



MARINE MAMMAL COMMISSION

2 April 2018

Ms. Jolie Harrison, Chief
Permits and Conservation Division
National Marine Fisheries Service
Office of Protected Resources
1315 East-West Highway
Silver Spring, MD 20910

Dear Ms. Harrison:

The Marine Mammal Commission (the Commission), in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the U.S. Navy's application seeking authorization under section 101(a)(5)(D) of the Marine Mammal Protection Act (the MMPA) to take marine mammals by harassment. The taking would be incidental to pile driving and removal in association with the service pier extension project at Naval Base Kitsap Bangor (Bangor) in Washington. The Commission also has reviewed the National Marine Fisheries Service's (NMFS) 12 March 2018 notice (83 Fed. Reg. 10689) announcing receipt of the application and proposing to issue the authorization, subject to certain conditions.

Background

The Navy plans to extend the service pier and construct associated support facilities to accommodate the relocation of two SEAWOLF Class submarines from Naval Base Kitsap Bremerton. During the project, the Navy would remove 36 15- to 18-in timber piles and 27 36-in temporary steel piles using direct pull, a vibratory hammer, and/or cutting at the mudline. The Navy also would install 27 36-in temporary steel piles, 50 24-in and 203 36-in permanent steel piles, and 103 18-in concrete piles using a vibratory and/or impact hammer. It expects the activities to occur on up to 160 days during daylight hours¹. In-water activities would occur from 16 July 2018 through 15 January 2019.

NMFS preliminarily has determined that, at most, the proposed activities would cause Level A and/or B harassment of small numbers of harbor seals², California sea lions, Steller sea lions, harbor porpoises, and transient killer whales. It also anticipates that any impact on the affected species and stocks would be negligible. NMFS does not anticipate any take of marine mammals by death or serious injury and believes that the potential for temporary or permanent hearing impairment would be at the least practicable level because of the proposed mitigation measures. The mitigation, monitoring, and reporting measures include—

¹ In-water activities would occur only during daylight hours (sunrise to sunset). From July 16 to September 15, impact pile-driving activities would only occur starting two hours after sunrise and ending two hours before sunset.

² The Commission noted that NMFS incorrectly reduced the number of Level B harassment takes by the number of Level A harassment takes in the *Federal Register* notice. NMFS verified the error and clarified that it plans to issue 4,375 Level B and 125 Level A harassment takes in the final authorization.

- using only one hammer at any given time;
- using a bubble curtain during impact pile driving of 24- to 36-in piles and implementing various performance standards measures;
- using soft-start, delay, and shut-down procedures;
- using delay and shut-down procedures, if a species for which authorization has not been granted or if a species for which authorization has been granted but the authorized takes have been met, approaches or is observed within the Level A and/or B harassment zone;
- using three to five qualified protected species observers to monitor the Level A and B harassment zones for 15 minutes before, during, and for 30 minutes after pile driving;
- ceasing other heavy machinery work (i.e., activities other than pile driving including pile removal) if any marine mammal comes within 10 m of the vessel or equipment;
- reporting any pinniped hauled out at unusual sites (e.g., in work boats) immediately to the local stranding network, and as soon as time allows to NMFS, and following any procedures or measures stipulated by the stranding network³;
- reporting injured and dead marine mammals to the regional stranding network and NMFS using NMFS's phased reporting approach and suspending activities, if appropriate; and
- submitting draft and final monitoring reports to NMFS.

Rounding of take estimates

The method NMFS used to estimate the numbers of takes during the proposed activities, which summed fractions of takes for each species across project days, does not account for and negates the intent of NMFS's 24-hour reset policy. As the Commission has indicated in previous letters regarding this matter⁴, the issue at hand involves policy rather than mathematical accuracy. Although NMFS developed criteria associated with rounding quite some time ago, NMFS has indicated that the draft criteria need additional revisions before it can share them with the Commission. Therefore, the Commission recommends that NMFS promptly revise its draft rounding criteria in order to share them with the Commission.

Appropriateness of the Level A harassment zones

As the Commission has indicated in previous letters, it supports NMFS's use of the updated permanent threshold shift (PTS) thresholds and associated weighting functions that are used to estimate the Level A harassment zones. However, there are some shortcomings that need to be addressed regarding the methodology for determining the extent of the Level A harassment zones based on the associated PTS cumulative sound exposure level (SEL_{cum}) thresholds for the various types of sound sources, including stationary sound sources. For determining the range to the PTS SEL_{cum} thresholds, NMFS uses a baseline accumulation period of 24 hours unless an activity would occur for less time (e.g., 8 hours). The Commission supports that approach *if* an action proponent is able to conduct more sophisticated sound propagation and animat modeling. However, that

³ The Commission noted that this standard measure was not included in the proposed incidental harassment authorization. NMFS has since clarified that the measures would be included in the final authorization.

