



WASHINGTON STATE FERRIES UNDERWATER NOISE MITIGATION AND MANAGEMENT PLAN FOR THE PROTECTION OF MARINE MAMMALS

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Washington State Ferries

CONTENTS

Introduction	2
Who We Are	3
What We Do11
References14

Introduction

Underwater noise and its effect on marine mammals have historically been monitored during construction activities, especially from pile driving noise, at Washington State Ferries (WSF) terminals. It is only since about 2015 that WSF has been engaged in researching the noise associated with vessel operations. WSF is a member of Green Marine, an environmental certification program for the North American marine industry. It is a voluntary, transparent, and inclusive initiative that addresses key environmental issues through 14 performance indicators. Underwater Noise is one of the 14 indicators and one criterion under this indicator is the development and adoption of a Marine Mammal Management Plan that strives to reduce the potential adverse effects of vessels, especially within known sensitive marine areas. This document meets this criterion.

This document discusses WSF's current and future efforts to protect marine mammals in the Salish Sea.

Who We Are

The Washington State Department of Transportation (WSDOT) Ferries Division (WSF) operates and maintains 19 ferry terminals and one maintenance facility, all of which are located in the Salish Sea (Georgia Basin/Puget Sound) (Figure 1). Since its creation in 1951, WSF has become the largest ferry system in the United States, operating 21 vessels on 10 routes with over 450 sailings each day (Figure 1).

The WSF vessel fleet is comprised of seven classes of vessel:

- Evergreen State
- Super
- Jumbo
- Issaquah
- Jumbo Mark II
- Kwa-di Tabil
- Olympic

There are various types of noise within the marine system, including construction noise (e.g., pile driving, dredging, blasting), shipping and boats, float planes and helicopters, and geophysical surveys. WSF contributes to both construction noise and noise from vessels.

WHERE WE OPERATE/MARINE MAMMALS IN THE WATER

The WSF system shares the waters of the Salish Sea with several marine mammal species. These include killer whales (both Southern Resident Killer Whales (SRKW) and Transient or Biggs Killer Whales), humpback whales, gray whales, Minke whales, and fin whales. In addition, other marine mammals such as dolphins, sea lions, and porpoises may be present.

Killer whales in the Eastern North Pacific region are categorized as resident, transient, or offshore whales. Residents in the North Pacific are further classified into Northern, Southern, Southern Alaska, and Western North Pacific groups. The SRKW group has been established as a Distinct Population Segment (DPS) and a stock under the Marine Mammal Protection Act of 1972; this group contains the pods, or groups, of J pod, K pod, and L pod, and was estimated to include approximately 74 individuals as of December 31, 2020.

The geographic distribution of SRKWs is year-round in the coastal waters off Oregon, Washington, Vancouver Island, and off the coast of central California and the Queen Charlotte Islands (Marine Mammal Commission 2021). In the summer, SRKWs are typically found in the Georgia Strait, Strait of Juan de Fuca, and the outer coastal waters of the continental shelf. In the fall, the J pod migrates into Puget Sound, while the rest of the population makes extended trips through the Strait of Juan de Fuca. In the winter, the K and L pods retreat from inland waters and are seldom detected in the core areas until late spring.



Figure 1. WSF Routes and Terminal Locations.

The J pod generally remains in inland waterways throughout the winter, with most of their activity in Puget Sound. Other winter movements and ranges of SRKWs are not well understood.

Killer whales use the entire water column, including regular access to the ocean surface to breathe and rest (Bateson 1974; Herman 1991). They remain underwater 95 percent of the time, with 60 to 70 percent of their time spent between the surface and a depth of 20 meters, while diving regularly to depths of over 200 meters (Baird 1994; Baird et al. 1998). SRKWs spend less than 5 percent of their time between depths of 60 and 250 meters (Center for Biological Diversity 2001). Time-depth recorder tagging studies of SRKWs have documented that whales regularly dive to greater than 150 meters. In recent years, however, there has been a trend toward a greater frequency of shallower dives (Baird and Hanson 2004).

For cetaceans, sound is the most critical sensory pathway of information. Killer whales communicate with each other over short and long distances with a variety of clicks, chirps, squeaks, and whistles. They also use echolocation to find prey and to navigate. Killer whales are mid-frequency cetaceans, with hearing in the range of 150 Hz to 20 kHz (Southall et al. 2007). Natural and anthropogenic sounds have the potential to impact the use of biologically important acoustic signals by killer whales (NOAA 2008). Long-term impacts from noise pollution would not likely show up as noticeable behavioral changes in habitat use, but rather as sensory damage or a gradual reduction in population health (NOAA 2008). Humpback whales sing long, complex songs lasting 10 to 20 minutes. Humpbacks are also thought to communicate with gestures involving tail and flipper slapping. Humpback whales are low-frequency cetaceans, with hearing in the range of 7 Hz to 22 kHz (Southall et al. 2007). It is not known whether humpback whales that tolerate chronic noise exposure undergo stress or are otherwise deleteriously affected.

