Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion

Action Agency: Department of the Navy, Joint Base Pearl Harbor-Hickam

Federal Action: Construction of a new Dry Dock and Waterfront Production Facility at the Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility, Joint Base Pearl Harbor- Hickam, Oahu, HI

Consultation Conducted by: National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division

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Acting Regional Administrator, Pacific Islands Region

Date Issued: November 12, 2022

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1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1536(a)(2)) requires each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. When a federal agency's action "may affect" a listed species or its designated critical habitat, that agency is required to consult formally with us, the National Marine Fisheries Service (NMFS), or the U.S. Fish and Wildlife Service (FWS), depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action (50 CFR 402.14(a)). Federal agencies are exempt from this general requirement if they have concluded that an action "may affect, but is not likely to adversely affect" endangered species, threatened species or their designated critical habitat, and we or the FWS concur with that conclusion (50 CFR 402.14 (b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, we provide an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If we determine that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, in accordance with the ESA Section 7(b)(3)(A), we provide a reasonable and prudent alternative that allows the action to proceed in compliance with Section 7(a)(2) of the ESA. If incidental take[1] is expected, Section 7(b)(4) requires us to provide an incidental take statement (ITS) that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures. We have, by regulation, determined that an ITS must be prepared when take is "reasonably certain to occur" as a result of the proposed action (50 C.F.R. 402.14(g)(7)).

For the actions we describe in this document, the action agency is the Department of Navy, specifically two commands: the Joint Base Pearl Harbor-Hickam (JBPHH) and Naval Facilities Engineering Systems Command Program Management Office 555 (hereinafter jointly referred to as the Navy). The Navy proposes to construct a new dry dock 5 and waterfront production facility (WPF) at the Pearl Harbor Naval Shipyard and Intermediate Maintenance Facility (PHNSY-IMF), located at JBPHH, Oahu, Hawaii. This document represents our final biological opinion (Opinion) on the effects of the proposed action on the following endangered and threatened species: threatened Central North Pacific Green sea turtle (*Chelonia mydas*), and the endangered Hawksbill turtle (*Eretmochelys imbricata*). We have prepared this Opinion in accordance with the requirements of Section 7 of the ESA, the implementing regulations (50

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[1] Take" is defined by the ESA as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. NMFS defines "harass" as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (Application and Interpretation of the Term "Harass" Pursuant to the Endangered Species Act: NMFS Guidance Memo May 2, 2016). NMFS defines "harm" as "an act which actually kills or injures fish or wildlife." 50 C.F.R. 222.102. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Take of species listed as endangered is prohibited at the time of listing, while take of threatened species may not be specifically prohibited unless NMFS has issued regulations prohibiting take under section 4(d) of the ESA.

CFR 402), agency policy, and guidance and we have based it on information contained in Navy's Biological Assessment (NAVFAC 2022a), NMFS and FWS recovery plans and status reviews for sea turtles (NMFS 2010; NMFS and FWS 1998a, 1998b, 1998c, 1998d; 2007, 2013; Seminoff et al. 2015), and other sources of information as cited herein.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. As a result, the 2019 regulations are once again in effect, and we are applying the 2019 regulations here. For purposes of this consultation, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

1.1 Consultation History

On March 25, 2020, the Navy convened a meeting with us to introduce their proposed action to construct and operate a dry dock and WPF in Pearl Harbor, and to initiate pre-consultation.

On March 31, 2020, Navy held a follow up meeting with us (including the ESA biologist, Sea Turtle Recovery Coordinator, and the Marine Turtle Biology and Assessment Program Lead) to discuss the discovery of turtle resting areas in the areas to be impacted by the proposed action. From this meeting, we determined that more information would be needed on turtle resting areas. The Navy continued the discussion with us in June and July.

On February 5, 2021, the Navy met with us to introduce the Navy's proposed action alternatives, the action area, potential stressors, and approach to analysis.

On May 6, 2021, the Navy met with us, and turtle biologists at the NMFS Pacific Islands Fisheries Science Center (PIFSC) to discuss a habitat model for green turtles in Pearl Harbor. We provided feedback to the Navy.

On July 20, 2021, the Navy convened a meeting with us to discuss approaches to effectively structure the Biological Assessment (BA) document. We provided suggestions to the Navy on how to structure the BA.

On September 28, 2021, the Navy held a meeting with us to introduce and discuss their approach to their acoustic effects analysis. We provided feedback to the Navy on possible approaches.

On October 13, 2021, the Navy held a meeting with us to share their early findings from their surveys of green turtle resting habitat use in their proposed construction areas in Pearl Harbor.

On November 30, 2021, the Navy requested our early, pre-consultation review of a "70% draft" BA by December 17, 2021.

On December 17, 2021, we provided comments and questions to the Navy on the draft BA. Our feedback included clarifying that we could not concur with Navy's preliminary determinations of NLAA from the proposed action to each of our listed species in the action area given the information provided in the BA. In a follow up conversation with the Navy, we recommended that the Navy pursue formal consultation given the likely adverse effects from some stressors to our ESA-listed species.

On February 22, 2022, the Navy convened a meeting with us to address our general comments on the draft BA and to share their updates and tentative timeline in finalizing the draft BA.

On May, 3, 2022, the Navy convened a meeting with us to discuss their updated underwater sound analysis. We provided the Navy feedback on the updated analysis.

On May 27, 2022, the Navy shared their final BA with us, and requested that we initiate formal consultation.

On June 21, 2022, within 30 days of receipt of the Navy's formal consultation request, we sent an email to the Navy, documenting the consultation request did not provide all of the information necessary to initiate formal consultation as described in the regulations governing interagency consultations (50 CFR §402.14(c)). We provided a list of questions and requested the Navy to provide more information.

On July 15, 2022, the Navy provided the additional information to us as per our request, including updated sections of the final BA.

On August 5, 2022, we provided the Navy a letter indicating that we had the necessary information to initiate formal consultation, with an initiation date of July 15, 2022 when the Navy provided us the requested additional information.

2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is the Navy constructing, operating, and maintaining a new dry dock on the JBPHH military base in Pearl Harbor (Figure 1). The new dry dock will be built at the PHNSY & IMF at JBPHH, and will replace an existing dry dock 3 (DD3) (Figure 2). It will be given a new dry dock number, dry dock 5 (DD5), because it will be in a location where a dry dock does not currently exist. The Navy will use DD5 for the maintenance and repair of submarines. The Navy additionally proposes to construct, operate, and maintain a new waterfront production facility (WPF) on land adjacent to the proposed new DD5. The WPF will house various facilities ("shops") and equipment used to support vessel service and maintenance operations.

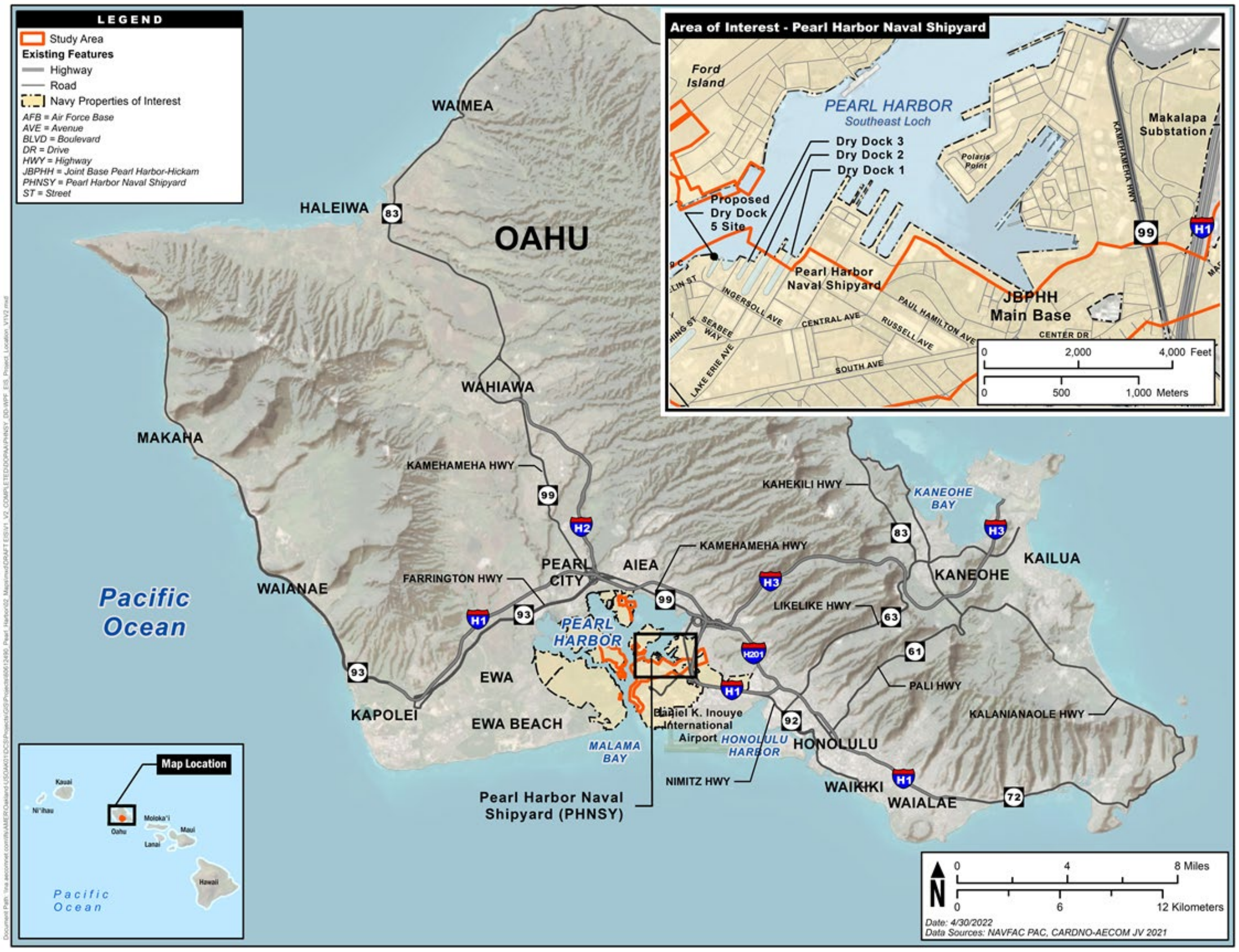

Figure 1 Location of proposed action in JBPHH, Pearl Harbor, Oahu, Hawaii (Source: NAVFAC 2022a).

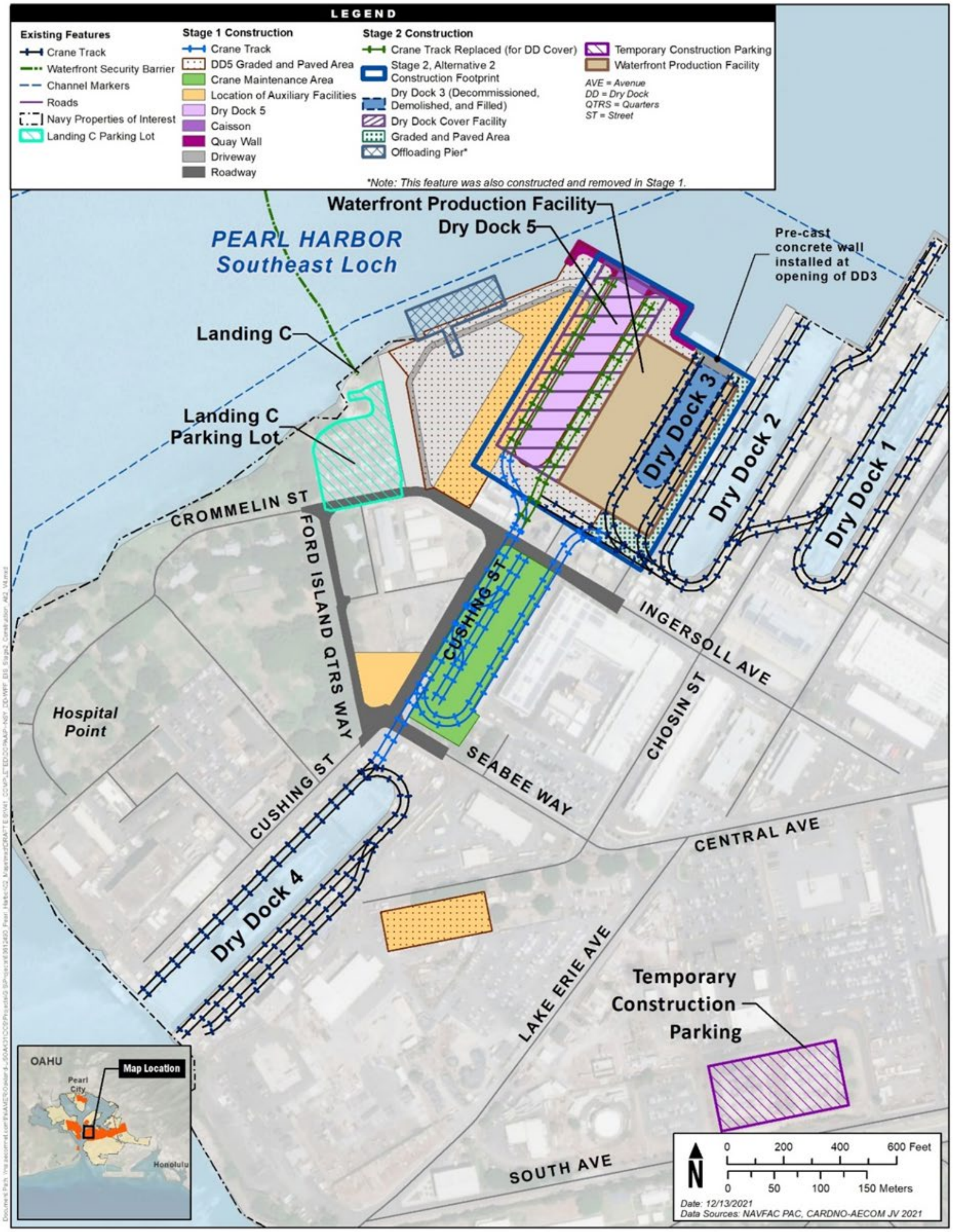

Figure 2. PHNSY & IMF where DD5 and WPF and some support elements will be built (Source: NAVFAC 2022a).

The Navy will build DD5 as a graving dry dock, a narrow basin that will be flooded to allow submarines to be floated in, then drained to allow the vessels to come to rest on a dry platform (Figure 3). The DD5 will be approximately 650 feet (ft) (198 meters [m]) long by 100 ft (30 m) wide, with a depth of 43.7 ft (13.3 m) below mean sea level (MSL). The Navy will equip DD5 with a caisson, a gate-like steel chamber that can be floated or sunk in the water to form a water-tight seal at the end of the basin to allow the dry dock to be emptied and flooded with seawater. The caisson will be approximately 118 ft by 57 ft by 22 feet (approximately 36 m by 17 m by 7 m).

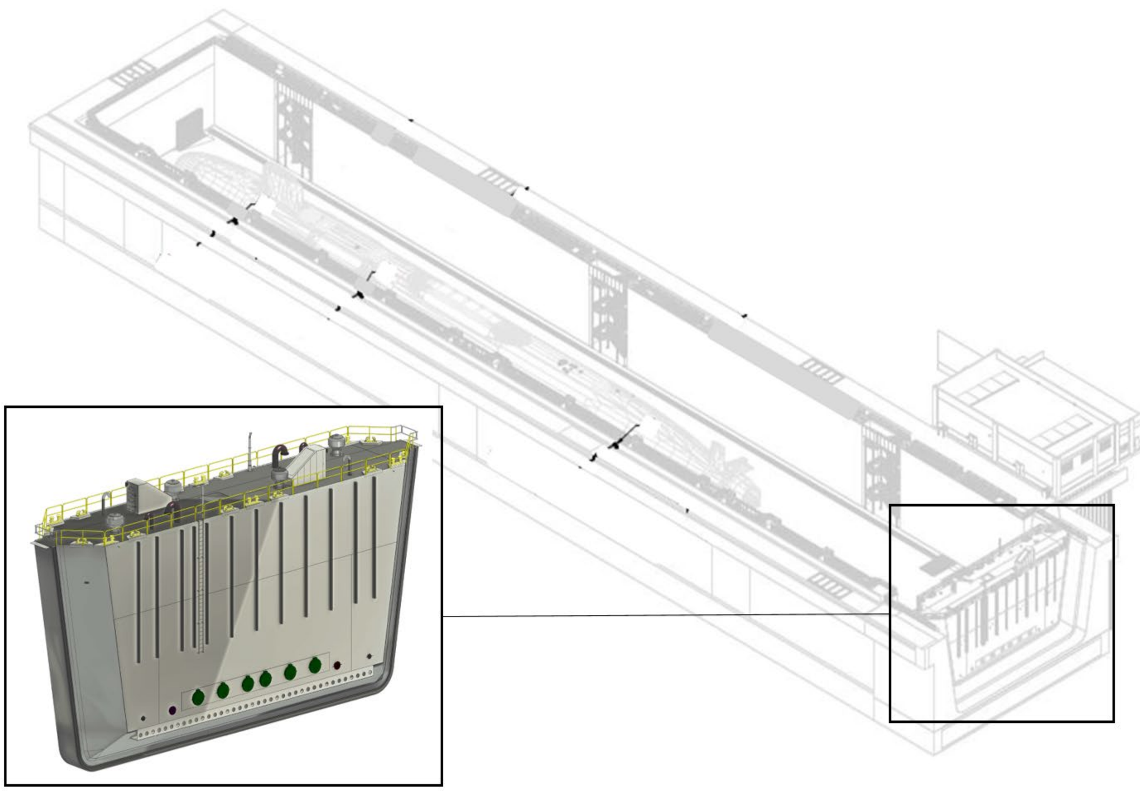

Figure 3. Isometric engineering drawing of DD5 (main schematic) and its caisson (inset map). (Source: NAVFAC 2022a).

The Navy will build the new WPF, an approximately 235,000-ft^2 (21,832-m^2) three-story facility, after DD5 is complete and operational (Figure 4). They will locate the WPF to the east of DD5 on top of the existing and operational dry dock 3 (DD3). To build the WPF, the Navy will decommission, dewater, and fill in DD3. Once constructed, the WPF will support maintenance of the vessels in both DD5 and the existing dry dock 2 (multiple support concept). It will reduce workers' transit time from their shipboard worksites to their home shops, to ultimately decrease turn-around time for vessel repair. The Navy will operate the WPF 24 hours per day, 7 days per week, and 365 days per year.

Figure 4. Visual simulation of WPF located adjacent to the dry dock (source: Navy Factsheet: https://www.pearlharbordrydockeis.org/api/files/6bb1ae0f-37a4-439e-9419-d498f7bdad3f).

To construct and operate DD5 and WPF, the Navy will construct, upgrade and/or operate various permanent auxiliary facilities at the same PHNSY & IMF site. These auxiliary facilities will include pump stations, a basin water treatment system (BWTS), storage tanks, parking lots, a crane maintenance area, and power and utility lines and access. The Navy will also construct temporary support facilities at the PHNSY & IMF site, and at two main support/laydown sites located outside the PHNSY & IMF at Waipio Peninsula (WP) and Pearl City Peninsula (PCP). In addition, the Navy will conduct activities related to the proposed action at Ford Island (FI), Iroquois Point (IP) and at various other locations in the Harbor (Upper Middle Loch, West Loch, East Loch and Foxtrot Pier). The support facilities will include temporary offloading piers, potential temporary parking lots associated with workforce transportation, temporary staging and laydown areas, and temporary barge mooring. With the exception of one open-ocean vessel trip to deliver the caisson to Pearl Harbor, the Navy will not require any other specifically-designated vessel deliveries for the construction materials or equipment.

