (0.14 acre [0.06 hectare]), thereby affecting a smaller amount of habitat supporting benthic prey species.

Shading of benthic habitat would be reduced under Alternative 3 compared to Alternative 2 with minor effects on benthic community productivity. Thus, the LWI footprint under Alternative 3 would be smaller and would pose no barrier to movement of marine biota. Opportunities for marine birds to prey on fish migrating around the seaward ends of the piers under Alternative 2 would not occur with Alternative 3. Installation of additional piles under Alternative 2 would increase hard-surface benthic habitat for encrusting species, which are prey for some waterfowl and seabirds, but since fewer piles would be installed under Alternative 3, the potential benefits to marine birds would be less likely than under Alternative 2. Similar to Alternative 2, impacts on the prey base for marine bird species are expected to be minor, but these changes cannot be quantified with available information. Marine birds are wide-ranging and have extensive foraging habitat available in Hood Canal relative to the foraging area that might be impacted by operation of the LWI. Localized changes in prey availability within the construction zone are possible under Alternative 3 but are expected to be negligible. The Mitigation Action Plan (Appendix C) describes the marine habitat compensatory mitigation that the Navy would undertake as part of the Proposed Action. The habitat mitigation would compensate for impacts of the Proposed Action on marine habitats and species that might indirectly affect the marine bird prey base.

Operation and maintenance of the LWI under Alternative 3 would include increased noise and visual disturbance from human activity and artificial light, similar to Alternative 2. However, disturbance levels would not be appreciably higher than existing levels to which marine birds appear to have habituated elsewhere at the Bangor waterfront. Direct and indirect effects of project operations on marine birds would be negligible, and no population level impacts are anticipated.

Therefore, the ESA effect determination for operation of LWI Alternative 3 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

3.5.2.2.4. SUMMARY OF LWI IMPACTS

Impacts on marine mammals during the construction and operation phases of the LWI project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.5-7.

Table 3.5–7. Summary of LWI Impacts on Marine Birds

Alternative	Environmental Impacts on Marine Birds
LWI Alternative 1: No Action	No impact.
LWI Alternative 2: Pile-Supported Pier	*Construction:* Potential direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to installation of pile-supported pier. Construction noise (primarily due to pile driving) may exceed USFWS underwater injury and airborne masking thresholds for marbled murrelet, but would be intermittent and temporary. Construction disturbance due to in-water work would occur over one season, including a total of 80 days of pile driving. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, and barriers to migratory fish. Increased hard-surface benthic habitat may benefit marine birds that consume encrusting invertebrates.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
LWI Alternative 3: PSB Modifications (Preferred)	*Construction:* Potential direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability, airborne construction noise (primarily due to impact pile driving) sufficient to exceed the USFWS airborne masking threshold. Construction disturbance due to in-water work would occur over one season, including a total of 30 days of pile driving, compared to 80 days for Alternative 2. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat, but no barriers to migratory fish, in contrast to Alternative 2. Increased hard-surface benthic habitat may benefit marine birds that consume invertebrates.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
Mitigation: Marbled murrelets would be monitored during impact pile installation activities of the LWI project within the airborne masking and underwater injury zones, and shutdown procedures would be implemented if any marbled murrelet enters the injury zone or the masking zone for impact pile driving. Appendix C (Mitigation Action Plan) details mitigation measures.	
Consultation and Permit Status: The Navy consulted with the USFWS Washington Fish and Wildlife Office on the marbled murrelet under the ESA. A Biological Assessment (BA) was submitted to USFWS in March 2015, and a revised BA was submitted in June 2015. In a concurrence letter dated March 4, 2016, USFWS stated that LWI project impacts to marbled murrelets are discountable.	

ESA = Endangered Species Act; USFWS = U.S. Fish and Wildlife Service

3.5.2.3. SPE PROJECT ALTERNATIVES

3.5.2.3.1. SPE ALTERNATIVE 1: NO ACTION

There would be no activities related to construction or operations that would disturb marine birds in the project area under the No Action Alternative. Therefore, this alternative would have no impacts on marine birds.

3.5.2.3.2. SPE ALTERNATIVE 2: SHORT PIER (PREFERRED)

Construction of the SPE would directly impact marine birds primarily through underwater and airborne noise generated by pile driving, visual disturbance due to construction activity and vessels, and temporary localized effects on prey availability within the construction zone. Indirect impacts could result from localized changes in the benthic prey (Section 3.2) and forage fish communities (Section 3.3). Impacts on marine birds from operation of this alternative are anticipated to be highly localized. Marine birds are wide-ranging and have a large foraging habitat available in Hood Canal, relative to the foraging area that might be impacted by operation of the SPE, and long-term impacts resulting from the Proposed Action would be minor.