Behavioral responses in cetaceans are difficult to observe and interpret. It is difficult to understand what does and does not constitute a response (Southall et al. 2007; NOAA 2008). Additionally, precise measurements of received noise exposure and other relevant variables

can be difficult to obtain. Only a few disturbance studies have been undertaken that estimate received sound levels, and only a very small number have measured received levels at the subject. Thus, behavioral reactions to acoustic exposure in cetaceans are generally more variable, context-dependent, and less predictable than effects of noise exposure on hearing or physiology (Southall et al. 2007).

Critical habitat has been designated for SRKW and encompasses the entire Salish Sea; therefore, all routes of the Washington State Ferry system fall within SRKW Critical Habitat (Figure 2). Humpback whale critical habitat has been proposed, but not yet designated. Proposed critical habitat for Humpback whales is not located within the Salish Sea and so will not be discussed further.



Figure 2. Southern Resident Killer Whale Critical Habitat.

CURRENT REGULATIONS FOR MANAGEMENT OF MARINE MAMMALS

Regulations for the management of marine mammals fall under the US Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). Jurisdiction for ESA and MMPA is shared by U.S. Fish and Wildlife Service and NOAA's National Marine Fisheries Service. In addition, there are state and federal regulations pertaining to vessel noise.

Current regulations for ESA and MMPA prohibit vessels from approaching SRKW within 200 yards (182.9 m) and from parking in the path of whales in inland waters of Washington State. The purpose of this regulation is to protect SRKW from interference and noise associated with vessels. Washington State has also set more stringent regulations, requiring vessels to stay a minimum of 300 yards from SRKW. Washington State also requires that all vessels traveling within half a nautical mile of the whales must slow to 7 knots per hour or less. Washington State Ferries applies the regulations for SRKWs to all cetacean species in Puget Sound.

HOW WE OPERATE

In 2019, with funding provided by the Washington State Legislature, WSDOT Research Office, and the Federal Highway Administration, WSF contracted with Noise Control Engineering, LLC (NCE) to perform underwater noise testing and analysis of nine different ferries representing all seven vessel classes of the WSF fleet. The testing and analysis were carried out to:

- Measure, assess, and understand the underwater radiated noise characteristics of the WSF fleet,
- Identify potential injury and harassment impacts to marine life for each WSF vessel class and,
- Identify the primary causes of radiated noise and potential mitigation strategies for each WSF vessel class.

The WSF vessel fleet is a combination of diesel only and diesel electric vessels. Noise signatures vary between the engine type, as well as size and class of vessel. The vessels used in the noise study have the following engine designs:

- Tacoma (Jumbo Mark II) – Diesel Electric
- Walla Walla (Jumbo) – Diesel Electric
- Wenatchee (Jumbo Mark II) – Diesel Electric
- Kaleetan (Super) – Diesel Electric
- Chimacum (Olympic) – Diesel
- Chelan (Issaquah) – Diesel
- Samish (Olympic) – Diesel
- Kennewick (Kwa-de Tabil) – Diesel
- Tillikum (Evergreen State) – Diesel Electric

NCE deployed acoustic data collection systems for eight days, measuring and recording underwater-radiated noise from WSF vessels while they made their regularly scheduled runs near Seattle, Anacortes, and Port Townsend. Crews navigated their vessels over the collection systems and operated at different conditions each day while recording critical information about each pass. The differing conditions and collected information allowed for the analysis of vessel noise as well as the identification of the sources of the vessel noise.

Overall, the analysis found that underwater-radiated noise from WSF vessels is dominated by bubbles formed by a propeller's motion and blade rate harmonics. A unique noise signature was identified for WSF's diesel electric vessels, which use both the forward and aft propellers for thrust, and thus produce additional propeller noise projecting from the bow of the vessel. In general, the study provided evidence that reduction in speed provided for a reduction in noise with the reduction being slightly less for diesel electric vessels than for diesel-gear vessels.

Impacts to marine life were calculated as permanent, temporary, or behavioral based on NOAA's National Marine Fisheries Service (NMFS) guidelines, which are usually used by WSF for construction work associated with pile driving noise. Permanent impacts were predicted only for high frequency cetaceans (i.e., porpoises) within 12 to 150 meters of the M/V Kennewick while at maximum ordered or make-up speeds. Temporary impacts were predicted for low frequency (i.e., baleen whales, such as humpbacks) and high frequency cetaceans within 15 meters to 2 kilometers of all vessels depending on vessel type and operating condition. Notably, mid-frequency cetaceans (i.e., toothed whales excluding porpoises), which include the SRKWs and other killer whales, were not predicted to be significantly affected in a permanent or temporary manner by WSF vessels. However, potential behavioral impacts were widespread for all cetaceans.