The Navy will implement the proposed action in two stages: Stage 1 includes the necessary components and activities to construct and operate DD5; and Stage 2 includes construction and operation of the WPF. The Navy's construction-related activities related to the proposed action include: demolition of existing in-water and landside structures; dredging; in-water fill; pile driving; pile extraction; barge mooring and moorings installation; vessel activity; and construction of landside facilities.

We have listed the various Navy's "project areas" related to the proposed action in section 2.1 in this Opinion. We have provided the Navy's Project schedule in Section 2.2. We have summarized the activities related to DD5 and WPF construction in section 2.3. We have listed the Navy's proposed best management practices (BMPs) in Section 2.4, and Navy's proposed protected species monitoring plan in Section 2.5. The Navy provides detailed descriptions of the proposed action, project areas, schedule, activities and mitigation measures in their BA (NAVFAC 2022a).

2.1 Project Areas

Pearl Harbor is a large, coastal-plain estuary divided into three lochs joined together by a main entrance channel that connects the harbor with the open ocean. JBPHH occupies most land immediately surrounding Pearl Harbor and the harbor waters (Figure 1). The Navy will undertake activities needed to complete the proposed action primarily at one central construction site at JBPHH in Pearl Harbor (at PHNSY & IMF), and at two support/laydown sites (Waipio Peninsula (WP) and Pearl City Peninsula (PCP)). The Navy will also undertake activities in other areas in Pearl Harbor, and on the open ocean along a vessel transit route to Pearl Harbor. The "project areas" are listed below:

1. **PHNSY & IMF** is the central construction site in the harbor (Figure 5) where the Navy will build DD5 and WPF and some support elements for the DD and WPF, such as power and water lines that will extend to other parts of the base. The Navy will establish a temporary concrete batch plant at this site, a pier for unloading materials, and construction crew parking at this site.

2. **Waipio Peninsula (WP)** is the primary support/laydown site in the harbor (Figure 5) where the Navy will dewater and process dredged material; stage and store construction materials; fabricate concrete elements of DD5; and construct crew parking and a loading dock for materials and personnel going to the PHNSY & IMF construction site. The Navy will build the temporary structures, i.e. 2 piers and a boat ramp, at this site, and establish a mooring at this site.

3. **Pearl City Peninsula (PCP)** is the main secondary support/laydown site in the harbor (Figure 5) where the Navy will stage and store construction materials; install construction crew parking; and build a pier and a bulkhead for loading materials and personnel going to the PHNSY & IMF construction site.

4. **Ford Island (FI)** is a support site in the harbor (Figure 5) where the Navy will install construction crew parking, and stage and store construction materials. They will use the existing seaplane ramp to load construction personnel for ferrying back and forth to the PHNSY & IMF construction site. In addition, the Navy will install pile clusters at wharf S369 on the southeast side of FI to store barges during the in-water construction.

5. **Iroquois Point (IP)** is the site on the western shoreline of the main channel east of Ewa Beach (Figure 5), where the Navy will establish construction crew parking, and pick up construction personnel at the Explosive Ordnance Disposal (EOD) Small Boat Landing via ferry to transport them to the PHNSY & IMF construction site.

6. **Barge Mooring Sites** are locations in Upper Middle Loch (UML), West Loch, East Loch and at Foxtrot Pier in Pearl Harbor (Figure 6), where the Navy will moor/store up to 48 barges that they will use for construction throughout the project.

7. **Vessel Transit Paths** include the various vessel routes (a) within the harbor where various vessels will operate to support construction activities, and (b) the route outside Pearl Harbor on the open ocean (Figure 7) that the Navy will use to transport and deliver a caisson from Norfolk, Virginia (VA) to Pearl Harbor.

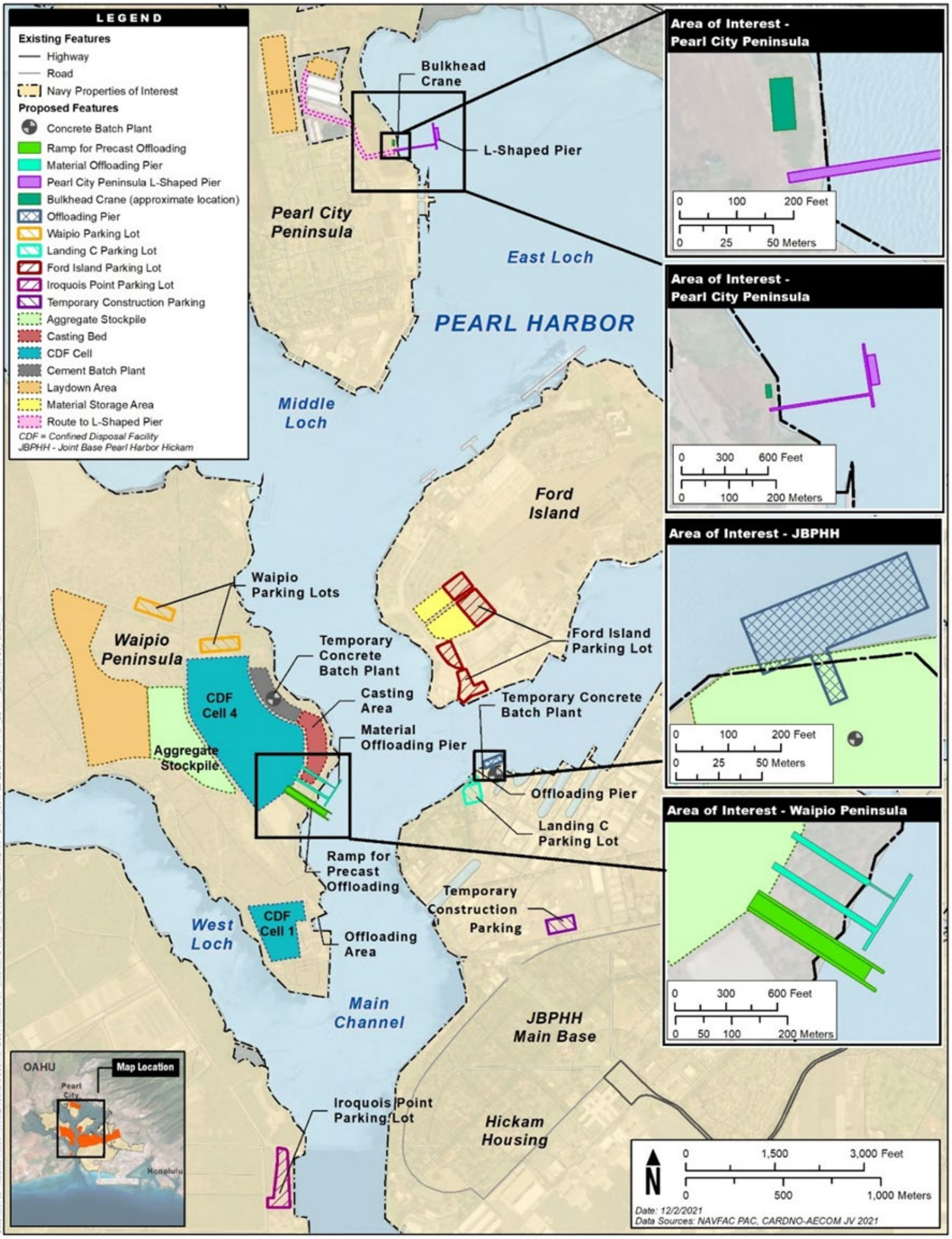

Figure 5. Map of the project areas in Pearl Harbor (Source: NAVFAC 2022a).

Figure 6. Existing and new barge mooring locations in Pearl Harbor, and areas of vessel transit amongst locations in the Harbor (Source: NAVFAC 2022a).

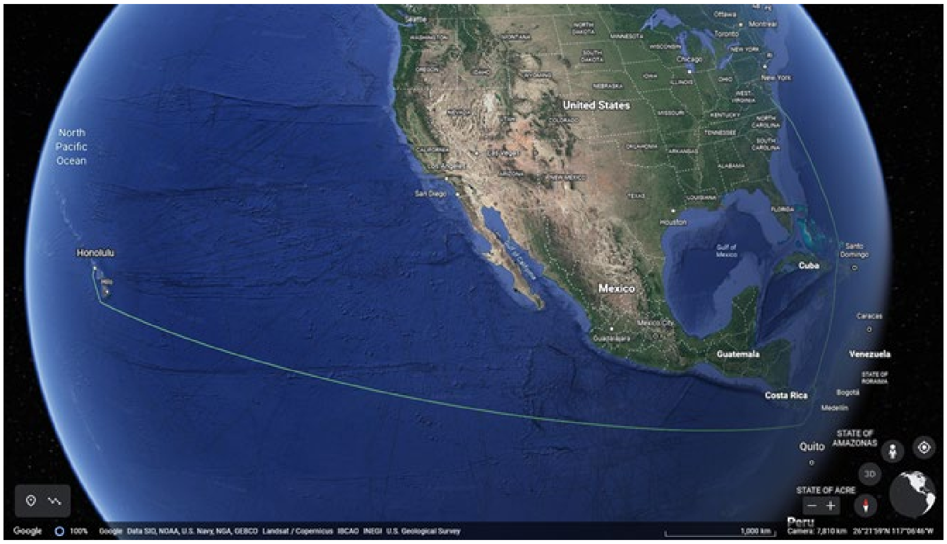

Figure 7. Vessel transit path from Norfolk, Virginia (VA) to Pearl Harbor for transport and delivery of the caisson (HI) (Source: NAVFAC 2022a).

2.2 Project Schedule

The Navy will implement the proposed action in two stages: Stage 1 involves the construction of DD5, and Stage 2 the construction of the WPF. The Navy's construction of DD5 will take approximately 65 months from start to finish, and their construction of the WPF approximately 42 months.

The Navy expects some overlap between the construction of DD5 and the WPF, although it is possible a gap in time could occur between the construction of the two facilities given Congressional approval for the funding if the WPF is not yet established, and will not be for several more years. Figures 8 and 9 illustrate the duration of Stage 1 DD5 construction, respectively Stage 2 WPF construction, and the main in-water activities associated with the construction of these two stages.

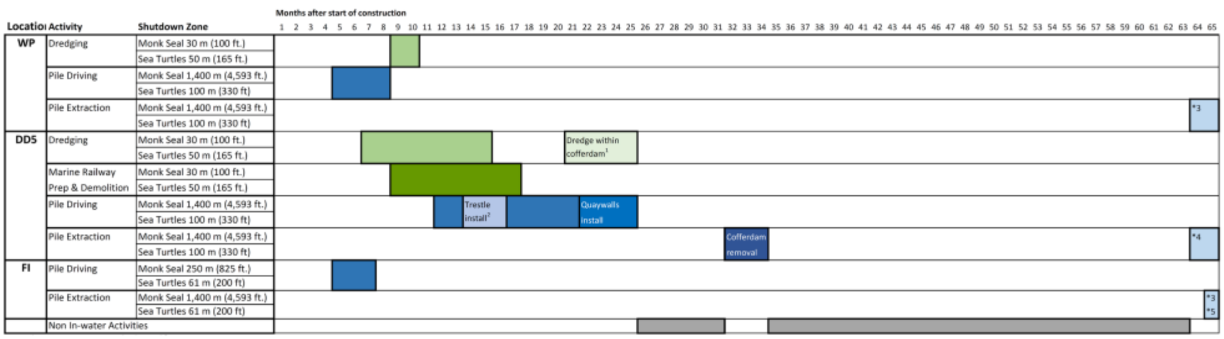

Figure 30. Notional schedule of in-water, dry dock construction activities.

Note: The PCP site is not expected to be used for constructing DD5. At time of writing, month 1 of the construction contract is anticipated to be April 2023. Assumptions of the durations and timing of construction is based on information in the 90% Construction Schedule from the design contractor.

[1] Dredging within the dry dock basin after the cofferdam is installed will not affect marine resources, because the dry dock will be an enclosed basin that is cut off.

[2] The piles from the trestles, which are temporary, will be removed after fill is in place, so marine resources will not be affected by sound or equipment.

[3] If the WSF construction can be started prior to the end of the 65 months of DD5 construction, temporary structures would not be removed between the DD5.

[4] Removal of the temporary pier on the rock revetment.

[5] The working plan is the concrete piles will be cut off at the mud line. Navy estimates that it would take 10 to 30 working days to cut the piles and remove them from the site. No vibratory hammer would be needed to remove piles. The source level of the sound from the saw is provided in Table 4 of Section 3 of the BA.

Figure 8. Notional schedule of in-water, dry dock construction activities (Source: NAVFAC 2022a).

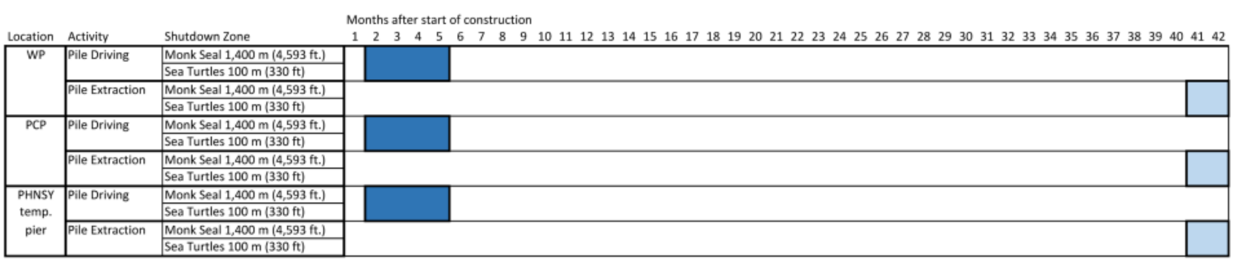

Figure 31. Notional schedule of in-water, WPF construction activities.

Note: If the WSF construction can be started prior to the end of the 65 months of DD5 construction, pile driving for the temporary structures at WP will be unnecessary. Also piles would not be removed between the DD5 construction and the WSF construction. It is not clear if the PCP will be needed to construct the WSF. That site will not be developed if the construction contractor does not require it for staging supplies for the WSF. Assumptions of the durations and timing of construction is based on information in the 90% Construction Schedule from the design contractor. The term Waterfront Production Facility (WPF) is changing to Waterfront Support Facility (WSF) in the Navy's vernacular, therefore the term will migrate over time to be exclusively WSF.

Figure 9. Notional schedule of in-water, WPF construction activities (Source: NAVFAC 2022a).

In-water sounds from Navy's pile driving, dredging, and drilling will potentially occur simultaneously within a project activity area (e.g. different sites within the PHNSY & IMF), and between project activity areas (PHNSY & IMF, WP, PCP and FI). The Navy expects the support sites at WP and PCP to be constructed before much of the primary work is accomplished at DD5, especially the pile driving, since the structures that will be made are necessary to move material and supplies to the construction site. Even though that is the case, the Navy will start some preparation of the DD5 site immediately, which can include demolition of buildings and dredging. It is possible that some of the Navy's construction activities will occur simultaneously, such as pile driving at WP and dredging at PHNSY & IMF.

2.3 Activities

The Navy will implement the proposed action in two stages. Stage 1 includes the necessary components and activities to construct and operate DD5. Stage 2 includes the necessary components and activities to construct and operate WPF.

2.3.1 Stage 1: DD5 Construction and Operation

As part of Stage 1 construction, the Navy will (a) build DD5, (b) construct various auxiliary permanent structures and facilities, and (c) install various temporary structures needed for constructing DD5 (Figure 10), then remove these once DD5 construction is completed. The Navy activities related to the construction, operation, and maintenance of DD5, as relevant to potential marine resource impacts, include:

- Demolition of Existing Structures
- Dredging
- In-Water Fill
- Pile Driving
- Pile Extraction
- Utilities Installation
- Stormwater Management
- Wastewater management
- DD5 Flooding & Dewatering
- Maintenance Dredging and Repair/Maintenance

We have summarized the activities per project area below. Detailed descriptions of these activities are provided by the Navy in their BA (NAVFAC 2022a).

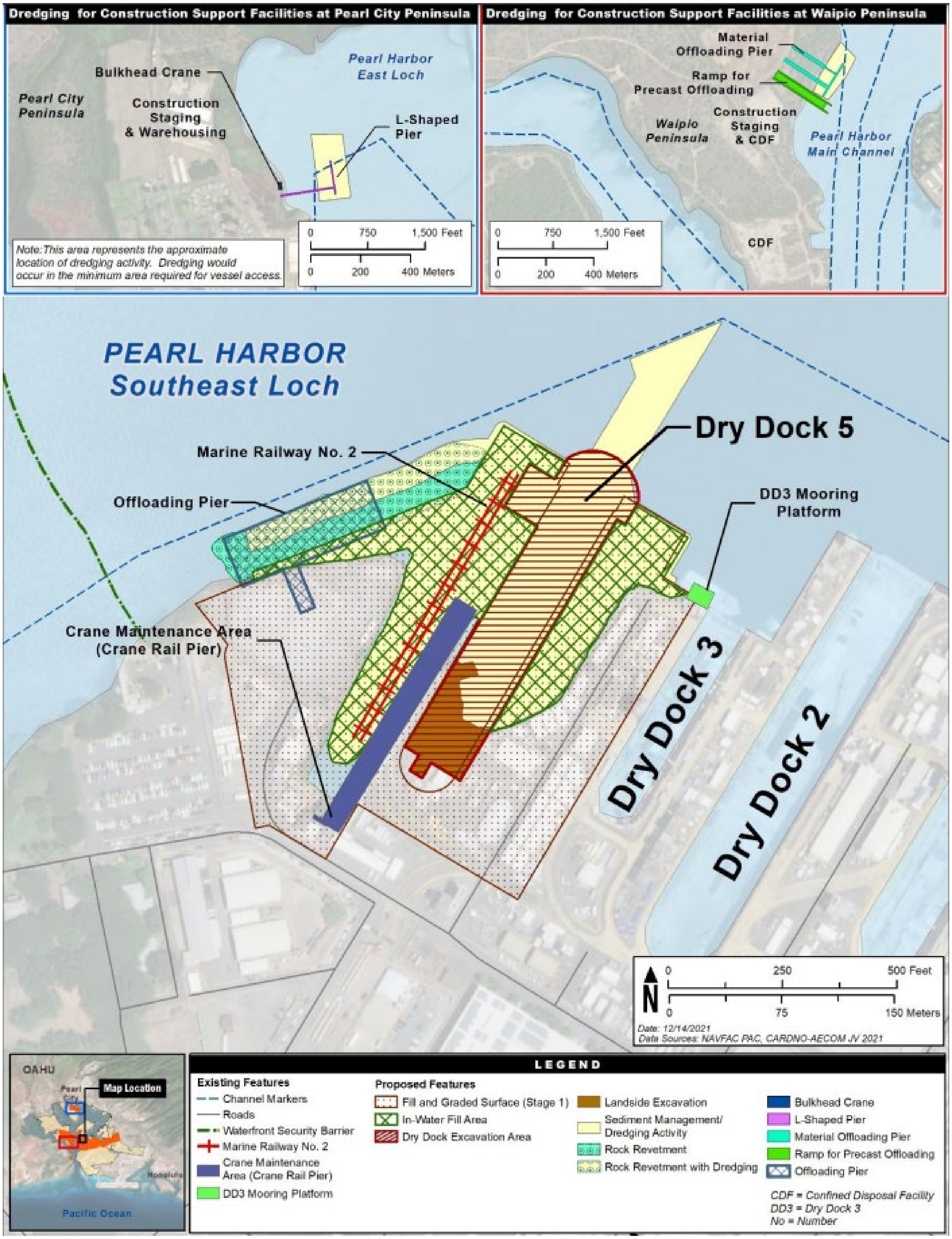

Figure 10. The location of these primary construction actions for Stage 1 DD5 construction (NAVFAC 2022b).

2.3.1.1 PHNSY & IMF

The Navy will use the PHNSY & IMF as its central location for activities related to the proposed action. It is where the Navy will build DD5 and WPF, and where other auxiliary permanent structures and temporary structures will be constructed.