⁴ See the Commission's [29 November 2016 letter](#) detailing this issue.

approach is less than ideal for action proponents that either are unable, or choose not, to conduct more sophisticated modeling.

As an example, the Level A harassment zone for high-frequency cetaceans was estimated to be much greater than the Level B harassment zone (740 vs. 541 m, respectively) for impact driving of 36-in piles⁵. Based on the extent of those zones, it is assumed that an animal would experience PTS before behaviorally responding and avoiding the area. That notion runs counter to the logic that permanent and temporary physiological effects are expected to occur closest to the sound source, with behavioral responses triggered at lower received levels, and thus at farther distances. Numerous Navy environmental impact statements⁶, as well as a National Research Council (NRC) report (Figure 4-1; NRC 2005), support this logic.

The Commission does not question the Level A harassment thresholds themselves, but rather the manner in which the PTS SEL_{cum} thresholds are currently implemented. The Level A and B harassment zones do not make sense biologically or acoustically due to NMFS's unrealistic assumption that the animals remain stationary throughout the entire day of the activity.⁷ This is particularly problematic when action proponents, including the Navy, are using a simple area x density method for take estimation. By assuming a stationary receiver, all of the energy emitted during a 24-hour period is accumulated for the PTS SEL_{cum} thresholds.

The Commission continues to believe that it would be prudent for NMFS to consult with scientists and acousticians to determine the appropriate accumulation time that action proponents should use to determine the extent of the Level A harassment zones based on the associated PTS SEL_{cum} thresholds in such situations. Those zones should incorporate more than a few hammer strikes (or acoustic pulses) but less than an entire workday's worth of strikes (or pulses). This recommendation is the same as those made in the Commission's [11 July 2017 letter](#) on NMFS's final Technical Guidance and multiple previous letters⁸. Other federal partners, including the Navy, have made similar recommendations. Since the Commission and other federal partners determined that this issue needs resolution, the Commission recommends that NMFS make this issue a *priority* to resolve in the near future. The Commission further recommends that NMFS consult with both internal⁹ and external scientists and acousticians to determine the appropriate accumulation time that action proponents should use to determine the extent of the Level A harassment zones based on the associated PTS SEL_{cum} thresholds for the various types of sound sources, including stationary sound sources, when simple area x density methods are employed. Estimated swimming speeds of various species and behavior patterns (including residency patterns)¹⁰ should be considered. Evaluating

⁵ A similar, but more pronounced, trend is observed for low-frequency cetaceans for which taking was not requested (see Table 6-5 in the application).

⁶ With which NMFS has been a cooperating agency.

⁷ Which generally has been more of an issue for stationary sound sources. However, this also could be an issue for moving sound sources that have short distances between transect lines, in which the user spreadsheet may not be appropriate for use unless the source level could be adjusted accordingly.

⁸ Including its 11 May 2017, 11 April 2017, and 31 August 2015 letters.

⁹ Including staff in the Marine Mammal and Sea Turtle Conservation Division of the Office of Protected Resources and staff in the Office of Science and Technology.

¹⁰ Results from monitoring reports, including animal responses, submitted in support of incidental harassment authorizations issued by NMFS also may inform this matter.

various scenarios using animat modeling should help address this issue as well.

Shut-down zones

The aforementioned issue is further confounded because the Navy has proposed to shut down its activities if a pinniped is observed within 220 m for impact pile driving and 30 m for vibratory pile driving. Both proposed zones are excessively large for otariids¹¹ in general and are exceedingly large for phocids¹² during all activities except for driving of 36-in piles. As noted in the Navy's application, harbor seals and California sea lions are present year-round at Bangor. The Navy also assumed that 35 harbor seals and 49 California sea lions could be harassed on each day of activities¹³, which is not an insignificant number of animals.