Behavioral impacts may include a range of responses from minor to significant changes in behavior including diving, surfacing, vocalizing, feeding, and/or mating. As discussed earlier, some marine mammals such as killer whales communicate using a variety of clicks, chirps, squeaks and whistles. They also use echolocation to locate prey and to navigate. Although short-term changes in behavior may not be noticeable, long term impacts may manifest as sensory damage or a gradual reduction in the health of the population (Whale Museum 2021).

For behavioral impacts, NCE used Sound Pressure Level (SPL) to calculate maximum distances for behavioral impacts. Impact zones were calculated using a conservative level of 120 dB re 1 μ Pa. This level is used by NOAA to calculate noise impact zones for other types of underwater noise. NCE also calculated an 'effective quiet' level, assumed to be a noise level at which no cumulative exposure effects will occur. The 'effective quiet' level was calculated using 130 dB re 1 μ Pa. This calculation can cause impact zones to drop by a factor of four or more (NCE 2020).

Using the conservative weighted sound pressure level of 120 dB re 1 μ Pa, impact zones varied from about 100 meters to over 20 km. However, these large impact distances do not account for real-world factors relating to line-of-sight. The model assumes a direct line-of-sight from the receiver (marine mammal) to the source of the noise. But noise is blocked by objects such as land masses, particularly at high frequencies. This is particularly important in the Salish Sea where there are plentiful islands and a shoreline that is not straight. Figures 3-5 provide a visual representation of this, using pile driving noise as an example. Noise from pile driving is calculated using a weighted sound pressure level of 120 dB re 1 μ Pa as well. In these figures, the in-water noise zone ranges from ~4 km to ~6.5 km.



Figure 3. In-water Noise Zone at the Anacortes Ferry Terminal



Figure 4. In-water Noise Zone at the Colman Dock Ferry Terminal.



Figure 5. In-water Noise Zone at the Clinton Ferry Terminal.

WSF's current efforts to slow down vessels when marine mammals are in the vicinity is an effective means of operationally lowering noise levels (thus decreasing behavioral impacts) and decreasing the possibility of vessel strikes. Permanent impact zones were found only for high frequency cetaceans (Dall's Porpoise, true porpoises, river dolphins) in the presence of the *Kennewick*, under specific speeds and distances. Under normal operating procedures, the *Kennewick* would not be operating at these speeds and distances, thus not posing a problem for the cetaceans. Although temporary impacts seem to be more widespread, both for vessel class and cetacean type, these impacts are confined to distances of approximately 2 km. In addition, the speed reductions that WSF has in place under normal operating procedures would further decrease these impacts by decreasing noise levels and areas in which cetaceans may be impacted. Finally, although behavioral impacts are predicted for all marine mammal species, this study noted that the decrease in speed while in the presence of these animals leads to significant decreases in impact to cetaceans.

What We Do

VESSEL OPERATIONS AND MARINE MAMMAL PROTECTION

WSF's Safety Management System (SMS) outlines the policies, objectives, and responsibilities associated with vessel operations and marine mammal protection and reporting.

WSF policy states that vessels shall operate throughout Puget Sound, in both the U.S. and Canada, in a manner that meets or exceeds all applicable federal and state/provincial laws, including the notification to appropriate external agencies of whale sightings and marine mammal strandings. Masters and Mates will, whenever safe operation of the vessel allows report sightings of whales to the WSF Operations Center, who in turn report the sightings to Orca Network. Since October 2019, vessel crews and Operations Center staff have also been reporting to the WhaleReport Alert System (WRAS) and monitoring WRAS for the presence of marine mammals near WSF vessels.

When marine mammals are present vessel operations must follow the guidelines below.

Whales Present

- Do not approach within one-quarter nautical mile of a whale.
- Do not position the vessel to be in the path of or behind a whale at any point within one-quarter nautical mile, taking into consideration prevailing wind and water current.
- Disengage the transmission of the vessel when it is within one-quarter nautical mile of a whale.
- Slow to seven knots over ground when the vessel is located within one-half nautical mile (1,013 yards) of a whale.

Other Marine Mammals Present

- Avoid driving through groups of porpoises or dolphins.
- When dolphins or porpoises choose to ride the bow wave of a vessel, avoid sudden course changes, and hold course and speed or reduce speed gradually.
- Do not position vessel to intercept a marine mammal's path of travel.

VESSEL STRIKES

A vessel strike is a collision between a vessel of any type and a marine mammal. They can occur anywhere that vessels share the waters with marine mammals. Often marine mammals are difficult to see from the surface. Even if marine mammals are spotted, there may not be time for the vessel to avoid a collision.