2.3.1.1.1 Demolition of Existing Structures

Prior to constructing DD5, the Navy will demolish existing structures in the construction footprint. They will remove an existing underwater marine railway; a crane maintenance pier; a small mooring platform and pier; and a mooring dolphin and walkway (Figure 10). Some of the structures are partially buried in soft surface sediment with the potential for munitions and explosives of concern (MEC).

The Navy will implement BMPs to reduce demolition impacts as listed in Section 2.4 (at a minimum, BMPs A, B, C, N, O, Q, and R will reduce impacts from demolition of the marine railway).

2.3.1.1.2 Dredging

After demolishing structures as described above, the Navy will dredge (a) the seafloor in the DD5 footprint to create new depth for DD5, (b) in an approximately 100 ft (30.5 m) wide by 300 ft (91.4 m) long area fronting the DD5 to provide access for vessels to DD5; and (c) the areas planned for fill that require removal of soft material or debris to meet geotechnical requirements. The total dredge area is depicted in yellow in Figure 10, and estimated by the Navy to be approximately 7.7 acres in size.

In the dredge footprint, the Navy will dredge two types of sediment: (1) soft unconsolidated surface sediments that blanket the site and have the potential to contain MEC; and (2) native sediments underlying the soft sediment layer that do not have the potential to contain MEC. The Navy will remove soft sediment first in pile installation footprints; areas to be deepened; areas where the soft layer is too thick for efficient soil improvement needs; the footprint of the marine railway to facilitate demolition; and at the toe of a rock revetment. The Navy will then dredge the underlying native material down to design depth.

Table 1 provides the Navy estimated dredging quantities including area. The Navy will establish a non-essential personnel safety zone of approximately 372 ft (113 m) to keep people safe and clear in the unlikely event of potential MEC detonation (NAVFAC PAC 2021a). To note is that the majority of the dredge footprint at PHNSY & IMF is within one of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) dredge boundaries for the Pearl Harbor Sediments Site (NAVAC 2020). The Navy will undertake the appropriate remedial activities to manage the CERCLA sediment within the footprint for DD5 prior to commencing dredging for this proposed action.

Table 1. Dredging area and volume for Dry Dock 5 construction site (source: NAVFAC 2022a).

Dredging Activity	Area (SF[SM])	Volume (CY[CM])	Average Cut Face (SF[SM])
Soft Unconsolidated Surface Sediment Removal			
DD5	239,300 (22,204)	78,775 (60,228)	9.0 (2.7)
2-foot overdredge allowance	Within DD5 footprint (above)	20,470 (15,650)	2.0 (0.6)
Potential sediment removal (shoreline east of DD5)	18,000 (1,672)	2,300 (1,758)	3.0 (0.9)
Potential sediment removal (Marine Railway No. 2)	84,200 (7,82)	10,810 (8,265)	3.0 (0.9)
TOTAL	341,200 (31,699)	112,355 (85,902)	N/A
Landside Excavation			
Landside excavation of southern portion of DD5, removal to 0 foot MSL	24,267 (2,254q)	8,050 (6,155)	9.0 (2.7)
TOTAL	24,267 (2,254q)	8,050 (6,155)	N/A
Deep Native Sediment			
Dredge to 65.5 feet (20 meters) below MSL	105,000 (9,755)	138,575 (105,948)	36.0 (11.0)
2-foot overdredge allowance	Within deep native sediment dredging footprint (above)	8,970 (6,858)	2.0 (0.6)
TOTAL	105,000 (9,755)	147,545 (112,806)	N/A
TOTAL (DD5 AREA)[(1)]	335,271 (31,147)	259,900 (198,708)	N/A

Notes:(1) Excludes landside excavation. (2) Total dredge footprint will not equal sum of dredge areas provided due to overlap of dredging for soft sediment and native material, as native material is located under soft sediment. (3) This volume assumes that no dredging has occurred within the CERCLA boundary prior to construction of DD5.

Key: CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; CM = cubic meter; CY = cubic yard; DD5 = Dry Dock 5; FT = foot; M = meter; MEC = munitions and explosives of concern; MSL = mean sea level; N/A = not applicable; SF = square feet; SM = square meter.

The Navy will reuse excavated material on site as much as possible. Soft sediment/MEC has prescriptive requirements that the Navy must adhere to; they will process all soft sediment with potential for MEC at the CDF prior to re-use or disposal.

The Navy estimates that the dredging and excavation activity at PHNSY & IMF will occur for up to 24 hours per day, 7 days per week, for approximately 15 months. The period of MEC dredging will be an exception to that schedule and occur continuously at night only. There could be periods of non-dredge activity during the 15 months.

The equipment that the Navy will likely use for dredging includes: Clamshell dredge; excavator; backhoe dredge; offloader/conveyor (likely mechanical, but could potentially be hydraulic if return water can be managed without impacting adjacent stockpiles or interfering with material processing and dewatering); scow(s); flat barge(s); tug(s); survey vessel(s); crew boat(s); and support equipment. Prior to dredging the Navy (contractor) will likely "rake" the dredge areas and remove debris encountered by swinging the bucket from side-to-side to sweep and level-off the target area, and then determine if there are any objects in the targeted area.

The Navy will implement BMPs as listed in Section 2.5 to reduce dredging impacts (e.g. BMPs A, B, C, F, H, I, N, O, P, and R).

2.3.1.1.3 In-Water Fill

The Navy will undertake multiple in-water fill activities in the DD5 construction footprint, which include pouring concrete to build the DD5 floor and walls; installing a temporary cofferdam around the DD5 to aid construction; installing a retaining wall and quay walls located east and west of the DD5 caisson; creating new dry land around the DD5 walls and peninsula west of DD5 to support auxiliary facilities for the DD5; and constructing a rock revetment along the western flank of DD5 to protect the created dry land. The fill area is shown in Figure 10 (green cross-hatched), and Figure 11. The total area of permanent in-water fill is estimated by the Navy to be approximately 9.6 acres (0.04 km^2).

Figure 11. Locations of fill activity within the DD5 footprint (Source: NAVFAC 2022a).

The Navy will construct the DD5 floor using both tremie concrete, i.e., concrete that is poured underwater, and precast sections. They will place tremie concrete using a gravity-fed hopper through a vertical pipe that extends from above the water surface to the underwater floor, or pour it through a hose to a pump placed above water. The Navy will place precast concrete sections using a construction crane and flotation tanks to control the buoyancy of the precast units.

The Navy will install a temporary (limited to the period of construction) cofferdam to allow dewatering of the dry dock basin and control spill over to the marine environment. They will install it after completing dredging, and after floating-in and setting in place all the precast concrete dry dock monoliths. The cofferdam will consist of a cantilevered north wall. A shoring wall consisting of braced east and west walls and a tremie concrete cutoff plug will complete the enclosure to allow dewatering. The Navy will construct the cofferdam by first driving a king pile combi-wall into the ground along the north side of the dry dock, then tying it into the shoring wall on the east and west sides, thereafter plugging the bottom of the cofferdam by placing tremie concrete at the floor. After the tremie concrete cutoff plug has reached its specified design strength, the Navy will dewater the DD5 work area. Once the DD5 dry dock basin enclosed by the cofferdam is dewatered, the Navy will construct the DD5 walls, in the dry, over the course of about a year.

The Navy will use only marine grade concrete in-water, avoiding lime, chemicals or other toxic or harmful materials. They will use only concrete grout, cement, and sealant that is non-toxic and non-hazardous to marine organisms. The Navy may build up to two temporary concrete batch plants on JBPHH, one at the PHNSY & IMF construction site west of DD5 and one on WP. They will maintain the plants in-place for as long as they need concrete, likely several years.

The Navy will create new dry land (< 9 acres in size) around the DD5 walls and the peninsula west of DD5 using structural fill. The land will be filled to a grade elevation of 11 ft (3.4 m) above MSL to account for flooding and long-term sea level rise. The Navy will bring fill to the site by barge, and store it at the CDF on WP.

The Navy will build a rock revetment (approximately 2.5 acres in size) along the western flank of DD5 to protect the newly created dry land, likely using one of two basic designs: a monolithic dike, or a tiered dike system. The Navy will utilize quarry rock as the core stone, with armor stone placed on top and on the outside for both options. The inner core and armor stone will collectively measure approximately 95,000 yd^3 (76,632 m^3) and occupy 115,887 ft^2 (10,766 m^2). The Navy will likely source the armor stone from the U.S. mainland, and quarry rock from the Hawaiian Islands. The Navy will use existing routine commercial methods to transport all supplies or deliveries, i.e. they will not require additional vessel trips to transport construction materials above what would occur without the proposed action. These vessel trips will occur with or without the proposed action. Therefore, they are not a consequence of the proposed action, and will not be discussed further.

The Navy will implement BMPs as listed in Section 2.4 to reduce impacts from in-water fill (e.g. BMPs A, B, C, F, H, I, J, K, L, M, N, O, P, and R) .

2.3.1.1.4 Pile Driving

The Navy will install a total of 2727 piles at the DD5 construction site to build the DD5, the adjacent rock revetment and a temporary material offloading pier. They will drive 75 36-inch steel pipe piles; 2157 42x18-inch steel H-piles/king piles; 58 18x18-inch steel H-piles; 320 24-

inch steel pipe piles; and 117 20-inch concrete piles. The Navy will use vibratory, impact, and/or drilling pile driving methods. The Navy will install a material offloading pier (an open, pile-supported pier that will allow water circulation beneath) after and over construction of the new rock revetment. Table 2 summarizes the types and sizes of piles to be driven, the method of pile driving, average strikes per pile needed, the number of piles a day, and other details.

Table 2. Summary of pile driving activity at DD5 (Source: NAVFAC 2022a).

Structure	Method of Pile Driving	# of Piles	Pile Type	Pile Size (Diam.)	Average Pile Strikes/ Pile	Pile Driving Minutes/ Pile (Vibratory or Drilling)	Average # of Piles Installed /Day	Total # of Pile Driving Days	Average # of Spreads (1)
Offloading Pier	Vibratory	75	Steel Pipe	36-inch	N/A	72	3	25	1
	Impact				1,800	N/A			
Quay Wall	Vibratory	653	Steel H-piles/ King Piles	42 × 18-inch	N/A	162	9	59	3
	Impact				5,000	N/A			
East and West Walls	Pre-Drilling	117	Concrete	20-inch	N/A	30	6	14	2
	Impact				750	N/A			
Quay Wall	Vibratory	182	Steel H-piles/	42×18-inch	N/A	162	9	51	2
Deadmen	Impact		King Piles		4,900	N/A			
Dry Dock Shoring Walls	Vibratory	395	Steel H-piles/ King Piles	42 × 18-inch	N/A	162	6	53	2
West Wall	Impact				4,800	N/A			
East Wall	Vibratory	462	Steel H-piles/	42 × 18-inch	N/A	132	6	76	2

Structure	Method of Pile Driving	# of Piles	Pile Type	Pile Size (Diam.)	Average Pile Strikes/ Pile	Pile Driving Minutes/ Pile (Vibratory or Drilling)	Average # of Piles Installed /Day	Total # of Pile Driving Days	Average # of Spreads (1)
	Impact		King Piles		3,600	N/A			
North Wall	Vibratory	108	Steel H-piles/ King Piles	42 × 18-inch	N/A	132	6	32	2
	Impact				3,600	N/A			
Anchor Wall East	Vibratory	76	Steel H-piles/ King Piles	42 × 18-inch	N/A	60	8	5	1
	Impact				1,500	N/A			
Anchor Wall West	Vibratory	141	Steel H-piles/ King Piles	42 × 18-inch	N/A	60	8	5	1
	Impact				1,500	N/A			
Trestle (East)	Vibratory	145	Steel Pipe	24-inch	N/A	132	6	48	2
	Impact				3,600	N/A			
Trestle (West)	Vibratory	175	Steel Pipe	24-inch	N/A	162	6	58	2
	Impact				4,800	N/A			
Pump House Walls	Vibratory	140	Steel H-piles/ King Piles	42 × 18-inch	N/A	168	6	28	2

Structure	Method of Pile Driving	# of Piles	Pile Type	Pile Size (Diam.)	Average Pile Strikes/ Pile	Pile Driving Minutes/ Pile (Vibratory or Drilling)	Average # of Piles Installed /Day	Total # of Pile Driving Days	Average # of Spreads (1)
	Impact				5,800	N/A			
Pumphouse Floor Slab	Vibratory	58	Steel H-pile	18 x 18-inch	N/A	168	6	22	2
Tension Piles	Impact				5,800	N/A			

Notes: All pile quantities include a 15 percent increase. (1) A spread is the number of teams/rigs/barges working concurrently. *Average # of piles is an estimated value of a likely scenario (TBD during construction). This number is not used to calculate the total number of piles. Method of pile driving note: vibratory procedures precedes impact procedures.

Key: DD5 = Dry Dock 5; N/A = not applicable.

The Navy will start pile driving using vibratory pile driving, and finish with impact pile driving, and will use pre-drilling in certain cases. The Navy will pile drive using pile drivers operating from land, barges, or on-water platforms.

The Navy may operate more than one pile-driving rig at the same site. They will operate 7 days per week, during daylight hours, for approximately 14 months (but may extend longer if unusual driving conditions are encountered).

The Navy will implement various measures including monitoring and BMPs as listed in section 2.4 to reduce impacts from pile driving (e.g. BMPs A, B, C, D, E, H, I, J, K, L, M, N, O, P, and R).

2.3.1.1.5 Pile Extraction

Once the Navy has completed DD5 construction, i.e. towards the end of Stage 1 construction, they will remove the temporary construction support facilities (Table 3). This will involve the Navy extracting the piles supporting the temporary offloading piers that they installed at the beginning of the period, using vibratory methods.

The Navy will operate 7 days per week, during daylight hours, for up to approximately 25 days. The Navy will also extract a portion of piles used to provide structural stability during construction of DD5. They will operate 7 days per week, during daylight hours, for 107 days.

Table 3. Pile extraction and demolition parameters at PHNSY & IMF.

Structure	# of Piles	Pile Type	Pile Size (Diameter)	Pile Extraction Minutes/day	# of Piles Extracted/Day	Total # of Demo Days
Access Trestles	320	Steel Pipe	24-inch	160	3	107
North Wall	163	Steel H-piles/ King Piles	42 × 18-inch	160	3	55
Offloading Pier	75	Steel pipe	36-inch	160	3	25

The Navy will implement BMPs as listed in Section 2.4 to reduce impacts from pile extraction (e.g. BMPs A, B, C, H, I, J, K, L, M, N, O, P, and R).

2.3.1.1.6 Utilities Installation

To serve the operational demands of DD5, including submarines docked at DD5, the Navy will install new electrical and mechanical utilities on land. Most utilities will connect to existing utilities in areas adjacent to DD5.

The mechanical utilities that the Navy will install include the below systems:

1. Portable water system
2. Saltwater and auxiliary seawater closed loop system
3. Freshwater system
4. Compressed air system
5. Chilled water loop system
6. Dewatering and drainage system
7. Sanitary wastewater system and industrial wastewater system
8. Waste disposal system
9. Caisson flooding system

The Navy will tie a potable water system into the PHNSY & IMF existing potable water system and a planned future expansion in the vicinity of DD5. The Navy will use a saltwater system interfaced with an existing saltwater supply to provide dockside (outside of vessel) fire protection and back-up flushing/cooling for the submarines docked at DD5. They will use a freshwater looped system to provide additional fire suppression support around DD5, fed from a fire water pump house and freshwater storage tank located adjacent to DD5. The Navy will provide low- and high-pressure compressed air to DD5 for dockside use and vessel maintenance: low-pressure air from a new Low Pressure Air Plant connected into an existing low-pressure air distribution system; and high-pressure air from a new high-pressure a standalone system air plant at the location of auxiliary facilities at DD5. Nitrogen gas will be provided to DD5 via portable bottles. The Navy will provide freshwater to vessels in the DD5 for cooling their auxiliary saltwater systems via a chilled water closed-loop design where water will not be discharged.

We summarize the Navy proposed management of stormwater and wastewater, also caisson flooding systems in separate sections below.

The Navy will implement BMPs as listed in Section 2.4 to reduce impacts from installation of utilities (e.g. BMPs A, B, C, F, H, I, J, K, L, M, N, O, P, and R) .

2.3.1.1.7 Stormwater Management

The Navy expects construction of DD5 (and the WPF) to result in increased peak stormwater runoff due to the increased impervious area from new pavement and increased efficiency of stormwater drainage (e.g., number of storm drain inlets and grading).

To manage stormwater during construction, the Navy will implement erosion and sediment control measures in areas where they are required, and construction BMPs designed to treat runoff from the construction areas. They will implement additional site-specific BMPs as identified in (a) the Stormwater Pollution Prevention Plan, and (b) their construction water quality permits. They will implement containment measures, including secondary containment and siting outside of known flood zones in areas with the potential to store hazardous materials.

To manage stormwater post-construction, the Navy will evaluate and implement a new stormwater collection system in accordance with the City and County of Honolulu Storm Drainage Standards (August 2017). They will capture the increase in runoff and allow it to infiltrate to the maximum extent practicable through the use of retention basins, gravel, and infiltration trenches. They will intercept and collect stormwater flow via newly-constructed, underground stormwater system trench drains and surface inlets. The Navy will establish new drainage management areas, each with separate discharge outlets to the harbor. The Navy will use these stormwater system treatment devices to mitigate impact of outfall flow into the harbor. The new stormwater system will also relieve the existing stormwater systems of DD3 and DD4 because the crane maintenance area will be regraded to flow to the new outfalls. The Navy will conduct periodic maintenance of the infiltration basins to ensure working effectiveness, including typical cutting of grass and semi-annual cleaning of the basin to remove excess dirt and debris.

The Navy will convey stormwater located outside of DD5 that does not come in contact with industrial equipment to outfalls into the harbor consistent with the way stormwater is managed currently at PHNSY & IMF (in accordance with the City and County of Honolulu Storm Drainage Standards (August 2017) and Stormwater BMP Guide for New and Redevelopment (July 2017) requirements).

2.3.1.1.8 Wastewater management

The Navy will collect normal seepage, storm, and process water (contact stormwater, groundwater seepage, industrial wastewater and submarine cooling water) that accumulates inside of DD5 in floor drains and convey this to the pump well where drainage pumps will discharge this to the Basin Water Treatment System (BWTS) for treatment. They will discharge the disposal from the BWTS either to the sanitary sewer, or to the existing Navy WWTP ocean outfall (Figure 12).

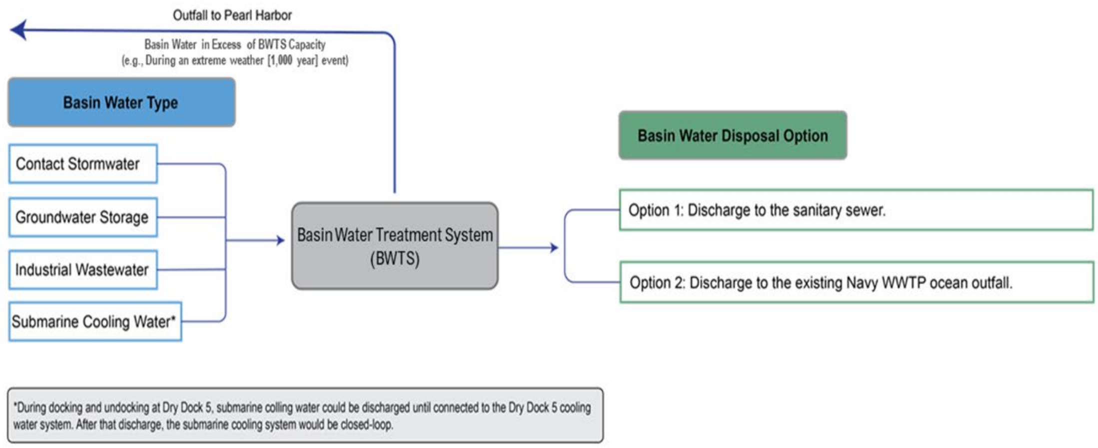

Figure 12. Basin Water Treatment System Block Flow Diagram (Source: NAVFAC 2022a).