In the Commission's review of previous monitoring reports from Bangor, it notes that the Navy had to shut down its activities 22 times on 15 separate days due to harbor seals occurring in the 20-m shut-down zone for impact pile driving (Department of the Navy 2015). Given that the previous shut-down zone is 10 times smaller than the proposed shut-down zone, it is very likely that the Navy would spend more time shutting down its activities and clearing its zone than actually driving piles. In addition, 44 of 47 harbor seal sightings were observed within 220 m of the Navy's other previous construction activities on just three days of observations (Department of the Navy 2016)¹⁴.

The Commission understands that NMFS also believes that the Navy's proposed shut-down zones are overly conservative and could result in numerous shut downs. However, the Navy has indicated that it is comfortable with its approach. The Commission is unsure why the Navy is reticent to change its approach—which is inconsistent with past practice—but notes this will set precedent for what is considered practicable for mitigation and monitoring. The Commission further contends that the Navy's proposed approach is neither necessary nor practical in regards to the Navy being able to conduct its activities in a timely manner. For these reasons, the Commission recommends that NMFS strongly encourage the Navy to reduce the sizes of its shut-down zones¹⁵ to ensure both that pinnipeds are sufficiently protected from Level A harassment and the activities can be completed in an appropriate manner and within an appropriate timeframe. If the sizes of the zones are reduced below 46 m, the Commission recommends that NMFS include the appropriate number of Level B harassment takes for all pinniped species during the 35 days of impact driving of 18-in concrete piles. Those additional takes should not affect NMFS's small numbers or negligible impact determinations.

¹¹ The predicted Level A harassment zones range from 1 to 12 m for impact pile driving and 1 to 2 m for vibratory pile driving.

¹² The predicted Level A harassment zones range from 19 to 34 m for impact driving of 18- and 24-in piles and 217 m for 36-in piles; while the Level A harassment zones range from 5 to 12 m for vibratory driving of 15- and 24-in piles and 26 m for 36-in piles.

¹³ Level B harassment takes were not included for impact driving of 18-in concrete piles on 35 days of activities due to the Level B harassment zone of 46 m being subsumed by the 220 m shut-down zone. Level A harassment takes were included for harbor seals.

¹⁴ California sea lions have been observed within 220 m of previous activities at Bangor for multiple authorizations but to a lesser degree than harbor seals.

¹⁵ 15 m is more than sufficient for California sea lions during all activities. 35 m (or less for certain activities) would be reasonable for harbor seals, while retaining the 220-m shut-down zone only for impact driving of 36-in piles.

Proposed one-year authorization renewals

NMFS has indicated that it may issue a one-year¹⁶ incidental harassment authorization renewal for this and other future authorizations—a tactic that is quite relevant in this particular instance given that an additional authorization likely would be necessary based on the Navy’s proposed measures. Generally though, NMFS would issue a renewal on a case-by-case basis without additional public notice or comment opportunity when (1) another year of identical, or nearly identical activities, as described in the ‘Specified Activities’ section of the *Federal Register* notice is planned or (2) the originally planned activities would not be completed by the time the incidental harassment authorization expires and a renewal would allow for completion of the authorized activities beyond the timeframe described in the ‘Dates and Duration’ section of the notice. NMFS would consider issuing a renewal only if—

- the request for renewal is received no later than 60 days prior to the expiration of the current authorization;
- the activities to be conducted either are identical to the previously analyzed and authorized activities or include changes so minor (e.g., reduction in pile size) that they do not affect the previous analyses, take estimates, or mitigation and monitoring requirements;
- a preliminary monitoring report provides the results of the required monitoring to date and those results do not indicate impacts of a scale or nature not previously analyzed or authorized;
- the status of the affected species or stocks and any other pertinent information, including the mitigation and monitoring requirements, remain the same and appropriate; and
- the original determinations under the MMPA remain valid.

The Commission agrees that NMFS should take appropriate steps to streamline the authorization process under section 101(a)(5)(D) of the MMPA to the extent possible. However, the Commission is concerned that the renewal process proposed in the *Federal Register* notice is inconsistent with the statutory requirements. Section 101(a)(5)(D) clearly states that proposed authorizations are subject to publication in the *Federal Register* and elsewhere and that there be a presumably concurrent opportunity for public review and comment. NMFS’s proposed renewal process would bypass the public notice and comment requirements at the point that NMFS is considering the renewal. Although sympathetic to what NMFS is trying to accomplish, the Commission recommends that NMFS refrain from implementing the proposed renewal process unless it is revised to allow for contemporaneous public notice and review.