CONSTRUCTION OF SPE ALTERNATIVE 2

Impacts on marine birds from construction of SPE Alternative 2 may include temporary water quality changes (turbidity) in nearshore habitats, noise associated with pile driving and other construction equipment, increased construction vessel traffic, changes in prey availability (benthic community and forage fish), and visual disturbance from the presence of construction workers and equipment during the in-water construction period.

Construction-related activities may disturb foraging marine birds because the number of vessels, including barges, and workers in the area would increase. However, birds occurring in the area may have habituated to anthropogenic stressors based on the ongoing military activities at the NAVASE Kitsap Bangor waterfront. Impacts on marine birds would occur when birds are foraging underwater at the same time that underwater noise is being generated by impact, and to a lesser extent vibratory, pile driving; but the simultaneous occurrence of underwater foraging and pile driving would be limited in time, scope, and intensity. Birds resting or foraging on the surface of the water, the shoreline, or manmade structures could also be exposed to airborne pile driving noise. Mitigation measures described in Appendix C, Section 5.0, would reduce the likelihood of adverse impacts on marbled murrelets, and would also benefit other marine bird species.

WATER QUALITY

Construction of the SPE would temporarily resuspend sediments in the project area due to anchoring of barges and tugs, installation of piles, and work vessel movements, as described in Section 3.1.2.3.2. Water quality would be impacted because bottom sediments would be temporarily resuspended and may spread up to 130 feet (40 meters) as described in Section 3.1.2.3.2. Up to 3.9 acres (1.6 hectares) of benthic habitat may be temporarily disturbed within the construction footprint. Potential impacts to marine birds due to changes in water quality are as detailed in Section 3.5.2.2.2 for LWI Alternative 2.

VESSEL TRAFFIC

During construction of the SPE, several additional vessels would operate in the project area, including one to two pile driving barges, one to two support barges, one tug boat, and two work skiffs. Six round trip barge transits per month are expected for the duration of the project (Table 2–2). At any given time, there would be no more than two tugs and six smaller boats, plus barges, present in the construction area. Construction activity involving vessel traffic may occur over 24 months, but the greatest activity levels would be associated with pile driving (up to 161 days over two in-water work seasons). The powered vessels would operate at low speeds within the relatively limited construction zone and access routes during the in-water construction period. Tugs would be used primarily to bring barges to and from the project area and to position them, which generally involves low speeds. Small boats used to ferry personnel or for monitoring would likewise be operating at slow speeds.

Potential impacts to marine birds due to vessel traffic during construction of SPE Alternative 2 are as detailed in Section 3.5.2.2.2 for LWI Alternative 2. Most marine bird species that occur along the Bangor waterfront appear to have habituated to high levels of vessel traffic, based on surveys of developed areas such as Delta Pier, Marginal Pier, and the Service Pier (Tannenbaum et al. 2009b, 2011b). Thus, although some individuals could be disturbed by increased construction-period vessel traffic in the project area, they probably would continue to frequent the project area during periods when vessel traffic is low.

PREY AVAILABILITY

The prey base for marine waterfowl includes vegetation, molluscs, and crustaceans, and for seabirds includes juvenile salmonids, forage fish, and invertebrates. As described in Section 3.3.1.1, fish species and groups that occur in the deeper-water SPE project area include some forage fish (e.g., Pacific sand lance and Pacific herring) and salmonids (juvenile Chinook salmon, coho salmon, and steelhead; and cutthroat trout) (Bhuthimethee et al. 2009). As described in Section 3.2.1.1, benthic invertebrate species characteristic of deeper water are present at the SPE project site. This portion of the Bangor shoreline has a steep subtidal grade, lacks flat bottom benthic habitat, and has no nearby freshwater nutrient input of the type that can contribute to higher abundance and diversity where these inputs occur. Potential impacts to marine birds due to temporary changes in prey availability during SPE Alternative 2 are as detailed in Section 3.5.2.2.2 for LWI Alternative 2.

Under Alternative 2, construction of the SPE may temporarily disturb up to 3.9 acres (1.6 hectares) of soft-bottom benthic habitat used by prey species. Mitigation efforts (Appendix C) would minimize potential impacts to prey communities. While localized effects of project construction may affect the prey base of marine birds that occur in the project vicinity, in the overall context of the Hood Canal marine bird populations, the impacts to prey availability would be minor.

VISUAL DISTURBANCE

Visual disturbance would also impact use of the construction area by marine bird species, which have variable levels of tolerance for disturbance. Birds that depart during construction activities may return to the area following a decrease in activity, such as evening or early morning hours

before work commences and when activities are completed. Due to the large size of the Bangor waterfront area and the surrounding Hood Canal, alternative foraging and resting areas are present that would minimize the potential effects of visual disturbance during construction.