The Navy has designed the size of the trench drain conveyance for a 100-year, 24-hour storm event. The Navy will treat the wastewater collected in the BWTS storage tank using oil/water separators for reduction of oil and grease, and disc filtration for reduction of total suspended solids (TSS) prior to discharging this to the sanitary sewer. The Navy will design the BWTS to meet the sanitary sewer system discharge limit requirements in COMNAVREG Hawaii Instruction 11345.2D. The BWTS will have a maximum (peak) treatment flow capacity of 464,000 gallons per day. The holding capacity of the BWTS storage systems is 474,000 gallons, which consists of the wet well (124,000 gallons) and two storage tanks at 175,000 gallons each (total of 350,000 gallons). The Navy will minimize TSS and contaminants from being discharged during dewatering from inside the dry dock, by using industry standard BMPs.

2.3.1.1.9 DD5 Flooding & Dewatering

Once DD5 is operational, the Navy will bring submarines into DD5 for repairs and maintenance. This will involve the Navy flooding the dry dock basin to allow submarines to be floated in, placing the caisson at the entrance to seal the dry dock, and then draining the basin to allow the vessels to come to rest on a dry basin platform.

The Navy will dewater and drain DD5 by lifting and discharging saltwater from DD5 into a gravity-based discharge pipe that passes through the rock revetment into the Harbor. They will do this using dewatering pumps located in a new one-story dewatering pump house located adjacent to the DD5. Sand traps between the drainage trenches in the dry dock floor and the drainage grates will collect debris and fine material prior to the water entering the drainage tunnel. The Navy will only pump water to the harbor that flooded the dry dock when a submarine entered the dry dock. The Navy will process any water that collects in the dry dock after it is dewatered through the existing Navy WWTP as described above.

When the vessel is ready to leave DD5, the Navy will flood the dry dock basin up to a superflood elevation of 2.34 ft (0.71 m) above MSL using pumps and flood-through tubes within the caisson. The Navy's preferences for velocity and flood time are equal to or less than 135 minutes. Once the dry dock basin is fully flooded, the Navy will move the caisson, moor it along the quay wall adjacent to the DD5 entrance, and transport the vessel out of DD5.

The Navy will maintain the DD5 operable 24 hours per day, 365 days per year, and predict undertaking approximately 2-3 flooding/dewatering events per year. The design life of DD5 will be approximately 100 years, defined as the time until major repairs are required. The design life for the caisson will be approximately 50 years.

The Navy will implement measures to reduce impacts from dry dock flooding and dewatering, as listed in Section 2.4 (BMPs P and S).

2.3.1.1.10 DD5 Maintenance and Repairs

During operations of DD5, the Navy will undertake maintenance dredging in front of DD5 to ensure adequate draft is maintained. They will do this on a 10- to 20 year cycle, depending on the local stream inflow, sediment load, and berth use.

The Navy will also undertake periodic cleaning and disposal of sediment deposited in the DD5 sump, drainage tunnels, filters, and sand trap, and will conduct routine inspection and maintenance activities on the steel caisson.

The Navy will schedule significant maintenance overhauls on DD5 on a 10- to 20-year cycle. They will reapply corrosion protection coatings as needed to the surfaces of the caisson and quay wall exposed to seawater, and replace the aluminum anodes that comprise the caisson cathodic protection system.

The Navy will implement BMPs to reduce impacts from maintenance and repair activities, as listed in Section 2.4 (BMPs, P and S).

2.3.1.2 Waipio Peninsula (WP)

The Navy will use WP as a key location for construction support facilities, i.e. for dewatering and processing dredged material, staging and storing construction materials, fabricating concrete elements of DD5, construction crew parking, and a loading dock for materials and personnel going to the PHNSY & IMF construction site (Figure 13). The Navy will build "temporary" structures, such as piers and a boat ramp on the Main Channel shoreline of the peninsula, and remove these once they have completed DD5 construction. The total in-water area that the Navy will permanently impact as a result of the installation and removal of construction support facilities at the site will be approximately 0.6 acres (0.002 km^2).

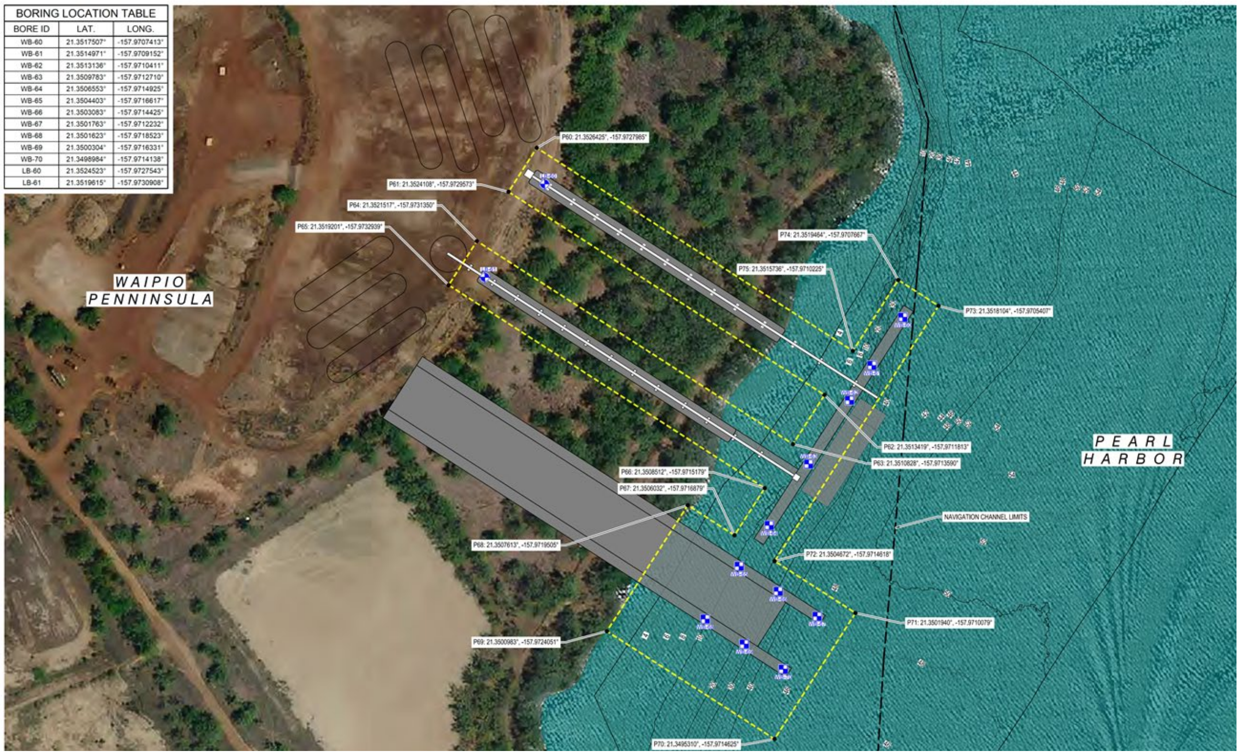

Figure 13. Conceptual design of temporary ramp and offloading pier at WP; the yellow border indicates the limit within which boring samples were collected, and the numbers in blue & white boxes indicate locations of boring samples collected.

2.3.1.2.1 In-Water Fill

The Navy will install a temporary ramp for precast offloading. The size of the ramp is estimated by the Navy to be approximately 75,527 ft^2 (7,017 m^2), i.e. 1.7 acres in size. The Navy's site preparation will involve vegetation clearing in land-side areas, dredging, installation of a gravel base and concrete runway for a mobile crane, and stationing of a barge for concrete casting.

2.3.1.2.2 Pile Driving

The Navy will install a total of 377 piles at WP. They will drive 168 36-inch Steel Pipe piles to install a temporary offloading pier that is approximately 61,911 ft^2 (5,752 m^2) in size. The Navy will additionally drive 209 36-inch Steel Pipe piles to support two temporary finger piers located at the end of the precast offloading ramp of about 34,094 ft^2 (3167 m^2) size.

The Navy will start pile driving using vibratory pile driving, and finish with impact pile driving, unless otherwise noted, and will use pre-drilling in certain cases. The Navy will use multiple barges with installation equipment to drive the piles. They will operate 7 days per week, during daylight hours, for 3-4 months. Table 4 summarizes pile driving details including the types and sizes of piles that the Navy will drive, the method of pile driving, average strikes/pile needed, and the number of piles a day.

Table 4. Summary of pile driving activity at WP (Source NAVFAC 2022a).

Structure	**Method of Pile Driving**	**# of Piles**	**Pile Type**	**Pile Size (Diam.)**	**Average Pile Strikes/ Pile**	**Pile Driving Minute/ Pile (Vibr. or Drilling)**	**Average # of Piles Driven/ Day**	**Total # of Pile Driving Days**	**Average # of Spreads (1)**
Material Offloading	Vibratory	168	Steel Pipe	36-inch	N/A	72	6	54	2
	Impact				1,800	N/A			
Finger Piers	Vibratory	209	Steel Pipe	36-inch	N/A	72	6	67	2
	Impact				1,800	N/A			

2.3.1.2.3 Pile Extraction

Following completion of DD5 construction, the Navy will remove the offloading pier and finger piers, and will extract all 377 installed piles using vibratory methods (Table 5). The Navy will operate 7 days per week, during daylight hours, for a duration of 70 days.

Table 5. Pile extraction and demolition parameters at WP (Source NAVFAC 2022a).

Structure	**# of Piles**	**Pile Type**	**Pile Size (Diameter)**	**Pile Extraction Minutes/day**	**# of Piles Extracted/Day**	**Total # of Demo Days**
Material Offloading Pier	168	Steel pipe	36-inch	160	3	56
Finger Piers	209	Steel pipe	36-inch	160	3	70

2.3.1.2.4 Dredging

Prior to installing the ramp, offloading pier, and finger piers, the Navy will dredge the construction footprints beneath these structures, and may also dredge areas adjacent to these footprints to provide adequate draft for vessels to access the facilities. They will dredge approximately 212,900 SF (19,800 SM) of area, i.e. 4.9 acres, to a cut depth of approximately 15,000 ft (11,468 m), involving a volume of 15,000 CY (11,500 m^3).

The Navy will use dredging methods similar to those described for PHNSY & IMF in section 2.3.1.1. The Navy expects a moderate to high potential for MEC in this area. They will dredge 24 hours per day, 7 days per week for a duration of approximately 2 months.

2.3.1.2.5 Dredge Spoils Handling

The Navy will offload the dredge spoils from all dredging at either an existing offloading site at WP or at the newly constructed temporary offloading pier. The Navy will dewater, screen and process the dredge spoils for contaminants and MEC at CDF Cell #1 and/or Cell #4 at WP. The Navy will segregate materials at the CDF to prevent mixing, and will process and store CERCLA material and non-CERCLA materials separately. They will dispose of CERCLA sediment at the PVT Integrated Solid Waste Management Facility Landfill on the island once all MEC have been removed.

The Navy is considering testing and determining the ocean suitability of the material dredged as future reuse and/or disposal methods will depend upon the sediment characterization. The Navy may place all material found to be suitable for unconfined disposal at the US Environmental Protection Agency (EPA) South Oahu Ocean Dredged Material Disposal site (SOODMDS), and may use material deemed suitable for beneficial reuse as fill material. The EPA previously consulted on the disposal of dredged material and vessel transit to the SOODMDS, which includes disposal and vessel transit by the Navy. We concurred with the determination that all effects were not likely to adversely affect all species (NMFS 2020d).

2.3.1.3 Pearl City Peninsula (PCP)

The Navy will use PCP as a location for staging and storage area for construction materials. Its function will be secondary to WP. The Navy will install a temporary L-shaped pier (2,734 m^2) for vessel docking and loading (Figure 14), and will remove this once they have completed DD5 construction. The Navy will not undertake any in-water fill at the site to construct the L-shaped Pier. The Navy may build only a component of the L-shaped pier, or none of it if their construction contractor realizes efficiencies or offers alternatives for producing or storing materials that are not located at JBPHH.

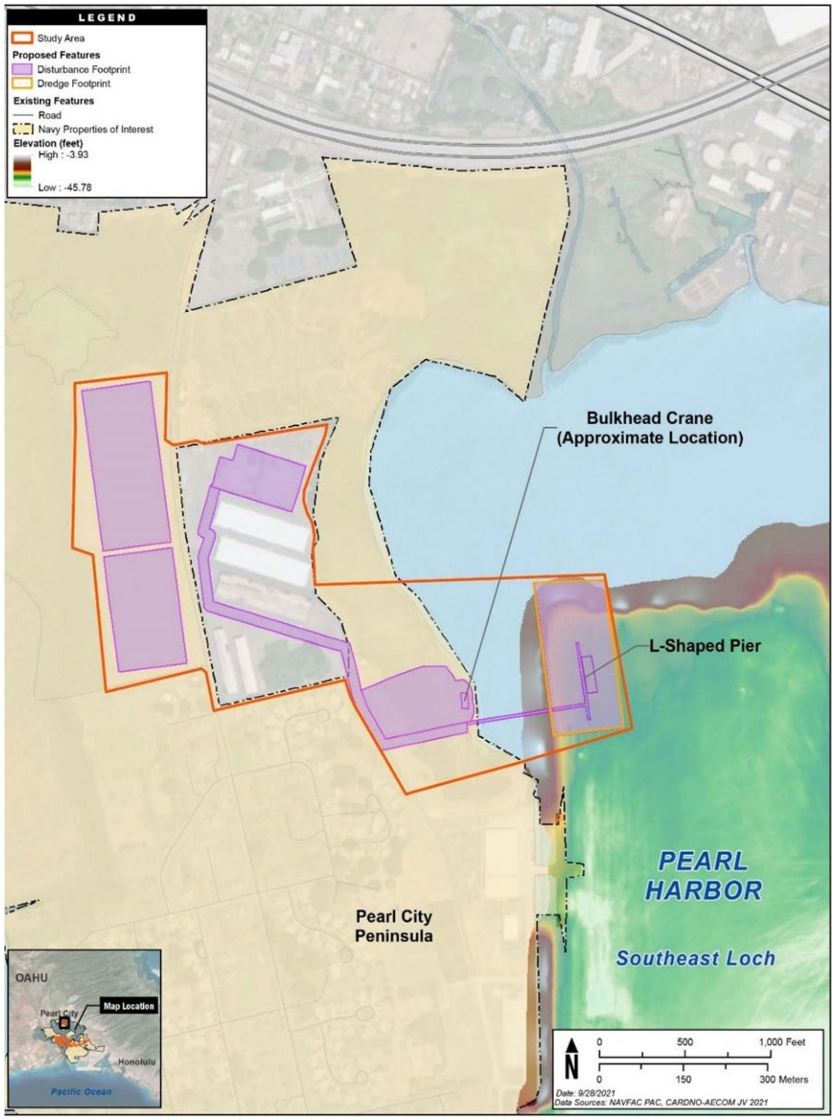

Figure 14. The conceptual design of support facilities for DD5 at PCP. A new temporary L-shaped Pier for loading and offloading materials extends into the water, and it is surrounded by a rectangular dredge footprint (Source: NAVFAC 2022a).

2.3.1.3.1 Pile Driving

The Navy will install a total of 41 36-inch Steel Pipe piles at PCP to construct the temporary offloading L-shaped pier. The Navy will start pile driving using vibratory pile driving, and finish with impact pile driving, and will use pre-drilling in certain cases.

The Navy will use barges with installation equipment to drive the piles, and operate 7 days per week, during daylight hours, for 7 days. Table 6 summarizes pile driving details including the types and sizes of piles that the Navy will drive, the method of pile driving, average strikes per pile needed, and the number of piles a day.

Table 6. Summary of pile driving activity at PCP (Source NAVFAC 2022a).

Structure	Method of Pile Driving	# of Piles	Pile Type	Pile Size (Diam.)	Average Pile Strikes/ Pile	Pile Driving Minutes /Pile (Vibr. or Drilling)	Average # of Piles Driven/ Day	Total # of Pile Driving Days	Average # of Spreads (1)
L-Shaped Pier	Vibratory	41	Steel Pipe	36-inch	N/A	72	6	7	2
	Impact				1,800	N/A			

2.3.1.3.2 *Pile Extraction*

Following completion of DD5 construction, the Navy will remove the L-shaped pier, and will extract all the installed piles using vibratory methods (Table 7). The Navy will operate 7 days per week, during daylight hours, for a duration of approximately 14 days.

Table 7. Pile extraction and demolition parameters at PCP.

Structure	# of Piles	Pile Type	Pile Size (Diameter)	Pile Extraction Minutes/day	# of Piles Extracted/Day	Total # of Demo Days
L-Shaped Pier	41	Steel pipe	36-inch	160	3	14

2.3.1.3.3 *Dredging*

The Navy may conduct some dredging around the end of the L-shaped Pier (if it is built) to provide vessel access to the pier. They will dredge approximately 354,700 ft^2 (33,000 m^2) of an area, to a cut depth of approximately 10.0 ft (3.0 m), involving a volume of 40,000 CY (30,600 m^3). The Navy will use dredging methods similar to those described for PHNSY & IMF in section 2.3.1.1. The Navy has projected dredging to occur 24 hours per day, 7 days per week for approximately 2 months.

2.3.1.4 Ford Island (FI)

The Navy will use FI for the use of existing structures and as a location for workforce parking and contractor access via small boat landings (Figure 15). The Navy will install up to seven temporary pile clusters to support construction activities. The Navy will use the pile clusters to support overnight mooring of approximately 6-12 barges that will store dredged sediment and construction materials. The Navy anticipates longer stays based on weather and construction progress.

Figure 15. The conceptual plan for construction support facilities at FI: (red) off-limits; (blue) Access Area for loading/unloading; (green) temporary pile clusters for loading/unloading and barge storage; and (brown) loading/unloading (source: NAVFAC 2022a).

2.3.1.4.1 Pile driving

The Navy will install up to 126 20-inch concrete piles within up to seven (7) pile clusters to support temporary mooring of barges during in-water construction of the DD5. Each pile cluster will comprise 5-18 piles, and the total size of each cluster will be up to 20 ft in diameter. Table 8 summarizes pile driving details including the types and sizes of piles that the Navy will drive, the method of pile driving, average strikes per pile needed, and the number of piles a day.

They will use pre-drilling and impact pile driving methods. The Navy will use barges with installation equipment to drive the piles, and operate 7 days per week, during daylight hours, for 14 days.

Table 8. Summarizes pile driving details including the types and sizes of piles that the Navy will drive, the method of pile driving, average strikes/pile needed, and the number of piles a day Source: NAVFAC 2022a).

Structure	Method of Pile Driving	# of Piles	Pile Type	Pile Size (Diam.)	Average Pile Strikes/ Pile	Pile Driving Minutes /Pile (Vibrat. or Drilling)	Average # of Piles Driven/ Day	Total # of Pile Driving Days	Average # of Spreads (1)
Pile Clusters	Pre-drilling	126	Concrete	20-inch	N/A	30	6	14	1
	Impact				750	N/A			

2.3.1.4.2 Pile Extraction

After Stage 1 DD5 construction is complete, the Navy will extract all the installed piles by cutting them at the mudline. The Navy has not identified the specific methods of cutting to be used, or the duration of this activity.

2.3.1.5 Barge Mooring Sites

The Navy will use existing and new moorings at various locations throughout Pearl Harbor (Figure 6) for the duration of DD5 construction. They will use these to moor up to 50 barges, overnight, used to transport and store materials. The Navy estimates that each barge will have an average overwater coverage of approximately 8,750 ft^2 (813 m^2), with barge dimensions ranging from the smallest barge size of 110’ x 35’ feet to the largest size of 200’ x 75’ feet.