If NMFS believes that its proposed renewal process is consistent with the applicable statutory requirements and intends that process to be generally applicable to all incidental harassment authorizations that meet the specified criteria, it should not seek to adopt such a process through a brief notice at the end of a specific proposed authorization. That process should be adopted through more general procedures, preferably a rulemaking, that provides NMFS’s rationale and analysis regarding why it believes the proposed renewal process is consistent with the

¹⁶ In another recent proposed authorization (83 Fed. Reg. 8456), NMFS clarified that it would issue a *second* one-year authorization. However, NMFS has yet to specify whether the renewal would be issued as a one-time opportunity, after which time a new authorization application would be required. These specifics should be included in all *Federal Register* notice that details the new proposed renewal process.

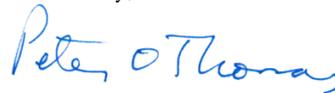
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requirements of section 101(a)(5)(D) of the MMPA and adequate public notice and opportunity for comment.

If NMFS adopts the proposed renewal process notwithstanding the Commission's recommendation, the Commission further recommends that NMFS provide it and the public with a legal analysis supporting NMFS's conclusion that such a process is consistent with the requirements under section 101(a)(5)(D) of the MMPA. In addition, if NMFS decides to bypass the notice and comment process in advance of issuing a renewal, it should nevertheless publish notice in the *Federal Register* whenever such a renewal has been issued.

The Commission hopes you find its letter useful. Please feel free to contact me should you have questions regarding the Commission's recommendations and comments.

Sincerely,



Peter O. Thomas, Ph.D.,
Executive Director

References

- Department of the Navy. 2015. Naval Base Kitsap–Bangor Explosives Handling Wharf 2: Year 3 marine mammal monitoring report (2014–2015), Bangor, Washington. Naval Facilities Engineering Northwest, Silverdale, Washington. 51 pages.
- Department of the Navy. 2016. Marine mammal monitoring report: EHW-1 pile replacement project 2015, Naval Base Kitsap–Bangor Washington. Naval Facilities Engineering Northwest, Silverdale, Washington. 73 pages.
- NRC. 2005. Marine mammal populations and ocean noise: Determining when noise causes biologically significant effects. The National Academies Press, Washington, D.C. 126 pages.



ITP Pauline - NOAA Service Account <itp.pauline@noaa.gov>

Public Comment on Kitsap Bangor Naval Base

2 messages

Brooke Dj Leavitt <bleavitt@email.arizona.edu>
To: ITP.pauline@noaa.gov

Mon, Mar 19, 2018 at 11:15 PM

Dear, Jolie Harrison

Upon extensive review of the Notice published in the Federal Registrar, we have identified a number of aspects that we find concerning and alarming. Foremost, there is not enough scientific data on sound impairment of marine mammals as a result of the types of activities this project will be performing. As such, we find it concerning that the Notice fails to specify the use of a hydraulic or electrical hammer while using an impact piledriver. Determination, or meaningful "assumptions," of how significantly marine mammals will be affected by frequency and amplitude cannot be successful if the variation between the two hammering techniques is not taken into account, nor if substantive scientific data is reported and utilized. The Notice also does not define or have set criteria for what "problematic geotechnical conditions" means. When broad, obscure language is utilized and not clearly defined, it leaves a considerable amount of room for manipulation and arbitrary and capricious interpretation. Additionally, due to the lack of available data, inconclusive or incomplete data, or the inexistence of necessary data, data is interpreted in a fashion that is persuasive and reinforces the idea that impacts won't possibly be more significantly dangerous than assumed, which is impetuous. Overall, the current project, as it stands, does not allow for a clear definition of many of its proposed processes and actions, and does not stand on a solid base of scientific exploration and understanding of the effects the project would have on the species in the surrounding area. While we understand the importance of this project, as it serves as an integral aspect to the improvement of the nation's safety, we feel these specific components need to be more explicitly defined, backed with more substantive scientific data, and that the potential impacts of these actions need to be better understood; "assumptions" are bias and inequitable.

Sincerely,

Gabby Dietrich, Bailey Dilgard, Abby Gritis, Brooke Leavitt

ITP Pauline - NOAA Service Account <itp.pauline@noaa.gov>
To: Robert Pauline - NOAA Affiliate <robert.pauline@noaa.gov>

Tue, Apr 17, 2018 at 2:59 PM

[Quoted text hidden]

April 2, 2018

Jolie Harrison, Chief
Permits and Conservation Division
Office of Protected Resources, National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910

Re: Taking Marine Mammals Incidental to the Service Pier Extension Project on Naval Base Kitsap Bangor, Washington (83 Fed. Reg. 10689)

Whale and Dolphin Conservation (WDC) is the leading global charity dedicated to the conservation and protection of whales, dolphins, and their habitats worldwide. In response to the request for public comments by the National Marine Fisheries Service (NMFS) regarding proposed construction by the U.S. Navy at Naval Base Kitsap Bangor, Washington, we respectfully submit the following comments.