WSF has had two vessel strikes in its history since 1951, with those occurring in 2019 and 2020 – both of humpback whales. In both cases, the whales surfaced directly underneath the hull of the vessel. In one case, the vessel crew did not know there were any whales present in the vicinity. In the second case, the vessel captain and crew were aware of the presence of humpback whales and were in the process of slowing the vessel's speed, per WSF requirements.

WSF has engaged marine mammal experts to discuss this issue and to brainstorm possible ways to lower the risk of vessel strikes. Discussions with Lynne Barre and Kristin Wilkinson of NOAA, and John Calambokidis of Cascadia Research concluded that the current protocols being followed by WSF crews are protective of marine mammals to the extent possible.

Baleen whales, which include humpback, gray, and minke whales are more likely to be subject to interactions with vessels and humans. When they are feeding, they are relatively oblivious to boats in their vicinity. In addition, although baleen whales often travel in straight lines, it can be difficult to predict their speed of travel, thus making it challenging to know when and where they are going to surface.

WSF vessel crews are trained to watch for marine mammals while on watch using the 'Whales in our Waters' training program. Whales in our Waters was developed by the Enhancing Cetacean Habitat and Observation (ECHO) Program and BC Ferries, with the support of Ocean Wise. By taking this training tutorial, WSF crews build awareness of local whale species, how to identify them, and best practices to implement when navigating ships in their presence. This training is now part of the on-boarding process for new crew members and will be made mandatory with the implementation of the 2021-2023 Sustainability Action Plan.

ENHANCING CETACEAN HABITAT AND OBSERVATIONS (ECHO) PROGRAM AND QUIET SOUND

WSF is a member of the Port of Vancouver's Enhancing Cetacean Habitat and Observations (ECHO) Program. The ECHO Program was formed to better understand and reduce the cumulative effects of shipping on whales. ECHO is comprised of a range of partners and advisors including government agencies, the marine transportation industry, Indigenous communities, environmental groups, and scientists. The goal of the ECHO Program is to develop and implement initiatives that results in a quantifiable reduction in threats to whales as a result of shipping/vessel activities. WSF serves on ECHO's Advisory Working Group and several of its technical committees. WSF has been part of the ECHO program since 2015 and is the only other US entity besides NOAA NMFS involved in the program.

Helping to implement Recommendation #22 of Washington State Governor Jay Inslee's Orca Task Force, WSF has served on the planning team for Quiet Sound, a program for Washington waters based off the Canadian ECHO Program. Quiet Sound will work collaboratively with the ECHO Program and will be tailored to address the unique characteristics of SRKW behavior and large commercial vessel movement in Washington waters. Quiet Sound is a voluntary effort implemented through the coordination of multiple entities with a structure that supports adaptive management and continuous improvement. WSF has a leadership role in Quiet Sound and will continue to be a strong proponent of this effort.

WSF's continued work with both ECHO and Quiet Sound will further help decrease underwater noise and protect marine mammals in the Salish Sea.

WHALE REPORTING SYSTEM

WSF uses the WhaleReport Alert System (WRAS) to report marine mammal sightings in the Salish Sea. Vessel crews report sightings to the WSF Operations Center, who then report it to WRAS. In 2019 and 2020, WSF provided 216 sighting reports to WRAS. These sightings included Dall's porpoise, Harbor porpoise, Gray whales, humpback whales, minke whales, killer whales (both SRKWs and Bigg's (transients)), as well as two unidentified whales. By reporting these sightings, mariners within 10 nautical miles of each sighting were alerted to the presence of these marine mammals in their immediate vicinity. As part of the SMS moving forward, vessel crews and Operations Center staff will be required to report marine mammal sightings through WRAS. This will be in addition to reporting marine mammal sightings to ORCA Network.

FUTURE WORK

The goal at WSF is to continue to find ways to decrease underwater noise in the Salish Sea. This includes vessel design, marine mammal reporting, and engagement with ECHO and Quiet Sound.

The NCE noise study concluded that propeller cavitation noise was responsible for much of the underwater noise measured during this study. WSF is continuing to research propeller designs and engage industry experts to find solutions to propeller noise. Currently, when new vessels are commissioned, WSF incentivizes builders to implement noise reduction design notations such as SILENT-E from DNV, which ensures that ships are designed to not exceed average-to-moderate underwater noise levels. The Washington State Ferries Long Range Plan proposes to increase the vessel fleet size over the next 20 years. This includes building 5 new electric-hybrid Olympic class vessels and investing in 11 additional new vessels, for a total of 16 new vessels. Quiet propeller designs will continue to be incentivized for these new vessels.

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