The Navy will install approximately 14 new moorings to include: six at Middle Loch; seven at Foxtrot Pier (F1, S369); and one at a WP (Mooring Ball or on the Offloading Pier). They will install the new moorings within the first 6-12 months from the date of project construction notice. They will install anchors on the seafloor of varying size based on ocean bottom conditions and barge size, using a barge crane and divers.

Table 9 summarizes the barge mooring locations, whether moorings are existing or to be installed, the number of moorings and barges, the approximate size of barges and the site preparations.

Table 9. Probable barge mooring locations and information (source: NAVFAC 2022a).

Construction Support Facility	New/ Existing	# of Moorings	# of Barges	Approximate Size	Site Preparation Required
Barge Mooring: Middle Loch	New	6	6-12 barges	Approximately 105,000 square feet (9,755 square meters)	Installation of mooring balls by connecting mooring ball floats to an anchor attached to the seabed
Barge Mooring: West Loch	Existing	6	6-12 barges	Approximately 105,000 square feet (9,755 square meters)	No site preparation required
Barge Mooring: East Loch	Existing	1	1-2 barges	Approximately 17,500 square feet (16,258 square meters)	No site preparation required
Barge Mooring: Foxtrot Pier (F1, S369)	New	7	9 barges	Approximately 78,750 square feet (7,316 square meters)	Installation of seven cluster piers
Barge Mooring: Foxtrot Pier (F12/13, S382)	Existing	6-12	6-12 barges	Approximately 105,000 square feet (9,755 square meters)	No site preparation required; however, there will be BMPs that are applied (see Section 2.4)

Construction Support Facility	New/ Existing	# of Moorings	# of Barges	Approximate Size	Site Preparation Required
Barge Mooring: WP Offloading Pier or Mooring Ball	New	1	1-2 barges	Approximately 17,500 square feet (16,258 square meters)	If mooring balls, installation of mooring balls by connecting mooring ball floats to an anchor attached to the seabed. If moored at Offloading Pier, site preparation will be as needed.

2.3.1.6 Vessel Transit

The Navy will operate multiple different types of vessels daily to support the various DD5 construction activities for the duration of DD5 construction. The vessel types and sizes that the Navy will operate include: scows; flat barges; tug boats, survey vessels (Boston Whalers between 17-ft (5.2 m) and 43-ft (13 m)); crew boats (between 40 and 75 ft (12.1 and 22.7 m) long); ferries; and an industrial heavy lift vessel for delivering the caisson (more than 600 ft (182.8 m) long).

2.3.1.6.1 Pearl Harbor

Within Pearl Harbor, the Navy will use barges to dredge and transport dredge material for processing (Table 10); tugs to move barges and scows; support boats to perform small minor such as deploying oil booms or inspecting mooring lines around barges, scows, and equipment; Boston Whalers to conduct surveys; and ferries to transport workforce, i.e. shuttle workers to and from PHNSY & IMF from three different support areas: WP, FI and IP.

The Navy estimates that vessel operations will involve up to 65 vessel trips per day in Pearl Harbor during the first 15 months of construction (dredging), and up to 15 vessel trips per day between months 16 and 65. While the Navy cannot estimate the exact number of vessel trips per specific vessel route within the Harbor, nor vessel trip lengths, their vessel routes will occur between (i.e., back and forth) the PHNSY, WP, IP, PCP, and FI.

Table 10. Dredge materials barge transport (source: NAVFAC 2022a).

Dredge Material Type	# of Barges/ Scows per Trip	# of Support Tugs per Trip	# of Barge/ Scow Transfers per Day	Operating Hours per Day	Operating Days per Week
Harbor Deposit Sediment with Potential to Contain MEC	1-2	1-2	1-2[(1)]	12	6-7
Native Dredge Materials	2-4	1-3	1-6[(1)]	24	6-7

Dredge Material Type	# of Barges/ Scows per Trip	# of Support Tugs per Trip	# of Barge/ Scow Transfers per Day	Operating Hours per Day	Operating Days per Week
Dredge Spoils to Offshore Disposal	1	1-2	N/A(2)	12	<1(2)

Note: (1) Offloading only. (2) Disposal site only. Estimated total of up to 18 trips to the offshore disposal site per year, based on an anticipated volume of 112,000 CY (85,630 CM) (if deemed suitable), a capacity of 1,270 CY (971 CM) per barge, and a 22-mile round trip with an average transit speed of 6 mph (5.2 knots). Key: CM = cubic meters; CY = cubic yards; MEC = munitions and explosives of concern; mph = miles per hour; N/A = not applicable.

2.3.1.6.2 Open-Ocean

The Navy will transport a pre-constructed DD5 caisson from a shipyard outside of Hawaii to Pearl Harbor via a special, heavy-lift vessel. The Navy currently identifies this location as Norfolk, Virginia (Figure 7). They state that they will not have any other additional (i.e. above baseline) vessel transport to deliver construction materials or equipment across the open ocean to Pearl Harbor associated with this proposed action.

2.3.2 Stage 2: WPF Construction and Operation

As part of Stage 2 construction, the Navy will (a) deconstruct and fill in DD3, (b) build the WPF on top of DD3 site (Figure 16), and (c) re-construct various temporary structures needed for constructing WPF (as used during DD5 construction), and remove these once the WPF construction is complete. The Navy activities related to the construction and operation of the WPF, as relevant to potential marine resource impacts include:

- Installation of Precast Concrete Wall
- Dredging
- Pile Driving
- Pile Extraction

We have summarized the activities in the below sections, per project activity area. Detailed descriptions of these activities are provided by the Navy in the Navy BA (NAVFAC 2022a).

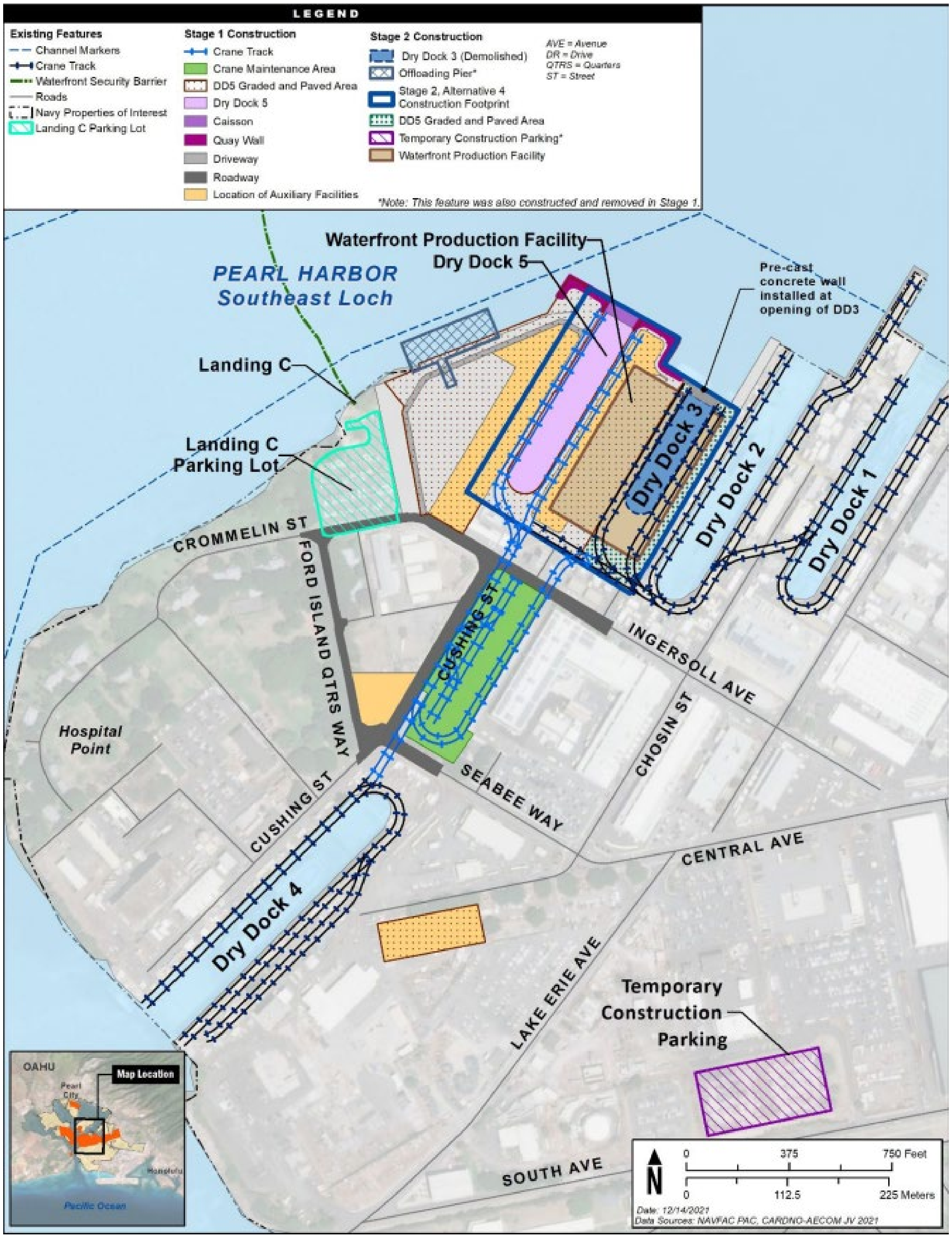

Figure 16. Location and construction of the WPF (Source: DON 2022a).

2.3.2.1 PHNSY & IMF

2.3.2.1.1 Installation of Precast Concrete Wall

The Navy will install a precast concrete wall at the entrance/opening of the existing DD3 (Figure 16). The wall will measure approximately 190 ft long by 85 ft high (58 m by 26 m). Once the wall is installed, it will seal the opening of DD3, after which the Navy will deconstruct and fill DD3 under dry conditions.

2.3.2.1.2 Pile driving

The Navy will install a total of 75 36-inch steel pipe piles to reconstruct the temporary material offloading pier that they built and removed during DD5 Stage 1 construction (Figure 16). They will build it in the same footprint used during Stage 1, over the rock revetment on the western flank of DD5. Table 11 summarizes the method of pile driving, average strikes/pile needed, the number of piles a day, and other details.

Table 11. Summary of pile driving activity at PHNSY & IMF during Stage 2 construction (course: NAVFAC 2022a).

Structure	Method of Pile Driving	# of Piles	Pile Type	Pile Size (Diam.)	Average Pile Strikes/ Pile	Pile Driving Minutes/ Pile (Vibratory or Drilling)	Average # of Piles Driven/ Day	Total # of Pile Driving Days	Average # of Spreads (1)
Offloading Pier	Vibratory	75	Steel Pipe	36-inch	N/A	72	3	25	1
	Impact				1,800	N/A			

Notes: All pile quantities include a 15 percent increase. (1) A spread is the number of teams/rigs/barges working concurrently. *Average # of piles is an estimated value of a likely scenario (TBD during construction). This number is not used to calculate the total number of piles. Method of pile driving note: vibratory procedures precedes impact procedures.

Key: N/A = not applicable.

They will pile drive using pile drivers operating from land, barges, or on-water platforms. They will operate 7 days per week, during daylight hours, for approximately 25 days.

2.3.2.1.3 Pile Extraction

Once the Navy has completed construction of the WPF, they will deconstruct the material offloading pier as done also after Stage 1 DD5 construction. They will extract the supporting piles installed using vibratory methods. The Navy will operate 7 days per week, during daylight hours, for up to approximately 25 days.

2.3.2.1.4 Dredging

The Navy will dredge work areas in the DD5 construction footprint if/as needed to remove soft sediment that has accumulated since these facilities were last in use during DD5 construction. The dredging methods will be similar to those used during dredging in Stage 1 and summarized in Section 2.3.1.1.

2.3.2.1.5 Stormwater Management

The Navy will use the same laydown and staging areas for constructing WPF as used when construction DD5, and therefore implement the same stormwater management methods and practices as Stage 1.

2.3.2.2 Waipio Peninsula

2.3.2.2.1 Pile Driving

The Navy will drive a total of 377 36-inch steel pipe piles to reconstruct the temporary offloading pier and finger piers that they built, and removed during Stage 1 DD5 construction. They will build the piers in the same footprints used during Stage 1. Table 12 summarizes the pile driving details including the average strikes per pile needed, and the number of piles to be installed a day.

The Navy will start pile driving using vibratory pile driving, and finish with impact pile driving. The Navy will use barges with installation equipment to drive the piles, and operate 7 days per week, during daylight hours, for approximately 3-4 months.

Table 12. Summary of pile driving activity at WP (source: NAVFAC 2022a).

Structure	Method of Pile Driving	# of Piles	Pile Type	Pile Size (Diam.)	Average Pile Strikes/ Pile	Pile Driving Minutes /Pile (Vibrat. or Drilling)	Average # of Piles Driven/ Day	Total # of Pile Driving Days	Average # of Spreads (1)
Material Offloading	Vibratory	168	Steel Pipe	36-inch	N/A	72	6	54	2
	Impact				1,800	N/A			
Finger Piers	Vibratory	209	Steel Pipe	36-inch	N/A	72	6	67	2
	Impact				1,800	N/A			

2.3.2.2.2 Pile Extraction

Following completion of WPF construction, the Navy will remove the offloading pier and finger piers as done after Stage 1 DD5 construction, and will extract all the installed piles using vibratory methods. The Navy will operate 7 days per week, during daylight hours, for a duration of approximately 126 days.

2.3.2.2.3 Dredging

The Navy will dredge the work areas at WP if/as needed to remove soft sediment that has accumulated since these facilities were last in use during DD5 construction. The dredging methods will be similar to those used during dredging in Stage 1.

2.3.2.3 Pearl City Peninsula (PCP)

The Navy will, similar to Stage 1 DD5 construction, use PCP as a location for staging and storage area for construction materials. Its function will be secondary to WP.

2.3.2.3.1 Pile Driving

The Navy will install a total of 41 36-inch Steel Pipe piles to reconstruct the temporary offloading L-shaped pier in the same footprint used during Stage 1. Table 13 summarizes pile driving details including average strikes/pile needed, and the number of piles to be driven a day.

The Navy will start pile driving using vibratory pile driving, and finish with impact pile driving, unless otherwise noted. The Navy will use barges with installation equipment to drive the piles, and operate 7 days per week, during daylight hours, for 2-3 months.

Table 13. Summary of pile driving activity at PCP (source: NAVFAC 2022a).

<table>
<tr><th>Structure</th><th>Method of Pile Driving</th><th># of Piles</th><th>Pile Type</th><th>Pile Size (Diam.)</th><th>Average Pile Strikes/ Pile</th><th>Pile Driving Minutes/ Pile (Vibrat. or Drilling)</th><th>Average # of Piles Installed /Day</th><th>Total # of Pile Driving Days</th><th>Average # of Spreads (1)</th></tr>
<tr><td rowspan="2">L-Shaped Pier</td><td>Vibratory</td><td rowspan="2">41</td><td rowspan="2">Steel Pipe</td><td rowspan="2">36-inch</td><td>N/A</td><td>72</td><td rowspan="2">6</td><td rowspan="2">7</td><td rowspan="2">2</td></tr>
<tr><td>Impact</td><td>1,800</td><td>N/A</td></tr>
</table>

2.3.2.3.2 Pile Extraction

Following completion of WPF construction, the Navy will remove the L-shaped pier as done after Stage 1 DD5 construction, and will extract all the installed piles using vibratory methods. The Navy will operate 7 days per week, during daylight hours, for a duration of approximately 46 days.

2.3.2.3.3 Maintenance Dredging

The Navy will dredge the work areas at PCP if/as needed to remove soft sediment that has accumulated since these facilities were last in use during DD5 construction. The dredging methods will be similar to those used during dredging in Stage 1.

2.3.2.4 Vessel Transit

The Navy will operate different types of vessels daily to support the various WPF construction activities, for the duration of WPF construction. The vessel types and sizes that the Navy will operate include: flat barges; tug boats, survey vessels (17-ft (5.2 m); 22-ft (6.7 m); 27-ft (8.2 m) Boston Whalers; and 43-ft (13 m) Delta Marine twin screw workboat); crew boats (Between 40 and 75 ft (12.1 and 22.7 m)); and ferries. The type of vessels and vessel routes may be somewhat similar to those described for stage 1 DD5 construction in Section 2.3.1.6 in this opinion, however, the Navy will use fewer vessels given that they will not conduct extensive dredging, not transport associated dredged material for processing, and will not transport and deliver a caisson. The Navy estimates that vessel operations will involve up to 15 vessel trips per day in Pearl Harbor during the WPF construction stage 2.

2.4 Best Management Practices

The Navy will implement the BMPs as listed below to avoid and minimize impacts to protected species and the marine environment. These BMPs are considered a part of the proposed action.

Throughout the duration of their involvement in the proposed action, the Navy will brief all workers, irrespective of their employment arrangement or affiliation (e.g., employee, contractor) on these BMPs and ensure their compliance with the requirements.

A. Constant vigilance will be kept for the presence of ESA-listed marine species during in-water construction activities of the proposed action starting 30 minutes before work begins until 30 minutes after work has completed, particularly during in-water activities, such as vessel operations, dredging, operating pre-drilling and pile driving equipment, and deployment of the silt curtain, anchors, or mooring lines.
    1. The Contractor's Project Manager, site foreman, or site superintendent (herein, Project Manager) will be responsible for ensuring these BMPs are adhered to. The Project Manager has stop work authority.
    2. Prior to start of construction, contractor and subcontractor personnel shall attend appropriate training for the proposed actions (to be provided by the contractor). Appropriate training will be an annual requirement.
    3. Marine species observers will be required to have more than one year of marine species observer experience in the field on their resume. Marine species observer qualifications will be subject to Navy review and approval[2].
    4. The Project Manager will designate at least two marine species observers who have attended Natural Resources Training to survey the areas adjacent to the proposed action for ESA-listed marine species during all activities.
    5. At least two dedicated marine observers per construction site will be on-site and observing during all active in-water construction. A set of observers may be necessary at PHNSY & IMF, WP, and PCP at the same time, if construction is

[2] Competent observers will be able to identify marine species, at minimum, to type of animal (e.g. shark, seal, dolphin, whale, turtle, ray, etc.), if sightings are brief or viewing conditions are poor, or to species if positive identification is possible. The observers will understand marine species behavior enough to be able to observe direction of movement, know diving patterns, and be able to determine when an observed species has departed or remained close to the project area. The observers will know enough about evaluating group size to state with high certainty how many animals were observed when they are seen in a group.

occurring at these sites simultaneously. One observer will cover, at most, an approximate 90° portion (one quarter of a circle) of the water area around a construction site (ex. a construction site on a flat coastline will require two observers to cover 180° of water view, a construction site on a point will require three observers to cover 270° of water view). Observers may be on a boat or on land to cover the portion of the site they are required to monitor.

i. The role of the observer will be to:

- Ensure BMPs are properly implemented/installed and maintained;
- Monitor possible impacts on ESA-listed species, including any potential interactions with ESA-listed species;
- Identify any ESA-related concerns;
- Notify the Project Manager if BMPs must be repaired or ESA-listed species enter within the species-specific Project limits;
- Maintain a log of marine species observed and any interactions that occur. Logs of marine observation will be provided to the Navy on a weekly basis.

ii. During all in-water construction activities, observers will use binoculars[3] to visually survey the shut-down zone each day, beginning 30 minutes prior to the start of work and regularly throughout the workday. The shut-down zone will be 100 m (328 ft) around the sound source for sea turtles at PHNSY& IMF, WP and PCP, and 60.6 m (200 ft) at Ford Island; and 1,400 m (4,593 ft) around the sound source for Hawaiian monk seals at PHNSY & IMF, WP and PCP. Visual surveys will be made prior to the start of each workday, and prior to resumption of work following any break of more than one half-hour.