The proposed construction activity will include vibratory and impact pile driving, both of which are contributors of anthropogenic noise to Washington State inland waters. We acknowledge and appreciate the plan to monitor and mitigate the anticipated impacts to marine mammals, and the planned in-water work windows to minimize the impacts on juvenile salmon. As an important source of food for the endangered Southern Resident orca population and for many other species in the Salish Sea, efforts to avoid harm to salmon are vital to protecting the Salish Sea ecosystem.

Our comments are specific to the two orca populations potentially impacted by this construction activity: the Southern Resident population, listed as Endangered under the U.S. Endangered Species Act (ESA) and Canada's Species at Risk Act (SARA),¹ and the West Coast Transient population, designated as Threatened under SARA.² While the Southern Residents are not expected to occur in the waters of Naval Base Kitsap (NBK) Bangor, located in Hood Canal, the area is part of their historical habitat,³ and though it is improbable, it is not impossible that they may visit Hood Canal. Lead observers should be familiar with, or adequately trained on, the differences in appearance between Resident and Transient orcas and be able to immediately report the presence of Southern Resident orcas should they enter or approach Hood Canal.

Increasing anthropogenic noise from chronic and acute sources is a threat to both these orca populations. Orcas depend on sound to navigate and locate prey and other objects in their habitat, communicate, maintain social cohesion, and detect and avoid threats. Underwater noise can result in a number of negative impacts, including: disruption of foraging behavior, decreased foraging success, displacement of prey, displacement from preferred habitat, temporary or permanent hearing loss, auditory masking, habitat degradation, physiological and physical harm, and chronic stress which may have long-term consequences for health and fitness.⁴ Noise reduces the echolocation range of orcas and may impair the ability of Transient orcas, who hunt by stealth, to listen for their prey. Research has shown that for every 1 dB increase in background noise, Southern Residents increase their call amplitude by a corresponding 1 dB.⁵

¹ National Marine Fisheries Service (NMFS). 2005. Endangered Status for Southern Resident Killer Whales. National Marine Fisheries Service, Northwest Region, Seattle, Washington. 70 FR 69903; Species at Risk Act (S.C. 2002)

² Fisheries and Oceans Canada. 2016. [Amended] Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Vancouver, vii + 54 pp.

³ NMFS 2006. Designation of Critical Habitat for the Southern Resident killer whale. 71 Fed. Reg. 69054; NMFS 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Northwest Region, Seattle, Washington.

⁴ Erbe, C. 2002. "Underwater noise of whale-watching boats and potential effects on killer whales (*Orcinus orca*), based on an acoustic impact model." *Marine Mammal Science*, vol. 18, pp. 394-418 (2002); Fisheries and Oceans Canada. 2016. [Amended] Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Vancouver, vii + 54 pp; Holt, M.M. 2008 Sound exposure and Southern Resident killer whales (*Orcinus orca*): A review of current knowledge and data gaps. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-89, 59p.; Holt, M.M., Noren D.P., Veirs V., Emmons C.K., and Veirs S. 2009. "Speaking up: Killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise." *The Journal of the Acoustical Society of America*, vol. 125, pp. EL27-L32; Holt, M.M., Noren D.P., and Emmons, C.K. 2011. "Effects of noise levels and call types on the source levels of killer whale calls." *The Journal of the Acoustical Society of America*, vol. 130, p. 3100; ; Matkin, C. O, Moore M. J., and Gulland F.M.D. "Review of Recent Research on Southern Resident Killer Whales (SRKW) to Detect Evidence of Poor Body Condition in the Population." Independent Science Panel Report to the SeaDoc Society. 3 pp. + Appendices; Veirs, S., Veirs, V. and Wood, J.D. "Ship noise in an urban estuary extends to frequencies used for echolocation by endangered killer whales." *PeerJ*, vol. 4, p. e1657 (2015).

⁵ Holt, M.M. 2008 Sound exposure and Southern Resident killer whales (*Orcinus orca*): A review of current knowledge and data gaps. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-89, 59p; Holt, M. M et al. 2009.