The Navy and USFWS Washington Fish and Wildlife Office have identified potential marbled murrelet nesting habitat in the stand of conifer forest that would be the site of the proposed parking lot, utilities, laydown area, and road improvements for the SPE project. Eight trees with a total of 10 platforms appear to be marginally suitable for nesting (Harke 2013, personal communication). The parking lot and other facilities would occupy approximately 7 acres (2.8 hectares) and would be located within the outline depicted in Figure 3.5–3. Up to 4 additional acres (1.6 hectares) may be cleared for a laydown area and other construction-related disturbance and revegetated with native species following construction. The Navy, through early coordination with USFWS, is minimizing impacts on marbled murrelet potential nesting habitat in the conifer stand on this site. The original parking lot design was situated farther north in the conifer stand to avoid impacts on a newly established heron rookery (subsequently abandoned) in the southeast corner of the proposed parking lot area. The original location was the site of several potential marbled murrelet nesting platforms. During a site visit on June 19, 2013, USFWS requested that the Navy avoid this potential nesting habitat and relocate the proposed parking area to the southwest corner of the site within an old orchard. The proposed design has incorporated the USFWS request to minimize impacts on the conifer stand, but a small portion of the conifer stand (<4 acres) including four potential nest trees may be removed. In addition, tree removal would not be conducted during the marbled murrelet breeding season of April 1 through September 23.

CONSTRUCTION AND PILE DRIVING NOISE

Underwater noise conditions at the NAVBASE Kitsap Bangor waterfront are detailed in Section 3.5.2.2.2 for LWI Alternative 2. Approximately 50 24-inch (60-centimeter), and 230 36-inch (90-centimenter), steel pipe support piles would be driven over 125 days during the first in-water work window to support the pier extension. 105 18-inch (45-centimeter) square concrete piles that would serve as fender piles would be driven over 36 days during the second in-water work window. Most steel piles would be driven with a vibratory driver, and an impact hammer would be used to proof piles, if necessary. Concrete piles would be driven by impact hammer only. Source levels for acoustic modeling under SPE Alternative 2 (Table 3.5-8) resulted in the calculated ranges to effect detailed in Table 3.5-9 and Figure 3.5-4.

Sound from impact pile driving would be detected above the average background noise levels at any location in Hood Canal with a direct acoustic path (i.e., line-of-sight from the driven pile to receiver location). Intervening land masses would block sound propagation outside of these pathways. Mitigation measures for underwater pile driving noise, including a bubble curtain, and marbled murrelet monitoring during pile driving, are described in Appendix C.

Figure 3.5-3. Proposed SPE Parking Lot Area

Table 3.5–8. Source Levels (unattenuated) for Impact Pile Driving - SPE Alternative 2

Underwater	
Pile Size / Type	**dB SEL — re: 1μPa^2 sec @ 33 feet (10 meters)**
36-inch (90-centimeter) steel pipe	181
18-inch (45-centimeter) square concrete	159
Airborne	
Pile Size / Type	**dBA RMS — re: 20 μPa @ 50 feet (15 meters)**
36-inch steel pipe	100
18-inch square concrete	

dB=decibel; re 1 μPa = referenced at 1 micropascal; SEL= sound exposure level

Table 3.5–9. Calculated Ranges to Effect - SPE Alternative 2

	Underwater Noise		Airborne Noise
	Barotrauma Injury 208 dB SEL	**Auditory Injury 202 dB SEL**	**Masking**
36-inch (60-centimeter) — Steel Piles			
Distance to Threshold[1]	24 ft (7 m)	61 ft (19 m)	138 ft (42 m)
Area Encompassed by Threshold	1,836 sq ft (171 sq m)	11,690 sq ft (1,134 sq m)	59,829 sq ft (5,542 sq m)
18-inch (45-centimeter) — Concrete Piles			
Distance to Threshold[2]	4 feet (1 meter)	9 feet (3 meters)	138 ft (42 m)
Area Encompassed by Threshold	28 sq ft (3 sq m)	314 sq ft (28 sq m)	59,829 sq ft (5,542 sq m)

dB = decibel; ft = feet; m = meter; SEL= sound exposure level (re 1 μPa^2-sec); sq ft = square feet; sq m = square meter

1. SEL values assume 2,000 strikes per day. Bubble curtain assumed to achieve an 8 dB reduction in sound pressure levels.
2. SEL values assume 3,000 strikes per day; no bubble curtain would be used during impact driving of concrete piles.
3. Available data are insufficient to estimate an accurate masking zone for 18-inch concrete piles; however, it is expected to be smaller than the zone assumed for 36- or 24-inch steel piles. Therefore, the sound levels for 36-inch steel piles were used as a proxy for 18-inch concrete piles as a conservative assumption in the acoustic model.