- Observers will record environmental and action-related information, including but not limited to date, time, weather, action undertaken, status, and ESA-listed marine species. Animal behavior will also be recorded.
- If no ESA-listed marine species is seen during the survey period prior to the start of work, activities may commence.
- If an ESA-listed marine species is seen during the survey period, the marine observer will notify the Project Manager immediately and monitor the animal. If the animal is within designated Shut-down Zones (see distances above), work will cease or not begin until the animal departs the area voluntarily or after 30 minutes

[3] The Navy contractors will use Fujinon 7x50 handheld binoculars, which is 100% fog and waterproof, withstands drastic temperature and humidity changes, and has abundant eye relief for use with sunglasses in bright conditions, with a high-resolution for prism binocular with a 7.5° angle of view. While a 25x binoculars offers a wider range of view, a 7x binoculars is commonly used to observe marine mammals during field surveys with a narrower view. Several recent publications use this same binoculars, including (but not limited to) NOAA surveys in the southwest (Barlow et al. 2011 and 2001) and Alaska (Jefferson et al. 2019), and humpback whales in Antarctica (Secchi et al. 2011, Friedlaender et al. 2006). Barlow et al. 2001 listed other environmental factors that significantly affect perpendicular sightings, such as Beaufort sea state and swell, both of which will always be at lowest/calmest values within Pearl Harbor.

have passed since the last animal sighting. Animal activities will be recorded during this time period.

- The Shut-down Zone constitutes the radial distance around the action area, and if a marine protected species enters this distance, all work will be shut down.

6. Specific species monitoring plan and protocols which take into account the relative risk of Hawaiian monk seal or sea turtle occurrence for each location will be developed with NMFS before construction commences. Species specific mitigation and monitoring distances discussed above may be subject to change based upon coordination with NMFS, results of real-time acoustic monitoring (see Section 3) and adaptive management, and changes in pile sizes or pile driving methods. All mitigations zones will at least be large enough to ensure that take of monk seals or sea turtles is not reasonably certain to occur (e.g., to the extent of behavioral take isopleth).Observer shifts will be limited to no more than eight hours per day in order to avoid fatigue. Additional observers may be needed.
7. Project-related personnel will not attempt to disturb, touch, ride, feed, or otherwise intentionally interact with any protected species.
8. Project-related personnel will stay more than 150 ft (45.7 m) away from protected marine species including sea turtles and Hawaiian monk seals.
9. The Contractor will document and report to the Navy's JBPHH Natural Resources Manager (JBPHH Emergency Response Phone: 808-722-7285), all sightings of an ESA-listed species (monthly). The JBPHH Natural Resources Manager will share reports with NMFS (PIRO ICCB Branch Chief). Any protected species that are injured or killed will be reported to the JBPHH Natural Resources Manager immediately (within 24 hours at the latest).

    i. Report if any protected species are sighted by marine species observers or project personnel to the JBPHH Natural Resources Manager, and the JBPHH Natural Resources Manager will subsequently report to NMFS (PIRO ICCB Branch Chief). For turtles, provide a summary report once a month. For monk seals, notify the stranding response program in real-time (7 am to 7 pm call the Oahu direct line at 808-725-5730; after hours [7 pm to 7 am] call NMFS stranding coordinator at 808-721-5343).

    ii. If a listed marine species is determined to have been disturbed, harassed, harmed, injured, or killed, it will be immediately reported to the JBPHH Natural Resources Manager (JBPHH Emergency Response Phone: 808-722- 7285), who will ensure that this information is also be reported to NMFS within one business day to the (PIRO ICCB Branch Chief). These reports, submitted in digital and searchable format to the Navy and NMFS, will include:

    - Information to be provided in the final report
    - Number and species of listed animals affected
    - The date, time, and location of each event (provide geographic coordinates)
    - Description of the event

- The time the animal(s) was first observed or entered the shutdown zone, and, if known, the time the animal was last seen or exited the zone, and the fate of the animal
- Mitigation measures implemented prior to and after the animal was taken
- Photographs or video footage of the animal(s) (if available).

iii. If an injured, sick, or dead protected marine species (i.e., stranded) is observed, the Contractor will notify the JBPHH Natural Resources Manager (JBPHH Emergency Response Phone: 808-722-7285) who will contact the (PIRO ICCB Branch Chief) and notify the stranding response program in real time (7 am to 7 pm call the Oahu direct line at 808-725-5730; After hours [7 pm to 7 am] call NMFS stranding coordinator at 808-721-5343). The observer will submit photos and data that will aid in determining how to respond to the stranded animal. Data submitted in response to stranded marine mammals will include date/time, location of stranded marine mammal, species and number of stranded marine mammals, description of the stranded marine mammal's condition, event type (e.g., entanglement, dead, floating), and behavior of live-stranded marine mammals.

10. For dredging operations occurring during night hours, adequate lighting will be employed such that protected species will be visible at the surface of the water within 100 m (328 ft) of in-water work.

B. In-water construction activities will employ measures to reduce potential vessel collisions and interactions with marine species.

1. Operational and maintenance standards for vessels will be practiced, and vessel operations will only occur during ocean conditions that do not compromise safe operation with contingency plans to cancel or delay the action for favorable weather conditions.
2. Vessel operators will halt or alter course to remain at least 150 ft (45.7 m) from ESA-listed marine species.
3. Vessels shall operate at speeds safe for the location and conditions. Within the harbor this is typically 10 knots or less, to prevent collision, and to 5 knots or less when piloting vessels in areas of known turtle presence. Operators will be particularly vigilant to watch for turtles at or near the surface in areas of known or suspected turtle activity. Ocean disposal transit speeds for a vessel or tugboat towing the scow/barge will be at slow speeds (i.e., less than 10 knots) to reduce potential collisions with ESA-listed marine species.
4. If approached by an ESA-listed marine species, the vessel operator will put the engine in neutral if the animal is within 150 ft (45.7 m) of the vessel, until the animal has moved at least 50 ft (15.2 m) away, and then engage the engine and slowly move way to 150 ft (45.7 m) or more from the animal.
5. Vessel operators will not encircle or trap ESA-listed marine species between multiple vessels or between vessels and the shore.
6. Vessels will take reasonable steps to alert other vessels in the vicinity of marine species.

7. Vessels will follow established transportation channels whenever practicable.
8. Vessels will not allow lines to remain in the water, and no trash or other debris will be thrown overboard, thereby reducing the potential for marine mammal entanglement.
9. Divers will not approach ESA-marine species closer than 50 ft (15.2 m) and will not touch or interact with marine species that approach divers.

C. In-water construction activities will employ measures to reduce potential direct physical impacts to ESA-listed species.

1. In-water tethers and mooring lines for vessels and marker buoys will be kept to the minimum lengths necessary and will remain deployed only as long as needed to accomplish the task. Lines shall be inspected regularly and kept taut.
2. Before any equipment or material enters the water, a responsible party (i.e., the Project Manager) will verify that no ESA-listed species are in the area where the equipment, anchor(s), or materials are expected to contact the substrate.
3. All objects lowered to the bottom will be lowered in a controlled manner. This will be achieved by the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of descent.
4. With the exception of the actual dredging apparatus (e.g., clamshell buckets, drilling augers), any heavy equipment will be operated from above and out of the water.
5. Anchor lines from construction vessels will be deployed with appropriate tension to avoid entanglement with ESA-listed species. Construction related equipment that may pose an entanglement hazard will be removed when not in use.
6. If feasible, work shall be conducted in the intertidal zone during the low and/or slack tides.
7. In the event of approaching foul weather (i.e., tropical storms and hurricanes), equipment shall either be removed from the Project site or adequately secured.
8. Physical contact by divers and construction-related tools, equipment, and materials regardless of size shall be minimized with live benthic organisms, especially corals and seagrass (if present).

D. During in-water pile driving activities, a soft start procedure will be used for impact pile driving at the beginning of each day's in-water pile driving activity or anytime that pile driving has ceased for more than 30 minutes. The soft start is an approach used to provide a warning pulse from the pile driver so that animals in the proximity have a chance to leave the area prior to the pile driver operating at full capacity, thereby exposing fewer animals to loud underwater sounds. The contractor shall provide an initial set of strikes from the impact hammer at reduced energy, followed by a 30-second waiting period, followed by two subsequent sets of strikes.

E. If practical, vibratory hammering and/or the use of a cap shall be used to minimize the impact of noise on ESA-listed species. Where feasible, measures shall be implemented that attenuate the sound or minimize impacts to aquatic resources during pile installation.

F. Environmental clamshell buckets shall be utilized for mechanical dredging.

G. It shall be ensured that all concrete grout, cement, and sealant used are non-toxic and non-hazardous to aquatic organisms.

H. Floating work platforms shall be oriented to minimize shading organisms on natural and artificial substrates to the greatest extent practicable. This may occur by allowing for the path of the sun to cross perpendicular to the length of the platform to reduce the duration of shading, thereby allowing light into areas under barges and work platforms. This BMP does not apply to temporary piers.

I. All anchors (e.g., for vessels and silt curtains) are set on hard or soft, sandy bottom void of corals and seagrass, and that chosen anchor locations take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. All barge and anchor systems (e.g. anchors, chains, moorings, etc.) shall be properly installed to avoid damaging bottom habitat. Systems will be inspected daily and monitored over time to assess the integrity and potential damages. If practicable, all intertidal work will be conducted at low and/or slack tides.

J. A Stormwater Pollution Prevention Plan (SWPPP) will be developed by the construction contractor, once selected, to reduce on-site erosion and off-site sedimentation. The SWPPP will include, at a minimum, silt socks, filter fabric, or an approved equivalent will be used around all topside construction located near waters of the US.

K. A plan will be developed to prevent trash and debris from entering the marine environment during the Project. The plan will be implemented throughout construction of the Project.

L. An oil spill contingency plan will be developed to control and clean spilled petroleum products and other toxic materials. The plan will be implemented throughout construction of the Project.

1. Oil or other hazardous substances will be prevented from seeping into the ground or entering any drainage inlet or local bodies of water.
2. When applicable, all temporary fuel oil or petroleum storage tanks will be surrounded with a temporary berm of sufficient size and strength to contain the contents of the tanks (plus 10% freeboard for precipitation) in the event of an accidental release.
3. Fueling of Project-related vehicles and equipment will take place at least 50 ft (15.2 m) away from the water and within a containment area, preferably over an impervious surface. With respect to equipment (e.g., crane on the barge) that cannot be fueled on land, spill prevention booms will be employed to contain potential spills. All fuel spilled will be cleaned immediately.
4. Lubricants and excess oil will be disposed of in accordance with applicable federal, territory, and local regulations, laws, ordinances, and permits.
5. Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.
6. All Project-related materials and equipment placed in the water will be free of pollutants.
7. Pre-work inspections of heavy equipment for cleanliness and leaks will be conducted daily, with all heavy equipment operations postponed or halted until leaks are repaired and equipment is cleaned.

M. A temporary floating debris boom will be installed around all work located below the high tide line. The location of the boom will shift as in-water work shifts during Project phasing.

N. Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices, and the curtailment of work during adverse weather and tidal/flow conditions.

1. During all in-water or over-water work, silt curtains will completely enclose the work area to the maximum extent practicable. Silt containment devices will isolate and contain the in-water work area and prevent turbid water from flowing outside the curtain limits.
2. Silt curtains will be monitored for damage, dislocation, or gaps, and immediately repaired where any such damage or issues are detected.
3. Installment of silt curtains around the project footprint shall be closely monitored. Once installed, silt curtains shall be deployed until the visible turbidity plume has dissipated.
4. If a plume is observed outside of the silt curtains, corrective action will be taken immediately. The Project Manager will inform the Action Proponent immediately if a plume is observed.

O. As practicable, work will be conducted during calm sea states with work stoppages during high surf, winds, and currents. In the event of approaching foul weather (i.e., tropical storms and hurricanes), equipment will be either removed from the Project site or adequately secured. Hurricane season in the Pacific is from 1 June to 30 November, however tropical storms can and do occur year round. Hawaii utilizes the National Weather System's warning and watch advisories, and Navy Region Hawaii adheres to the following Condition of Readiness (COR) Levels to forecast destructive force winds (50 mph):

1. COR V: Lowest condition of hurricane readiness; destructive force winds are not expected.
2. COR IV: first condition of heightened hurricane readiness; within 72 hours.
3. COR III: within 48 hours.
4. COR II: within 24 hours.
5. COR I: within 12 hours.

In order to provide 48 hours leeway preparation, work activities will immediately begin the appropriate removal and/or securement of all in water equipment, vessels and barges once a COR III is triggered. Once post storm activities permit a safe assessment of equipment and conditions of the project sites, as feasible, that will be evaluated for a safe return to work providing reports of any additional adverse storm impacts.

P. The portions of the equipment that enter the water will be clean and free of pollutants, including aquatic invasive species (AIS). All vessels and equipment (including barges and dredging equipment) will be free from fouling organisms before entering Hawaii's coastal waters. A biofouling management plan will be developed for all vessels entering Hawaii waters.

1. The Project Manager and the heavy equipment operator will perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations will be postponed or halted should a leak be detected, and will not proceed until the leak is repaired and equipment cleaned.
2. Prior to commencing in-water work, the Navy, contractor, or other shall ensure that all contracted vessel and barges complete an AIS risk assessment that meets the biosecurity standards defined by the Navy and the State of Hawaii.

Q. For all in-water activities that require staging materials in the marine environment and/or be supported by divers (e.g. removing the marine railway, etc.), the Navy will ensure that these activities avoid any unnecessary contact with marine organisms and that divers also avoid exposing corals directly or indirectly to toxicopathological agents.

1. The Navy and NMFS will be notified immediately in the event a vessel is grounded and/or abandoned during the proposed action. Depending on the action, vessels will wait at a safe distance in deeper waters after deploying personnel overboard to avoid anchoring.
2. Established moorings will be used to the greatest extent practicable.
3. Anchors will be routinely monitored for slippage by the vessel crew and watch will be maintained when personnel are onboard.

R. During DD5 operation, the following BMPs will be implemented to protect water quality during dry dock evolutions:

1. There will be no discharge of oils, fuels, or chemicals to surface waters, or onto land where there is a potential for re-entry into surface waters. Fuel hoses, oil drums, oil or fuel transfer valves, fittings, etc., will be checked regularly for leaks. Materials will be maintained and stored properly to prevent spills.
2. No cleaning chemicals or solvents will be discharged to ground or surface waters.
3. Dry docks will be swept to a broom clean condition and inspected prior to flooding.
4. Third-party inspection of dry dock cleaning will occur prior to flooding; this includes inspecting the dock for general cleanliness and inspecting the dry dock for any debris or materials that may become dislodged due to flooding.
5. Prior to flooding, Environmental Staff inspects the dock for general cleanliness and the Docking Officer and Dockmaster inspect the dock for debris and anything that may become dislodged due to flooding, (i.e., deteriorated concrete or piping along the dry dock walls).
6. Minimize caisson off period, to the extent practicable.
7. Routine maintenance and checks of all bubble screens.
8. Routine inspection, at least annually, to ensure dry dock sumps and outfalls are cleaned (i.e., sediment removal), as necessary.

S. The following BMPs will avoid or minimize entrainment:

1. To minimize entry of sea turtles into the dry dock, an air curtain shall be used around the dry dock to prevent entrainment of sea turtles and marine mammals resulting from entering the dry dock; and
2. The air curtain will be permanently installed within the dry dock near or within the caisson seat to minimize the number of marine species entering the dry dock.

3. If a sea turtle or any marine species is entrained, shipyard staff will immediately notify the stranding response program prior to handling sea turtles entrained during DD5 operations (7 am to 7 pm call the Oahu direct line at 808-725-5730; After hours [7 pm to 7 am] call NMFS stranding coordinator at 808-721-5343). Note: the Stranding Program will provide NMFS with an official stranding report within 24 hrs.
4. The Navy will notify NMFS (PIRO ICCB branch chief) of sea turtle entrainment incidents within 24-48 hours, for awareness.

2.5 ESA-listed Species Monitoring Plan

The Navy proposed to implement two types of monitoring to protect or benefit ESA listed species from effects related to the proposed action as outlined in their BA (NAVFAC 2022a): 1) Stationed personnel will look for sea turtles and monk seals approaching shutdown zones around pile driving, dredging, pile extraction, and other sound-producing construction activities and signal the construction crew when shutdown is necessary and how long the shutdown needs to continue; and 2) measurement of levels of underwater sound from pile driving, pre-drilling, pile extraction, and other sound-producing activities. Measuring sound will establish actual source levels of various construction activities and the characteristics of sound propagation in Pearl Harbor. Shutdown and monitoring zones could be adjusted for the project, if measurements indicate that established zones are inappropriate in size.

3 APPROACH TO THE ASSESSMENT

3.1 Overview of NMFS Assessment Framework

Biological opinions address two central questions: (1) Has a Federal agency insured that an action it proposes to authorize, fund, or carry out is not likely to jeopardize the continued existence of endangered or threatened species and (2) has a Federal agency insured that an action it proposes to authorize, fund, or carry out is not likely to result in the destruction or adverse modification of critical habitat that has been designated for such species. Every section of a biological opinion from its opening page and its conclusion and all of the information, evidence, reasoning, and analyses presented in between is designed to help inform these two questions.

Before we introduce the assessment methodology, we want to explain how we analyze an "effect." For this, we analyze the change or departure from a prior state or condition of a system caused by an action or exposure (Figure 17). Although Figure 17 depicts a negative effect, the definition itself is neutral: it applies to activities that benefit endangered and threatened species as well as to activities that harm them. Whether the effect is positive (beneficial) or negative (adverse), an "effect" represents a change or departure from a prior condition (a in Figure 17); in consultations, the prior global condition of species and designated critical habitat is summarized in the Status of the Species narratives while their prior condition in a particular geographic area (the action area) is summarized in the Environmental Baseline section of this opinion. Extending this baseline condition over time to form a future without the project condition (line b in the figure); this is alternatively called a counterfactual because it describes the world as it might exist if a particular action did not occur. Although consultations do not address it explicitly, the future without a project is implicit in almost every effects analysis.

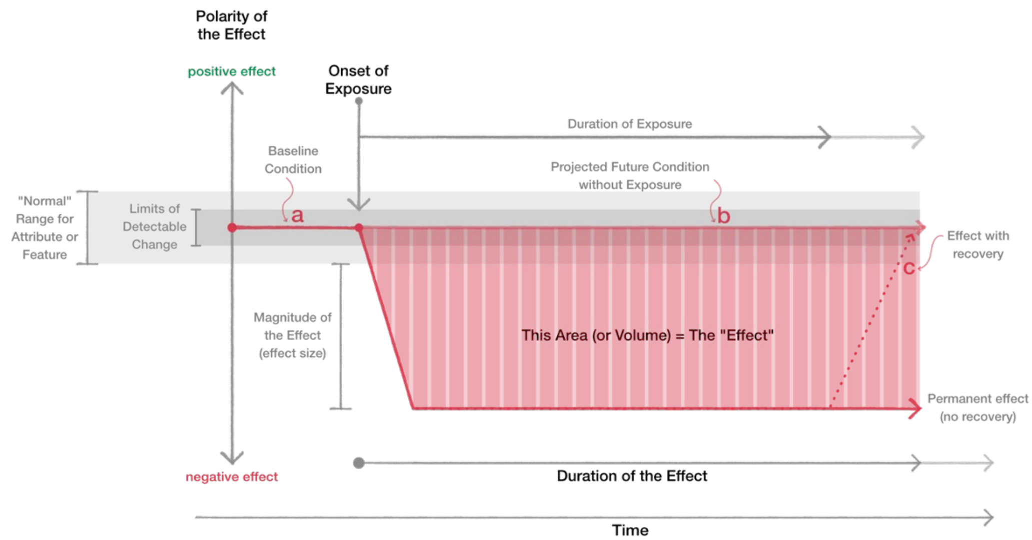

Figure 17. A schematic of the various elements encompassed by the word "effect." The vertical bars depict a series of annual "effects" (negative changes from a pre-existing or "baseline" condition) that are summed over time to estimate the action's full effect.