A world where every whale and dolphin is safe and free



Anthropogenic sources are a significant contributor to underwater noise in Puget Sound and in the habitat of orcas, and construction activities add to the total amount of noise, thus impacts should be mitigated for the least practicable impact to orcas.

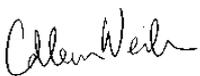
WDC encourages placement of the proposed hydroacoustic system to detect the presence of marine mammals at or near the entrance to Hood Canal, particularly to monitor for Southern Resident orcas, which tend to be more vocally active than Transient orcas. If the Southern Residents are detected acoustically near Hood Canal, observers should visually monitor the passage in the instance that the orcas do enter Hood Canal, given that the Navy did not request any authorized takes for Southern Resident orcas in this application. Transient orcas are more difficult to detect on hydrophones with their stealthy foraging behavior and use of cryptic clicks in echolocation to avoid detection by their prey.⁶ We urge the Navy and observers for this construction project to frequently communicate with the NMFS West Coast Regional office for updates, and to check citizen sightings networks, such as one operated by Orca Network, on a daily basis for orca presence and activity in the area before construction activities begin.

The inner coast subpopulation of West Coast Transients is estimated to consist of approximately 304 individuals,⁷ and has been increasing in both size and presence in inland waters in recent years.⁸ Although Transient presence is usually assumed to be unpredictable and erratic, increasing populations of target prey species in Puget Sound has caused a relatively stable presence of Transient orcas in recent years. For example, in 2017, Transient orcas were present in the Salish Sea on 280 days, with more than 45 individual orcas observed on some days.⁹ This increasing use of inland waters by Transient orcas suggests a strong possibility that they may enter Hood Canal during this construction period. We urge the Navy to ensure adequate numbers and placement of marine mammal observers to detect Transient orcas in the shutdown zone of the construction area, and again to maintain constant contact with NMFS and sightings networks for orca presence and movement in Puget Sound. Transients can be difficult to detect visually and acoustically, and their smaller group sizes increase the difficulty of visual observation – likelihood of visual detection rapidly decreases at distances greater than 1km.¹⁰

We hope that NMFS and the Navy fully consider these factors while finalizing this Incidental Harassment Authorization: the diverse negative impacts increased underwater noise can have on orcas, the possibility that Southern Resident orcas may enter Hood Canal, the increased presence of Transient orcas in the Puget Sound area, and the potential difficulty of detecting Transients. While WDC is encouraged by the Navy's proposed mitigation and monitoring measures, we are concerned that these measures may not be sufficient to protect orcas from harassment and the effects of additional noise in their habitat.

Thank you for the opportunity to submit comments on this proposed construction activity, and please contact us with questions or for additional information.

Regards,



Colleen Weiler
Rekos Fellow for Orca Conservation
Whale and Dolphin Conservation

Speaking up: Killer whales (*Orcinus orca*) increase their call amplitude in response to vessel noise. *The Journal of the Acoustical Society of America*, 125(1):EL27-EL32

⁶ Fisheries and Oceans Canada. 2016. [Amended] Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Vancouver, vii + 54 pp.

⁷ Fisheries and Oceans Canada. 2016. [Amended] Recovery Strategy for the Transient Killer Whale (*Orcinus orca*) in Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Vancouver, vii + 54 pp; Wiles, G. J. 2016. Periodic status review for the killer whale in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 26+iii pp.

⁸ Houghton J, RW Baird, CK Emmons, MB Hanson. 2015. Changes in the occurrence and behavior of mammal-eating killer whales in southern British Columbia and Washington State, 1987-2010. *Northwest Science* 89(2), 154-169; Orca Network sightings archive

(http://www.orcanetwork.org/Archives/index.php?categories_file=Sightings%20Archives%20Home) accessed 3/22/2018; Wiles, G. J. 2016. Periodic status review for the killer whale in Washington. Washington Department of Fish and Wildlife, Olympia, Washington. 26+iii pp.

⁹ Orca Network sightings archive

(http://www.orcanetwork.org/Archives/index.php?categories_file=Sightings%20Archives%20Home) Accessed 3/22/2018

¹⁰ Wade, P.R., J.W. Durban, J.M. Waite, A.N. Zerbin, and M.W. Dahlheim. 2003. Surveying killer whale abundance and distribution in the Gulf of Alaska and Aleutian Islands. AFSC Quarterly Report Oct-Dec. Pages 1-16.

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