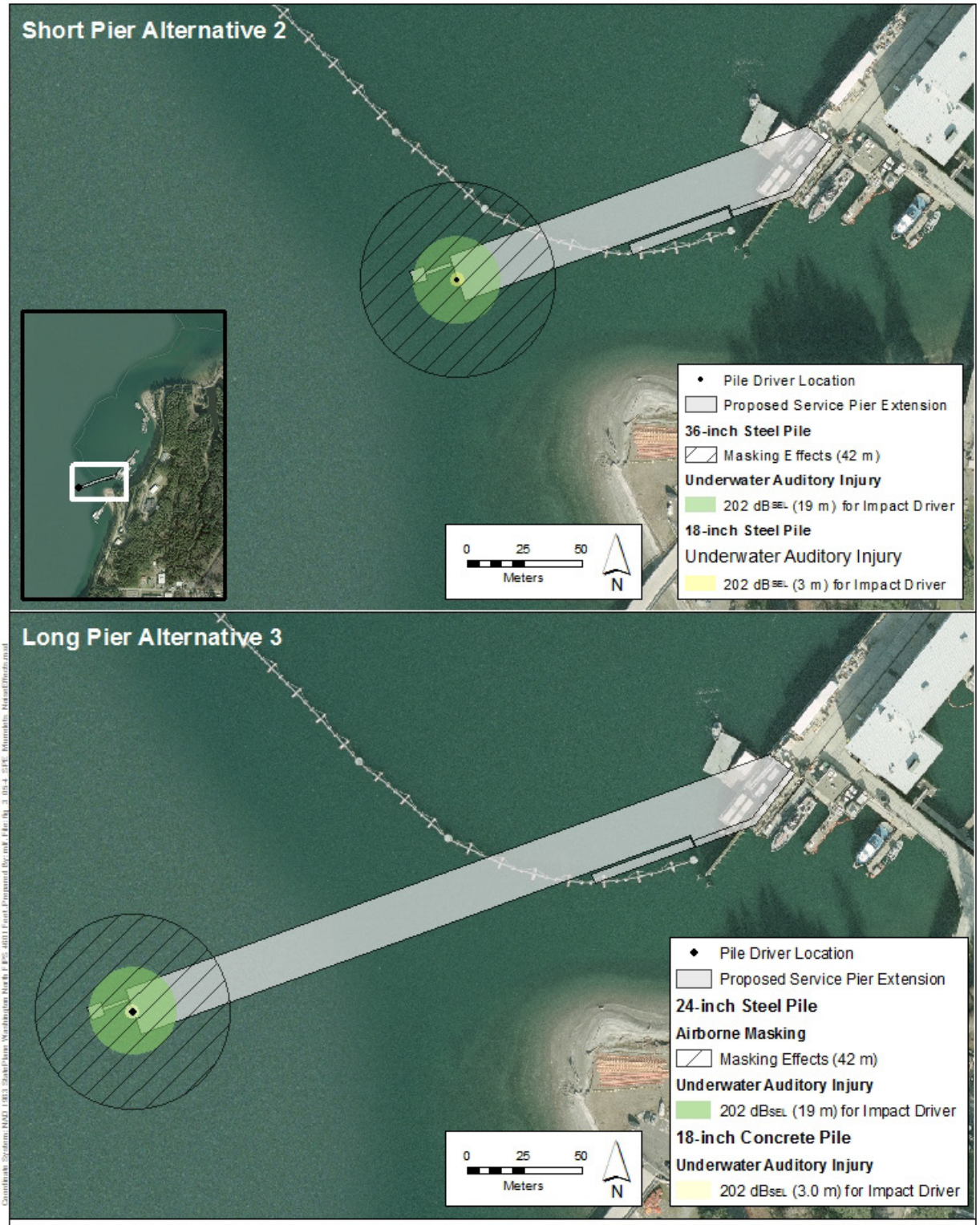

Figure 3.5-4. Representative View of Affected Areas for Marbled Murrelets due to Underwater and Airborne Pile Driving Noise during Construction of SPE Alternatives 2 and 3

PHYSIOLOGICAL AND BEHAVIORAL IMPACTS OF NOISE

Because 36- and 24-inch (90- and 60-centimeter) steel piles may be installed interchangeably during the first in-water work window under SPE Alternative 2, the largest source level (i.e., for 36-inch steel piles) is assumed for analysis. The model assumes up to 200 strikes may be required to proof steel piles, and up to 300 strikes would be required to fully install concrete piles. Up to 10 piles may be installed on any day of active pile driving. The potential physiological and behavioral impacts of noise, including habituation, to seabirds are described in Section 3.5.2.2.2 under LWI Alternative 2.