As Figure 17 illustrates, effects have several attributes: polarity (positive, negative, or both), magnitude (how much a proposed action causes individuals, populations, species, and habitat to depart from their prior state or condition) and duration (how long any departure persists). The last of these attributes—duration—implies the possibility of recovery which has the additional attributes recovery rate (how quickly recovery occurs over time; the slope of line c in the figure) and degree of recovery (complete or partial).

As described in the following narratives, biological opinions apply this concept of effects to endangered and threatened species and designated critical habitat. Jeopardy analyses are designed to identify probable departures from the prior state or condition of individual members of listed species, populations of those individuals, and the species themselves. Destruction or adverse modification analyses are designed to identify departures in the area, quantity, quality, and availability of the physical and biological features that represent habitat for these species.

3.1.1 Jeopardy analyses

The section 7 regulations define "jeopardize the continued existence of " as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). The jeopardy standard is focused on the effects of the action when considered together with the species' status and all other threats acting on it. A federal action that adversely affects a declining population does not necessarily jeopardize that species unless the action itself is the cause of some active change of the species' status for the worse. *See National Wildlife Federation v. NMFS*, 524 F.3d 917, 930 (9th Cir. 2008). Minor reductions in the reproduction, numbers, or distribution of a species that are inconsequential at the species level will not be sufficient to jeopardize that species. In other words, a jeopardizing action requires that any reduction in the likelihood of survival or recovery be appreciable; i.e., material or meaningful from a biological perspective. *See Oceana v. Pritzker*, 75 F. Supp. 3d 469, 481-84 (DDC 2014)(holding that NMFS was within the bounds of its discretion to construe the word "appreciably" as entailing more than a bare reduction in the likelihood of survival and recovery, but rather "a considerable or material reduction in the likelihood of survival and recovery"). We note, however, that for a species that has a particularly dire pre-action condition, an action's even slight impacts may rise to the level of appreciable reduction.

This definition requires our assessments to address four primary variables:

1. Reproduction
2. Numbers
3. Distribution
4. The probability of the proposed action will cause one or more of these variables to change in a way that represents an appreciable reduction in a species' likelihood of surviving and recovering in the wild.

Reproduction leads this list because it is "the most important determinant of population dynamics and growth" (Carey and Roach 2020). Reproduction encompasses the reproductive ecology of endangered and threatened species; specifically, the abundance of adults in their populations, the fertility or maternity (the number of live births rather than the number of eggs they produce) of those adults, the number of live young adults produced over their reproductive lifespans, how they rear their young (if they do), and the influence of habitat on their reproductive success, among others. Reducing one or more of these components of a population's reproductive ecology can alter its dynamics so reproduction is a central consideration of jeopardy analyses.

The second of these variables—numbers—receives the most attention in the majority of risk assessments and that is true for jeopardy analyses as well. Numbers or abundance usually represents the total number of individuals that comprise the species, a population, or a subpopulation; it can also refer to the number of breeding adults or the number of individuals that become adults. For species faced with extinction or endangerment several numbers matter: the number of populations that comprise the species, the number of individuals in those populations, the proportion of reproductively active adults in those populations, the proportion of sub-adults that can be expected to recruit into the adult population in any time interval, the proportion of younger individuals that can be expected to become sub-adults, the proportion of individuals in the different genders (where applicable) in the different populations, and the number of individuals that move between populations over time (immigration and emigration). Reducing these numbers or proportions can alter the dynamics of wild populations in ways that can reinforce their tendency to decline, their rate of decline, or both. Conversely, increasing these numbers or proportions can help reverse a wild population's tendency to decline or cause the population to increase in abundance.

The third of these variables—distribution— refers to the number and geographic arrangement of the populations that comprise a species. Jeopardy analyses must focus on populations because the fate of species is determined by the fate of the populations that comprise them: species become extinct with the death of the last individual of the last population. For that reason, jeopardy analyses may consider changes in the number of populations, which provides the strongest evidence of a species' extinction risks or its probability of recovery. Jeopardy analyses also may consider changes in the spatial distribution of the populations that comprise a species because such changes provide insight into how a species is responding to long-term changes in its environment (for example, to climate change). The spatial distribution of a species' populations also determines, among other things, whether all of a species' populations are affected by the same natural and anthropogenic stressors and whether some populations occur in protected areas or are at least protected from stressors that affect other populations.

To assess whether reductions in a species' reproduction, numbers, or distribution that are caused by an action measurably reduce the species' likelihood of surviving and recovering in the wild, NMFS first assesses the status of the endangered or threatened species that may be affected by an action. That is the primary purpose of the narratives in the Status of the Species sections of biological opinions. Those sections of biological opinions also present descriptions of the number of populations that comprise the species and their geographic distribution. Then NMFS' assessments must consider the status of those populations in a particular action area based on how prior activities in the action area have affected them. The Environmental Baseline sections of biological opinions contain these analyses; the baseline condition of the populations and individuals in an action area determines their probable responses to future actions.

To assess the effects of actions considered in biological opinions, NMFS' consultations use an exposure–response–risk assessment framework. The assessments that result from this framework begin by identifying the physical, chemical, or biotic aspects of proposed actions that are known or are likely to have individual, interactive, or cumulative direct and indirect effects on the environment (we use the term "potential stressors" for these aspects of an action). As part of this step, we identify the spatial extent of any potential stressors and recognize that the spatial extent of those stressors may change with time. The area that results from this step of our analyses is the action area for a consultation.

After they identify the action area for a consultation, jeopardy analyses then identify the listed species and designated critical habitat (collectively, "listed resources"; critical habitat is discussed further below) that are likely to occur in that action area. If we conclude that one or more species is likely to occur in an action area when the action would occur, jeopardy analyses try to estimate the number of individuals that are likely to be exposed to stressors caused the action: the intensity, duration, and frequency of any exposure (these represent our exposure analyses). In this step of our analyses, we try to identify the number, age (or life stage), and gender of the individuals that are likely to be exposed to an Action's effects and the populations or subpopulations those individuals represent.

Once we identify the individuals of listed species that are likely to be exposed to an action's effects and the nature of that exposure, we examine the scientific and commercial data available to determine whether and how those individuals are likely to respond given their exposure (these represent our response analyses). Our individual-level assessments conclude with an estimate of the probable consequences of these responses for the "fitness" of the individuals exposed to the action. Specifically, we estimate the probability that exposed individuals will experience changes in their growth, development, longevity, and the number of living young they produce over their lifetime. These estimates consider life history tradeoffs, which occur because individuals must allocate finite resources to growth, maintenance and surviving or producing offspring; energy that is diverted to recover from disease or injury is not available for reproduction.

If we conclude that an action can be expected to reduce the fitness of at least some individuals of threatened or endangered species, our jeopardy analyses then estimate the consequences of those changes on the viability of the population(s) those individuals represent. This step of our jeopardy analysis considers the abundance of the populations whose individuals are exposed to an action; their prior pattern of growth and decline over time in the face of other stressors; the proportion of individuals in different ages and stages; gender ratios; whether the populations are "open" or "closed" (how much they are influenced by immigration and emigration); and their ecology (for example, whether they mature early or late, whether they produce many young or a small number of them, etc.). Because the fate of species is determined by the fate of the populations that comprise them, this is a critical step in our jeopardy analyses.

The final step of our analyses assesses the probability of changes in the number of populations that comprise the species, the spatial distribution of those populations, and their expected patterns of growth and decline over time. In this step of our jeopardy analyses, we consider population-level changes based on our knowledge of the patterns that have led to the decline, collapse, or extinction of populations and species in the past as well as patterns that have led to their recovery from extinction. These patterns inform our jeopardy determinations.

3.2 Application of this Approach in this Consultation

We identify the various aspects of the Navy's proposed action to construct, operate and maintain the DD5 and WPF that represent potential stressors to threatened or endangered species or critical habitat that has been designated for them. The term stressor means any physical, chemical, or biological entity that can induce a direct or indirect effect on the environment (action area) or that can induce an adverse response on threatened or endangered species and/or their critical habitat.

Based on our review of the Navy's BA (NAVFAC 2022a) for the proposed action, we consider that the sources of the stressors are primarily in-water construction (fill, pile-driving, dredging); vessel movement; and dry dock operations. The specific stressors include:

- Elevated underwater sound
- Vessel transit and collisions
- Removal/loss of habitat
- Entrainment and entrapment in dry dock
- Increased turbidity and sedimentation
- Disturbance from human activity and equipment operation
- Wastes and discharges
- Entanglement in lines

3.2.1 Action Area

The action area is defined by regulation as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR §402.02). The action area for the proposed activities encompasses the full extent of the action's modifications to land, water, and air. For the Navy's proposed action to construct, operate and maintain DD5 and a WPF at PHNSY & IMF, we define the action area to include: (1) Each of the construction sites in Pearl Harbor (Figure 5), (2) the marine area extending from these sites in all directions to account for sound from the construction activities, (3) the various mooring locations in the Harbor (Figure 6), and (4) the various vessel transit paths between constructions sites, moorings, and additionally the transit path for the delivery of the caisson from Norfolk, VA, to Pearl Harbor (Figures 6, 7 and 8). We illustrate the locations of activities in Pearl Harbor and the approximate outer area of effect in Figure 18.

Figure 18. Approximate boundaries of the action area at Pearl Harbor (created by NMFS/Bubb).

3.3 Approach to Evaluating Effects

After identifying the action area for this consultation, we identify the listed species that occur, or have the potential to occur within the action area that may be affected by the proposed action for this consultation. We identify those activities and associated stressors that are likely to co-occur with (a) individuals of endangered or threatened species or areas designated as critical habitat for threatened or endangered species; (b) species that are food for endangered or threatened species;

or (c) species that prey on or compete with endangered or threatened species. The latter step represents our exposure analyses, which are designed to identify:

- The exposure pathway (the course the stressor takes from the source to the listed resource or its prey);
- The exposed listed resource (what life history forms or stages of listed species are exposed; the number of individuals that are exposed; which populations the individuals represent); and
- The timing, duration, frequency, and severity of exposure.

We parse species by the general location of their exposure (Pearl Harbor, The Caisson Transit Path), and when exposure occurs related to the proposed action (during Construction, and/or during Operations). We then evaluate the likelihood that each species would be exposed to the stressors described above. We also describe how the exposure might vary depending on the characteristics of the environment (for example, sound transmission within an estuary/harbor, seasonality) and seasonal differences in those characteristics, behavior of individual animals, etc. Our exposure analyses require knowledge of the action, and a species' population structure and distribution, migratory behaviors, life history strategy, and abundance. We use available data to describe the proposed action location and its stressors, including the Navy's Biological Assessment for the PHNSY Dry Dock and WPF Construction Project.

Next, we identify how listed species, and their designated critical habitat if applicable, are likely to respond once exposed to the action's stressors. These analyses evaluate whether the species responses are expected to be immediate or later in time, and consider the severity, frequency, and duration of those responses.

For the listed species where we conclude exposure to stressors is extremely unlikely or the adverse response will not rise to the level of harm or harassment, we do not include the species or stressors further in our exposure or response analyses. The justifications for these determinations are presented in Appendix A. As a result we focus on the primary threats, and on characterizing the effects of those interactions on listed resources.

For the listed species where we conclude that the response to exposure is likely to result in adverse effects we consider the number of animals that might be exposed to each of these different stressors, the nature of those exposures, and the animal's probable responses upon being exposed. We further consider the risks those responses might pose to individual animals, the populations those individuals represent and the species those populations comprise. We lay the foundation for our risk assessment and our understanding of the animal's pre-existing physical, physiological, or behavioral state in the Status of Listed Resources and the Environmental Baseline using qualitative and quantitative analytical methods.

3.3.1 Climate Change

Future climate will depend on warming caused by past anthropogenic emissions, future anthropogenic emissions and natural climate variability. We rely on NMFS' policy (NMFS 2016a) to use climate indicator values projected under the most up to date Intergovernmental Panel on Climate Change (IPCC) available models (IPCC 2022a,b), and other best available science.

We address the effects of climate, including changes in climate, in multiple sections of this assessment: Status of Listed Resources, Environmental Baseline, and the exposure, response, and risk analyses. In the Status of Listed Resources and the Environmental Baseline we present a review of the best scientific and commercial data available to describe how the listed species and its designated critical habitat is affected by climate change—the status of individuals, and its demographically independent units (subpopulations, populations), and critical habitat in the action area and range wide.

We do this by identifying species sensitivities to climate parameters and variability, and focusing on specific parameters that influence a species health and fitness, and the conservation value of their habitat. We examine marine habitat variables that are affected by climate change such as sea level rise, temperatures (water and air), foraging resources, and changes in weather patterns (precipitation), and tried to assess how species have coped with these stressors to date, and how they are likely to cope in a changing environment. We look for information to evaluate whether climate changes affect the species' ability to feed, reproduce, and carry out normal life functions, including movements and migrations.

We review existing studies and information on climate change and the local patterns of change to characterize the environmental baseline and action area changes to environmental conditions that will likely occur under IPCC's worst case projections (IPCC 2022b), and where available we used changing climatic parameters (magnitude, distribution, and rate of changes) information to inform our assessment. In our exposure analyses, we try to examine whether changes in climate related phenomena will alter the timing, location, or intensity of exposure to the action. In our response analyses we ask, whether and to what degree a species' responses to anthropogenic stressors will change as they are forced to cope with higher background levels of stress caused by climate-related phenomena.

3.3.2 Evidence Available for this Consultation

Section 7(a)(2) of the ESA and its implementing regulations require NMFS to use the best scientific and commercial data available during consultations. To support our status assessments, assessments of the expected impacts of the environmental baseline on endangered and threatened species and designated critical habitat, response analyses, and risk assessments, we look to (1) data and other information contained in the Navy's BA (NAVFAC 2022a); (2) relevant NMFS Letter of Concurrences and biological opinions, available recovery plans, final rulings to list species under the ESA, status reports and white papers that have been developed for the endangered or threatened species that may be affected by the PHNSY Dry Dock and WPF Construction Project; and (3) various relevant independent studies pertaining to the assessment.

We supplement these sources with electronic searches of literature published in English or with English abstracts to cross search multiple databases for relevant scientific journals, open access resources, conference proceedings, web sites, doctoral dissertations and master's theses.

We conduct literature searches to collect general information we need to support the analyses that we present in the Status of the Species, Environmental Baseline, Effects of the Action, and Cumulative Effects sections of this biological opinion. We also conduct literature searches to address specific questions that developed, or that we do not have the answer to.

For our literature searches, we use paired combinations of the keywords: "green sea turtle", "hawksbill sea turtle", "distribution", "status", "sound", "vessel collision", "entrapment", "impingement", "entanglement", "dry dock", "habitat", "foraging", "resting", "home ranges", "movement", "displacement", "climate change", "surveys", "Pearl Harbor", "Oahu", "behavior modification", and many others to search these electronic databases.

Electronic searches have important limitations. First, electronic databases commonly do not include articles published in small or obscure journals or magazines that contain credible and relevant scientific and commercial data. Second, electronic databases rarely include "white" or "gray" literature–unpublished reports from government agencies, consulting firms, and non-governmental organizations–that contain credible scientific and commercial data that will be relevant to a consultation. To overcome these limitations, we supplement our electronic searches by searching the literature cited sections and bibliographies of references we retrieved to identify additional papers that had not been captured in our electronic searches. We acquired references that, based on a reading of their titles and abstracts, appear to comply with our keywords. If a references' title and abstract did not allow us to eliminate it as irrelevant to this inquiry, we acquired the reference. We continued this process until we identified all of the relevant references cited by the introduction and discussion sections of the relevant papers, articles, books, and reports and all of the references cited in the materials and methods, and results sections of those documents. We did not conduct hand searches of published journals for this consultation.

4 STATUS OF LISTED RESOURCES

The Navy determined that its proposed action may affect the threatened and endangered species listed in Table 14.

Table 14. Listed species in the action area that may be affected by the proposed action, and their designated critical habitat.

ESA- Listed Species	Scientific Name	ESA Status	ESA Listing Date & Federal Register Reference	Critical Habitat Designation Date & Federal Register Reference
Central North Pacific Green Sea Turtles	*Chelonia mydas*	Threatened	05/06/2016 81FR20057	-
East Pacific Green Sea Turtles	*Chelonia mydas*	Threatened	05/06/2016 81FR20057	-
North Atlantic Green Sea Turtles	*Chelonia mydas*	Threatened	05/06/2016 81FR20057	-
Hawksbill Sea Turtle	*Eretmochelys imbricata*	Endangered	06/03/1970 35FR8491	-

ESA- Listed Species	Scientific Name	ESA Status	ESA Listing Date & Federal Register Reference	Critical Habitat Designation Date & Federal Register Reference
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	06/03/1970 35FR8491	-
North Pacific Loggerhead Sea Turtle	*Caretta caretta*	Endangered	10/24/2011 76 FR 58867	-
Northwest Atlantic Ocean Loggerhead Sea Turtle	*Caretta caretta*	Threatened	10/24/2011 76 FR 58867	08/11/2014 79 FR 39855
Olive Ridley Sea Turtle (Mexican breeding population)*	*Lepidochelys olivacea*	Endangered	08/27/1978 43FR32800	-
Olive Ridley Sea Turtle (all other populations)	*Lepidochelys olivacea*	Threatened	08/27/1978 43FR32800	-
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Endangered	12/02/1970 35 FR 18319	-
Hawaiian Monk Seal	*Neomonachus schauinslandi*	Endangered	11/23/1976 41 FR 51612	09/21/2015 80 FR 50925
Blue Whale	*Balaenoptera musculus*	Endangered	12/02/1970 35 FR 18319	-
Fin Whale	*Balaenoptera physalus*	Endangered	12/02/1970 35 FR 18319	-
Sei Whale	*Balaenoptera borealis*	Endangered	12/02/1970 35 FR 18319	-
Sperm Whale	*Physeter macrocephalus*	Endangered	12/02/1970 35 FR 18319	-
Mexico Humpback whale	*Megaptera novaeangliae*	Threatened	10/11/2016 81 FR 62259	05/21/2021 86 FR 21082
Central America Humpback whale	*Megaptera novaeangliae*	Endangered	10/11/2016 81 FR 62259	05/21/2021 86 FR 21082
Main Hawaiian Island Insular False Killer Whale	*Pseudorca crassidens*	Endangered	12/28/2012 77 FR 70915	08/23/2018 83 FR 35062
North Pacific right	*Eubalaena*	Endangered	04/07/2008	05/08/2008

ESA- Listed Species	Scientific Name	ESA Status	ESA Listing Date & Federal Register Reference	Critical Habitat Designation Date & Federal Register Reference
whale	*japonica*		73 FR 12024	73 FR 19000
North Atlantic Right Whale	*Eubalaena glacialis*	Endangered	04/07/2008 73 FR 12024	02/26/2016 81 FR 4837
Giant Manta Ray	*Manta birostris*	Threatened	02/21/2018 83 FR 2916	-
Central & Southwest Atlantic Scalloped Hammerhead Shark	*Sphyrna lewini*	Threatened	07/03/2014 79 FR 38213	-
Eastern Pacific Scalloped Hammerhead Shark	*Sphyrna lewini*	Endangered	09/02/2014 79 FR 38213	-
Oceanic Whitetip Shark	*Carcharhinus longimanus*	Threatened	03/01/2018 83 FR 4153	-
Carolina Atlantic sturgeon	*Acipenser oxyrinchus*	Endangered	04/06/2012 77 FR 5913	09/18/2017 82 FR 39160
Chesapeake Bay Atlantic sturgeon	*Acipenser oxyrinchus*	Endangered	04/06/2012 77 FR 5879	09/18/2017 82 FR 39160
New York Bight Atlantic sturgeon	*Acipenser oxyrinchus*	Endangered	04/06/2012 77 FR 5879	09/18/2017 82 FR 39160
South Atlantic Atlantic sturgeon	*Acipenser oxyrinchus*	Endangered	04/06/2012 77 FR 5913	09/18/2017 82 FR 39160

4.1 Listed Resources Not Considered Further

As described in the *Approach to the Assessment* section of this biological opinion, NMFS uses two criteria to identify those endangered or threatened species or critical habitat that are not likely to be adversely affected by the proposed action. The first criterion is the probability of *exposure* or some reasonable expectation of a co-occurrence between one or more potential stressor associated with the proposed action and a particular listed species or designated critical habitat. If we conclude that a listed species or designated critical habitat is extremely unlikely to be exposed to stressors of the proposed action, we conclude it is not likely to be adversely affected. The second criterion is the magnitude of a *response* given exposure, which considers *susceptibility*. For example, species that may be exposed to vessel noise from vessels operating near them but are not likely to respond to that noise (at noise levels they are likely exposed to) are also not likely to be adversely affected by the proposed action.