AIRBORNE NOISE

Similar to LWI Alternative 2, marine birds would potentially be disturbed by airborne noise associated with construction of SPE Alternative 2. The highest airborne noise levels over water would be associated with impact proofing of steel piles (Table 3.5-8). Airborne noise from vibratory driving is estimated to be 96 dBA RMS re: 20 µPa at 50 feet (15 meters) from the pile being installed. No vibratory driving of concrete piles would occur during the second in-water work window. The dominant airborne noise frequencies produced by pile driving are between 50 and 1,000 Hz (WSDOT 2013), which are within the frequency range detected by marine birds.

In addition to pile driving, other SPE construction activities and equipment would generate lower noise levels that are comparable to ambient levels elsewhere along the Bangor waterfront where ongoing operations use trucks, forklifts, cranes, and other equipment (Section 3.9.3.2). Construction equipment for the SPE project would include backhoes, bulldozers, loaders, graders, trucks, and cranes. Activities that would generate elevated noise levels could include construction of the pier extension deck, construction of the Pier Services and Compressor Building, and other uses of heavy equipment. Average noise levels are expected to be in the 60 to 68 dBA range, consistent with urbanized or industrial environments where equipment is operating and similar to the range of noise measured on Delta Pier (Navy 2010). Operation of non-pile driving, heavy construction equipment would produce airborne noise levels ranging from 78 to 90 dBA at 50 feet (15 meters) (WSDOT 2013). In the absence of pile driving noise and with simultaneous operation of two types of heavy equipment, the maximum construction noise level is estimated to be 94 dBA at a distance of 50 feet (Section 3.9), but this noise level would be intermittent; this level is consistent with the typical ambient noise at an industrial waterfront.

MASKING

Masking is introduced in Section 3.5.2.2.2 under LWI Alternative 2. As with underwater noise, the method of calculating masking distance is detailed in Appendix D. Under typical conditions on the waterfront, the maximum distance within which pile driving noise for a 24-inch (60-centimeter) steel pile is expected to compromise communication between foraging murrelets, assuming the birds are no more than 100 feet (30 meters) apart, would be 138 feet (42 meters) (Table 3.5-9). Representative scenarios of areas encompassed by masking effects are shown in Figure 3.5-4. As described in Appendix C, the masking zone would be monitored and pile driving halted if a marbled murrelet is observed. Masking effects cease immediately when the masking noise stops. Therefore, the potential for impact to marbled murrelets from masking is minimal.

SUMMARY OF POTENTIAL IMPACTS

Nearshore waters in the vicinity provide foraging habitat and prey species for marbled murrelets, and they have been observed in the area during the months of the proposed in-water construction window. They appear to be most abundant during the winter (USFWS 2010); that is, during the proposed in-water construction window for pile driving.

Marbled murrelets are expected to avoid the immediate vicinity of project activities because of construction activities. If individuals were to occur, they would be expected in very small numbers because they have never been observed regularly in the area. Murrelets occurring in the vicinity may have habituated to pile driving and other construction noise, and measurable effects of exposure to noise in this location are not anticipated.

Based on the conservative assumptions used in the sound propagation model to determine the distance to the injurious underwater noise thresholds, the low likelihood of occurrence in the project area, and the protective measures being implemented during construction (Appendix C), any impacts to marbled murrelets would be insignificant and discountable. No population-level impacts would occur, and the species' overall fitness would not be affected.

Therefore, the ESA effect determination for construction activities under SPE Alternative 2 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

Direct and indirect impacts on other bird species would be similar to those described for marbled murrelets. While it is likely that most marine birds would avoid the immediate vicinity of the construction site, especially while pile driving is taking place, it is possible that some individuals may habituate sufficiently to occur in the vicinity. Some mitigation measures designed to protect marbled murrelets (e.g., daily time restrictions for pile driving and no tree removal during the breeding season) would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise and habitat disturbance. Migratory marine birds are widespread throughout Puget Sound in winter months, but the area affected by the SPE would be limited and would not impact marine bird populations overall.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 2

PREY AVAILABILITY

SPE Alternative 2 would increase the length of the existing pier by 540 feet [165 meters], permanently displacing a small area (approximately 0.045 acre [0.018 hectare]) of deeper water soft-bottom benthic habitat that is used by prey populations. This would result in indirect effects on marine birds primarily in terms of their prey base. Installation of additional piles would increase hard-surface benthic habitat for encrusting species, which would benefit waterfowl and seabirds that forage on these resources. Given the water depth, the overwater structures would have a minor effect on biological productivity of sessile benthic organisms (Section 3.2.2.3.2). Moreover, these impacts would be highly localized to the immediate vicinity of the pier. Therefore, habitat degradation and barriers for fish and invertebrates in the project area would not result in a significant change in the prey base for marine birds. Increased lighting at the SPE may affect prey availability, depending on the species, for marine birds. Some fish such as sand

lance, an important forage fish species, may be attracted by artificial lighting, which may in turn attract predators and facilitate predation on these fish. Thus, localized changes to the prey base for some marine birds are possible but these changes cannot be quantified with available information.

NOISE AND VISUAL DISTURBANCE

Underwater and airborne noise levels may increase slightly from two additional submarines that would berth at the enlarged Service Pier. Marine birds that utilize the Bangor waterfront are assumed to have habituated to vessel traffic noise.

Under existing conditions, the Bangor waterfront produces an environment of complex and highly variable noise and visual disturbance for marine birds. Marine birds perch on manmade structures and forage and rest in the nearshore and deeper waters along the Bangor waterfront in close proximity to ongoing operations. Future operations of the larger Service Pier would be greater than existing levels due to an increase in submarine use of the pier. In general, however, most individual marine birds are likely to habituate to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the Bangor waterfront.

Maintenance of the larger Service Pier would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine birds through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than current conditions at the Bangor industrial waterfront, to which many marine birds appear to have habituated. Therefore, maintenance activities would have negligible impacts on marine birds.

Impacts of long-term operations of the larger Service Pier on prey availability, noise, and visual disturbance are expected to be minor, with no species or population-level changes to marine bird behavior or fitness.

Therefore, the ESA effect determination for operation of SPE Alternative 2 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

3.5.2.3.3. SPE ALTERNATIVE 3: LONG PIER

SPE Alternative 3 would increase the length of the existing pier by 975 feet (297 meters), or almost twice the length of the SPE under Alternative 2. The number of piles and pile driving days would be greater for Alternative 3 than for Alternative 2, thereby increasing the duration of elevated underwater and airborne noise levels due to pile driving. Long-term operations of the SPE would be similar to Alternative 2 with no major consequences for marine bird populations.

CONSTRUCTION OF SPE ALTERNATIVE 3

Marine birds are expected to avoid the project area due to increased human activity. General concerns over construction period impacts, including water quality, vessel traffic, prey availability, and construction noise, are similar to those described for SPE Alternative 2, but overall SPE Alternative 3 would have slightly greater and longer-duration impacts on marine

birds in the project area due to the larger size of the pier. The following sections describe the quantitative differences between the impacts of the two alternatives on marine birds.

WATER QUALITY

A larger seafloor area (6.6 acres [2.7 hectares]) would be disturbed by pile driving and other construction for SPE Alternative 3 compared to Alternative 2 (3.9 acres [1.6 hectares]), thereby increasing turbidity levels and suspended sediments (Section 3.1.2.3). Impacts on visibility at the project site, which could affect marine bird foraging success, would be greater for Alternative 3 than for Alternative 2. The disturbance in the affected area would be temporary and limited to the construction corridor associated with pile driving and construction-period impacts are not expected to exceed water quality standards. Compared to the wide distribution of marine bird species in inland waters, water quality changes due to the SPE project would not significantly affect marine bird populations or overall distribution.

VESSEL TRAFFIC

A similar number of barge trips would be required for construction of both SPE alternatives (six round trips per month). However, because a larger number of piles would be installed for SPE Alternative 3 (500 24-inch [60-centimeter] steel piles and 160 18-inch [45-centimeter] concrete piles versus 230 36-inch [90-centimeter] steel piles, 50 24-inch steel piles, and 105 18-inch concrete piles for Alternative 2), Alternative 3 would increase overall disturbance levels for marine birds in the project vicinity for longer periods of time (205 days of pile driving under Alternative 3 compared to 161 days under Alternative 2). The affected area would be limited to the project vicinity and, relative to the wide distribution of marine bird species in inland waters, vessel traffic changes due to the SPE project would not affect population size or overall distribution.

PREY AVAILABILITY

Impacts of construction on prey availability for fish-eating marine birds would be similar under both SPE alternatives. However, because the area affected by Alternative 3 (6.6 acres [2.7 hectares]) would be greater than for Alternative 2 (3.9 acres [1.6 hectares) for Alternative 3), the magnitude of the impact under Alternative 3 would be greater. The affected area under either alternative would be limited to the footprint of the larger pier and adjacent to the area subject to construction disturbance. Relative to the wide distribution of marine bird species and the prey resources in inland waters, SPE Alternative 3 would not alter population size or overall distribution.

Construction of Alternative 3 may expose fish to potential injury or behavioral disturbance due to underwater pile driving noise (Section 3.3). The time period for behavioral disturbance of fish populations would be greater for Alternative 3 than for Alternative 2 because a larger number of piles would be installed and more pile driving days (161 days under Alternative 2 compared to 205 days under Alternative 3) would be required, as described above for vessel traffic.

However, compared to the wide distribution of marine bird species and their prey resources in inland marine waters, the small area affected by construction of Alternative 3 on prey availability

would not result in a significant impact on marine bird populations or distribution, including the ESA-listed marbled murrelet.

NOISE

As described for Alternative 2, underwater and airborne noise associated with impact proofing of steel piles may cause the greatest impacts on marine birds occurring in the project area during construction of the SPE. The acoustic modeling approach is described in Appendix D. Both SPE Alternatives would require two in-water pile driving seasons, but the number of pile driving days would be greater for SPE Alternative 3 (155 days for installation of steel piles and 50 days for installation of concrete piles compared to 125 days for steel piles and 36 days for concrete piles with Alternative 2). Thus, the overall noise-related impacts of Alternative 3 would be slightly greater than those of Alternative 2. Ranges to effect for SPE Alternative 2 are detailed in Table 3.5-9. The proxy source level for 36- and 24-inch steel piles is 181 dB SEL re: 1 µPa. Therefore, the resulting ranges to effect are the same. Representative views of the ZOIs for underwater injury and in-air masking for SPE Alternative 3 are shown in Figure 3.5–4.

SUMMARY OF POTENTIAL IMPACTS

Marbled murrelets are expected to avoid the immediate vicinity of project activities because of construction activities. If individuals were to occur, they would be expected in very small numbers because they have never been observed regularly in the area. Murrelets occurring in the vicinity may have habituated to pile driving and other construction noise, and measurable effects of exposure to noise in this location are not anticipated.

Based on the conservative assumptions used in the sound propagation model to determine the distance to the injurious underwater noise thresholds, the low likelihood of occurrence in the project area, and the protective measures being implemented during construction (Appendix C), any impacts to marbled murrelets would be insignificant and discountable. No population-level impacts would occur, and the species' overall fitness would not be affected.

Therefore, the ESA effect determination for construction activities under SPE Alternative 3 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

Direct and indirect impacts on other bird species would be similar to those described for marbled murrelets. While it is likely that most marine birds would avoid the immediate vicinity of the construction site, especially while pile driving is taking place, it is possible that some individuals may habituate sufficiently to occur in the vicinity. Some mitigation measures designed to protect marbled murrelets (e.g., daily time restrictions for pile driving and no tree removal during the breeding season) would protect MBTA-protected seabird species as well as the marbled murrelet from exposure to construction noise and habitat disturbance. Migratory marine birds are widespread throughout Puget Sound in winter months, but the area affected by the SPE would be limited and would not impact marine bird populations overall.

OPERATION/LONG-TERM IMPACTS OF SPE ALTERNATIVE 3

The long-term operational impacts of SPE Alternative 3 would be qualitatively similar to those described for SPE Alternative 2. Alternative 3 would permanently displace a slightly smaller area (0.043 acre [0.017 hectare]) of deeper water, soft-bottom benthic habitat than Alternative 2 (0.045 acre [0.018 hectare]), potentially affecting a small amount of habitat supporting benthic prey species.

Given the water depth at the SPE site, shading by the overwater structures would have a minor impact on benthic community productivity (Section 3.2.2.3.2). Similar to SPE Alternative 2, the impacts on the prey base for marine birds are not expected to be significant, but these changes cannot be quantified with available information. Marine birds are wide-ranging and have extensive foraging habitat available in Hood Canal, relative to the foraging area that would be impacted by operation of the SPE. Localized changes in prey availability are possible under Alternative 3, but are expected to be discountable.

Impacts of increased vessel traffic and vessel noise would be similar to the impacts described for SPE Alternative 2 because the number of submarines berthed at the enlarged Service Pier with Alternative 3 would be the same. As described for Alternative 2, most individual marine birds occurring in the vicinity would be assumed to have habituated to the post-construction activity levels, as they have habituated to activity levels at other developed portions of the waterfront.

Maintenance of the larger Service Pier would include routine inspections, repair, and replacement of facility components as required (but no pile replacement). These activities could affect marine birds through noise impacts and increased human activity and vessel traffic. However, noise levels would not be appreciably higher than existing levels elsewhere at the Bangor industrial waterfront, to which marine birds appear to have habituated. Measures would be employed (Section 3.1.2.3.2) to avoid discharge of contaminants to the marine environment. Therefore, maintenance activities would have negligible impacts on marine birds.

Impacts of long-term operations of the Service Pier on prey availability, noise, and visual disturbance are expected to be minor, with no species or population-level changes to marine bird behavior or fitness.

Therefore, the ESA effect determination for operation of SPE Alternative 3 is "may affect, not likely to adversely affect" marbled murrelets. There would be "no effect" on critical habitat for the species.

3.5.2.3.4. SUMMARY OF IMPACTS FOR SPE PROJECT ALTERNATIVES

Impacts on marine birds during the construction and operation phases of the SPE project alternatives, along with mitigation and consultation and permit status, are summarized in Table 3.5-10.

Table 3.5–10. Summary of SPE Impacts on Marine Birds

Alternative	Environmental Impacts on Marine Birds
SPE Alternative 1: No Action	No impact.
SPE Alternative 2: Short Pier (Preferred)	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of pile-supported pier. Construction noise (primarily due to pile driving) may exceed USFWS underwater injury and airborne masking thresholds for marbled murrelet, but would be intermittent and temporary. Construction disturbance due to in-water work would occur over 2 seasons, including a total of 161 days of pile driving. *Operation/Long-term Impacts:* Indirect impacts on prey species due to loss and degradation of benthic habitat; direct impacts (displacement during periods of high activity) due to increased vessel traffic, operations noise, and visual disturbance. Increased hard-surface benthic habitat may benefit marine birds that consume encrusting invertebrates.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
SPE Alternative 3: Long Pier	*Construction:* Direct and indirect impacts on prey species due to loss and degradation of benthic habitat, changes in prey availability due to extension of the pile-supported pier. Construction noise (primarily due to pile driving) sufficient to exceed USFWS injury and masking thresholds for marbled murrelet. Construction disturbance due to in-water work would occur over 2 seasons, including a total of 205 days of pile driving. *Operation/Long-term Impacts:* Slightly greater potential indirect impacts on prey species due to loss and degradation of larger benthic habitat area, direct impacts (displacement during periods of high activity) due to increased vessel traffic, operations noise, and visual disturbance.
	ESA: Effect determination for the marbled murrelet is "may affect, not likely to adversely affect" with "no effect" on critical habitat for the species.
Mitigation: Marbled murrelets would be monitored during impact pile installation activities of the SPE project within the airborne masking and underwater injury zones, and shutdown procedures would be implemented if any marbled murrelet enters the injury zone or the masking zone for impact pile driving. Appendix C (Mitigation Action Plan) details mitigation measures. Tree removal would not occur during the marbled murrelet breeding season (April 1 through September 23) and would be in a manner protective of all migratory birds.	
Consultation and Permit Status: The Navy consulted with the USFWS Washington Fish and Wildlife Office on the marbled murrelet under the ESA. A Biological Assessment (BA) was submitted to USFWS in March 2015, and a revised BA was submitted in June 2015. In a concurrence letter dated March 4, 2016, USFWS stated that SPE project impacts to marbled murrelets are discountable.	

ESA = Endangered Species Act; USFWS = U.S. Fish and Wildlife Service

3.5.2.4. COMBINED IMPACTS OF LWI AND SPE PROJECTS

The LWI structures and SPE piles may alter local availability of marine bird prey (Sections 3.2, Marine Vegetation and Invertebrates, and 3.3, Fish). Visual disturbance due to barge and other vessel traffic during concurrent construction of both projects may inhibit use of the project sites by marine birds that frequent nearshore waters, such as marine waterfowl, seabirds, wading birds, shorebirds, and raptors, potentially reducing the area available for foraging, resting, and transiting along the waterfront. Monitoring of the injury and masking zones during impact pile driving at the LWI and SPE sites would minimize the likelihood of exposure of marbled murrelets to injurious noise levels and auditory masking. The combined impacts of the LWI and SPE projects on marine birds are summarized below in Table 3.5–11.

Table 3.5–11. Summary of Combined LWI/SPE Impacts for Marbled Murrelets and Other Marine Birds

Resource	Combined LWI/SPE Impacts
Marbled Murrelets and Other Marine Birds	The combined impacts of the LWI and SPE projects on marbled murrelets and other marine birds may include minor alterations of prey availability, visual disturbance, and exposure to elevated noise levels underwater (for diving birds) and in the air, including up to 285 days of pile driving over four in-water work seasons. Indirect impacts on prey species due to loss and degradation of benthic habitat; direct impacts (displacement during periods of high activity) due to increased vessel traffic, operations noise, and visual disturbance. Increased hard-surface benthic habitat may benefit marine birds that consume encrusting invertebrates.

Up to 80 days of in-water pile driving may be required for construction of the LWI structures, and up to 205 days may be required for the SPE, depending on the alternative, for a total of up to 285 days of in-water pile driving. Once construction is completed, underwater noise during operations would return to levels similar to existing conditions. Construction of the two projects would not overlap; therefore, concurrent or overlapping noise impacts would not occur.