Based on the general exposure profiles that we developed during the course of this consultation, and described in Appendix A of this biological opinion, we determine that the following threatened and endangered species are not likely to be adversely affected by the Navy's construction, operation and maintenance of DD5 and WPF: East Pacific Green Sea Turtles; North Atlantic Green Sea Turtles; Leatherback Sea Turtle; North Pacific Loggerhead Sea Turtle; Northwest Atlantic Loggerhead Sea Turtle; Olive Ridley Sea Turtle (Mexican breeding population); Olive Ridley Sea Turtle (all other populations); Kemp's Ridley Sea Turtle; Hawaiian Monk Seal; Blue Whale; Fin Whale; Sei Whale; Sperm Whale; Mexico Humpback whale; Central America Humpback whale; Main Hawaiian Island Insular False Killer Whale; North Pacific right whale; North Atlantic Right Whale; Giant Manta Ray; Central & Southwest Atlantic Scalloped Hammerhead Shark; Eastern Pacific Scalloped Hammerhead Shark; Oceanic Whitetip Shark; Carolina Atlantic sturgeon; Chesapeake Bay Atlantic sturgeon; New York Bight Atlantic sturgeon; and South Atlantic Atlantic sturgeon. We also determine that the proposed action is not likely to adversely affect critical habitats designated for any of the above listed species.

4.2 Status of Listed Species That Are Likely to be Affected

The rest of this section of the Opinion consists of narratives for the threatened and endangered species that occur in the action area and that may be adversely affected by the proposed action. These species include (1) the threatened Central North Pacific Green Sea Turtle, and (2) the endangered Hawksbill sea turtle (Table 15).

Table 15. Listed Resources within Pearl Harbor that are likely to be adversely affected by exposure to stressors of concern, organized by the timing of exposure.

Listed Species That Are Likely to be Affected	**Stressors of Concern**	
	During Construction	**During Operations**
Central North Pacific Green sea turtle *(Chelonia mydas)*	Elevated Underwater Sound Vessel Collision Habitat Disturbance and Loss	Entrapment in DD5
Hawksbill sea turtle *(Eretmochelys imbricata)*	Elevated Underwater Sound Vessel Collision	Entrapment in DD5

To fulfill that purpose, each species' narrative presents a summary of (1) the species' distribution and population structure; (2) the status and trend of the abundance of those different populations; (3) natural and anthropogenic threats to the species; and (4) conservation of the species.

4.2.1 Central North Pacific Green Sea Turtle

In 1978, green sea turtles were listed as threatened (43 FR 32800, July 28, 1978), except for breeding populations that occur in Florida and the Pacific coast of Mexico, which were listed as endangered. In 2016, NMFS and the FWS replaced the global green sea turtle listing with 11 distinct population segments (Figure 19). These 11 distinct population segments are demographically, spatially, and genetically independent. As a result, they have been listed as separate "species" for the purposes of the ESA. Eight of these species are listed as threatened (light- colored polygons in Figure 19) and three are listed as endangered (dark-colored polygons in Figure 19). The species of green sea turtles whose individuals are likely to be affected in the action area are the Central North Pacific green sea turtles (DPS #10 in Figure 19).

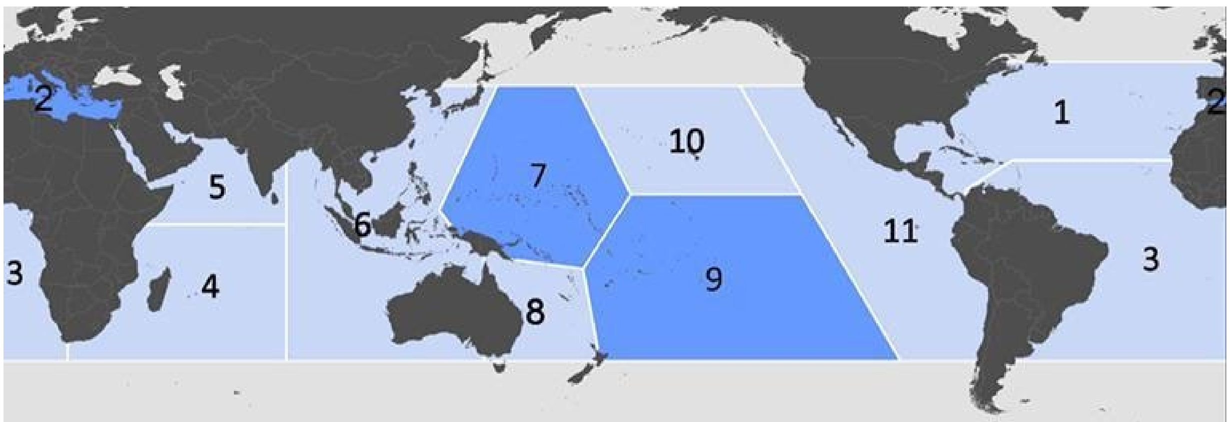

Figure 19. Overview of listed green sea turtle species, where (10) is the Central North Pacific DPS. Light blue indicates threatened populations.

4.2.1.1 Distribution and Population Structure

The distribution of Central North Pacific green turtles encompasses the Hawaiian Archipelago and Johnston Atoll. It is bounded by a four-sided polygon with open ocean extents reaching to 41˚N,169˚E in the northwest corner, 41˚N, 143˚W in the northeast, 9˚N, 125˚W in southeast, and 9˚N, 175˚W in the southwest (Figure 20). About 96% of the nesting occurs in French Frigate Shoals and half of the nesting in French Frigate Shoals occurred on East Island. Based on spatially concentrated (limited) distributions of nesting and lack of evidence of genetic substructuring, Seminoff et al. (2015) concluded that the Central North Pacific green sea turtle consists of a single population.

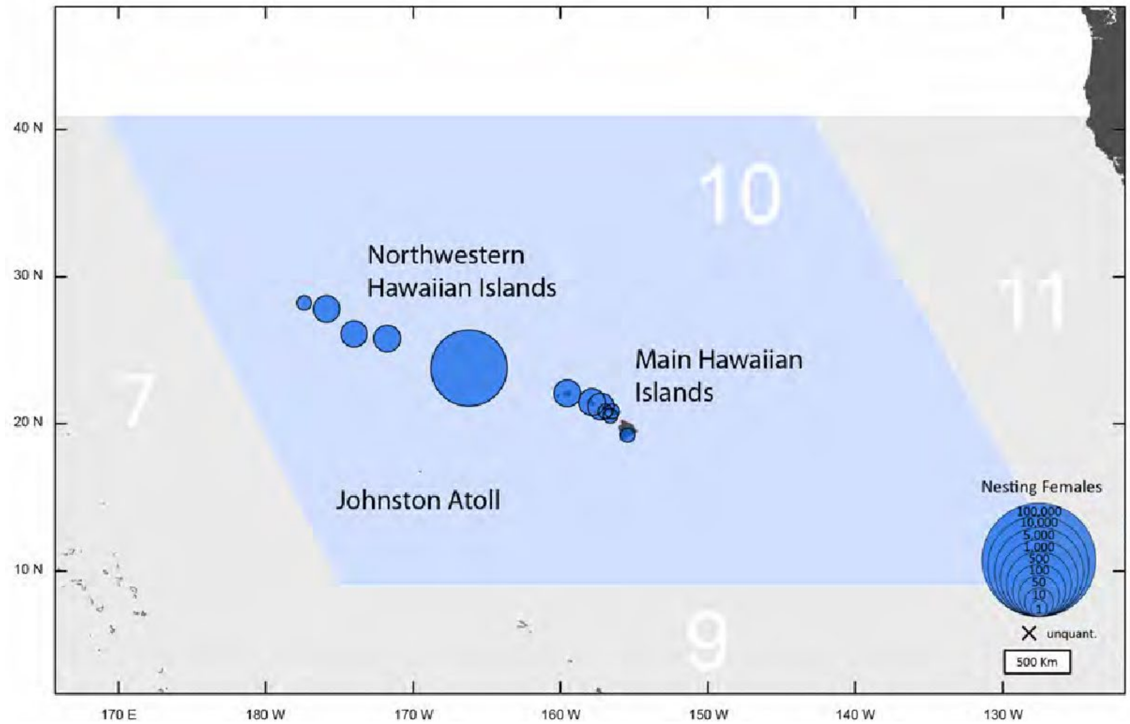

Figure 20. Nesting distribution of Central North Pacific green sea turtles. Size of circles indicates estimated nester abundance. The geographic range of this species encompasses the entire Hawaiian archipelago and Johnston Atoll.

Variations in sea turtles' spatial distribution in given regions is explained by the availability of resources, which is highly correlated with environmental features such as structural complexity of habitats and water temperature. Benthic structure and cover type have been found to be significant predictors of sea turtle abundance (Rincon-Diaz et al. 2011; Williams et al. 2017), thus a characterization of benthic habitats within foraging grounds is essential to examine relationships between habitat type and sea turtle presence. Sea surface temperature also impacts turtle distribution (Hawkes et al. 2007; Becker et al. 2019). Size-partitioning of sea turtles within their feeding areas have been described for green turtles. Bresette et al. (2010) found size-class differences according to bathymetry, with juvenile green turtles using shallower locations whereas larger individuals were sighted foraging in deeper waters, revealing distinct habitat requirements according to turtle size.

During their pelagic phase, juvenile green turtles have a varied diet that includes planktonic material including crustaceans, jellyfish, and ctenophores. Sub-adults and adult green turtles predominately eat benthic marine algae (Bjorndal 1997). In Hawaii, adults and benthic-foraging juveniles are selective foragers that target a few species but opportunistically feed on many others, including: 275 species of marine macroalgae, two species of seagrass (*Halophila hawaiiana and Halophila decipiens*), and nine marine invertebrate taxa (Balazs 1980; Russell et al. 2003; McDermid et al. 2015). The most common diet items include seagrass (*H. hawaiiana*) and nine species of benthic red, green, and brown algae, including: *Ulva fasciata, Codium edule, Codium arabicum*, and *Codium phasmaticum* throughout the Archipelago; *Pterocladia capillacea* and *Amansia glomerata* in the MHI; and *Caulerpa racemosa, Spyridia filamentosa,* and *Turbinaria ornata* in the Papahanaumokuakea Marine National Monument (Balazs 1980). The analysis of 2,471 digestive track samples, collected over 35 years, revealed more than 30 animal taxa, including cnidarians, mollusks, crustaceans, echinoderms, and sponges (Russell et al. 2011).

Green sea turtles are known to reside in a home range – an area in which an individual inhabits to undergo daily activities (Seminoff *et al*. 2002; Bailey 1984). Within these home ranges, green sea turtles may occupy multiple activity centers, which may be characterized by priority foraging or resting areas (Lamont *et al*. 2015). An individual's home range can vary in size and shape, and may be characterized by and dependent on availability of resources, generally overlapping with foraging and shelter sites (Lamont *et al.* 2015; Makowski *et al.* 2006; Seminoff *et al.* 2002). Balazs et al. (2017) calculated "Minimum Home Range" values of green sea turtles in Hawaii that ranged from 0.1 – 20.4 km2 (0.04 mi2 – 7.88 mi2), with a mean of 7.2 km2 ± 7.7 km2 (2.78 mi2 ± 2.97mi2).

The population dynamics of green sea turtles are usually based on adult females (or the number of nests laid), rather than their male counterparts. The spatial structure of male sea turtles and their fidelity to specific coastal areas is unknown; however, we discuss sea turtle populations based on the nesting beaches that female sea turtles return to when they mature. Because the patterns of increase or decrease in the abundance of sea turtle nests over time are determined by internal dynamics rather than external dynamics, we make inferences about the growth or decline of sea turtle populations based on the status and trend of their nests.

The life cycle of green sea turtles encompasses several stages: eggs, hatchlings, juveniles, sub-adults, and adults. The dynamics are determined by the number of eggs that survive to adults and the number of adults that produce those eggs. After the hatchlings emerge from the nest and enter the ocean, they are thought to reside in the pelagic environment in the north central Pacific region. Juveniles then recruit to Hawaiian coastal foraging habitats, at approximately 35 cm in straight line carapace length (SCL) (Balazs & Chaloupka 2004). Distribution of adults, subadults and juveniles above 35 cm SCL in Hawaii seem to overlap, and it is mostly determined by the presence of sites with suitable breeding, foraging, and resting habitats (Balazs 1980). Green turtles settle into foraging grounds around the main Hawaiian Islands, showing strong fidelity to preferred foraging areas (Balazs 1976; Bennett et al. 2000; Balazs et al. 2017) and exhibit diurnal foraging/nocturnal rest cycle (Balazs 1996).

Adult females can take 30 to 50 years to become sexually mature, and the average size at first reproduction for green turtles in Hawaii is 89 cm SCL (Balazs et al. 2015). Once mature, Hawaiian green turtles generally reproduce every 4 years, laying 4 clutches of eggs per season, with an average of 104 eggs per clutch (Balazs et al. 2015). Adult females may remain reproductively active for up to 38 years (Balazs et al. 2015). Given that most of the data we collect on this species consists of counts of adult females on nesting beaches, we have limited understanding of stock structure and total population dynamics.

In the early 1990s resident green turtles in Hawaii began to display non-reproductive terrestrial emergence behavior (or 'basking') ashore, which has increased throughout the Archipelago over time (Van Houtan et al. 2015; Seminoff et al. 2015). Green turtles bask on beaches for rest, thermoregulation, digestion, and predator avoidance (Balazs 1977; Wittow and Balazs 1982; Rice and Balazs 2008; Van Houtan et al. 2015).

Based on the behavior of post-hatchlings and juvenile green turtles raised in captivity, it is presumed that those in pelagic habitats live and feed at or near the ocean surface, and that their dives do not normally exceed several meters in depth (NMFS and FWS 1998). The deepest dives recorded for green turtles are from adults migrating from the MHI to the Northwest Hawaiian Islands. Several of these turtles dove to greater than 100 m depth in pelagic areas, where they may have been feeding on plankton, resting, or avoiding predators (Rice and Balazs 2008). Hatase et al. (2006) observed nighttime dives >20 m and indicated that green turtles were not only resting, but also feeding on macroplankton that exhibit diel migrations. Neritic green turtles typically forage in shallow coastal areas, primarily on algae and seagrass.

4.2.1.2 Status and Trends

The Central North Pacific green sea turtle is listed as threatened under the ESA. The internationally-recognized IUCN Redlist categorized this species as "near threatened" in 2012 and estimated at that time a population size of approximately 265,600 turtles or more (Chaloupka and Balazs 2007; Pilcher et al. 2012; IUCN 2012). Our NMFS modeling estimates the current population size to be about 682,296 individuals (range: 460,965 to 1,145,988) above the age of one based on the estimate of 3,846 adult females (Seminoff et al. 2015). We specifically developed a pre-breeding census population model for the Central North Pacific green sea turtle based on the reproductive values of Balazs et al. (2015), and the survival rates and range of age at maturity reported in Piacenza et al. (2016, 2017). The model was semi-stochastic in that we allowed the values for juvenile and adult survival and age at maturity to range across the values reported in the literature.

During the most recent ESA status review, the abundance of nesting females was estimated at 3,846 (Seminoff et al. 2015), or approximately 500 females nesting annually at French Frigate Shoals (aka. Lalo). This is a substantial increase since nesting surveys at the French Frigate Shoals index beach began in 1973 (Balazs and Chaloupka 2004). Balazs et al. (2015) report that the sex ratio of adults is female biased with 61.6% females, hence we estimate a total adult breeding population size of approximately 6,500.

Counts of nesting female green turtles have increased over the past 40 years by an average annual rate of 5.4% (Balazs et al. 2015; Figure 21, NMFS unpublished). Estimates of the in-water abundance of green turtles have increased in a pattern that is similar to that of nesting trends (Balazs and Chaloupka 2004; Chaloupka et al. 2008a). In addition, there has been a dramatic increase in the number of basking turtles in the MHI and the Northwest Hawaiian Islands (Whittow and Balazs 1982; Parker and Balazs 2010). These increases have been attributed to increased survivorship (since harvesting of turtles in foraging areas was prohibited in the mid-1970s) and egg harvest prohibitions at the French Frigate Shoals rookery since the early 1950s (Balazs and Chaloupka 2004).

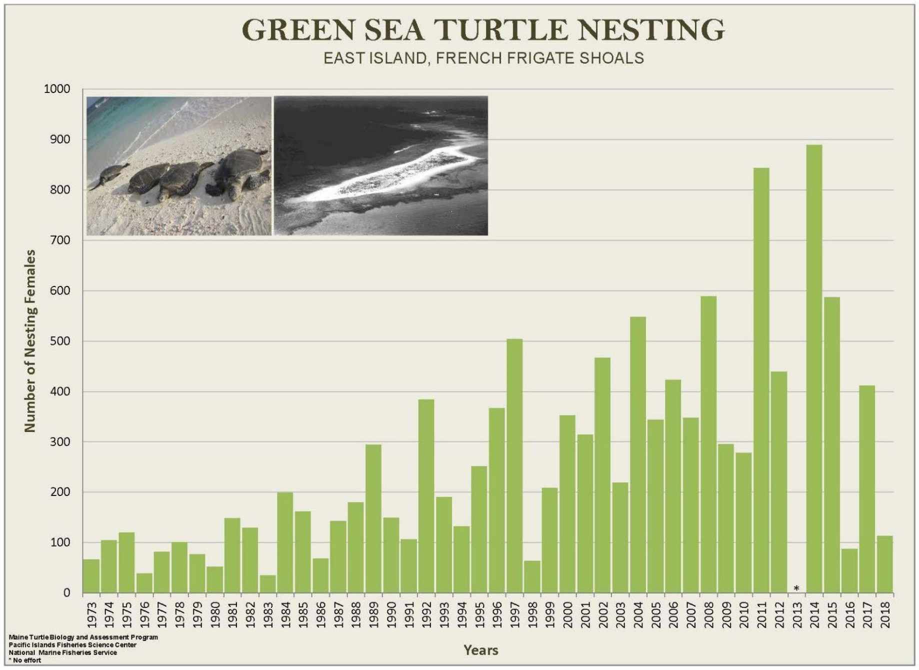

Figure 21. Counts of nesting Green sea turtle females on East Island, French Frigate Shoals (source: NMFS unpublished).

Although the trajectory of the nesting population has been increasing in recent years, the distribution of this green turtle has declined substantially: as much as 80% of historically major nesting sites have been extirpated or the abundance of nesting females at these sites has declined substantially between 1875 and 2012 (Kittinger et al. 2013). Nesting that once occurred across a wide geographic area has been largely concentrated in a small geographic area: more than 96% of nesting occurs at French Frigate Shoals in the Northwest Hawaiian Islands, which is a low-lying coral atoll that is susceptible to erosion, geomorphological changes, and sea level rise (Seminoff et al. 2015).

A range contraction of this magnitude usually places vulnerable species at greater risk of extinction because it makes them more susceptible to being destroyed by random events such as severe storms (Udvardy 1969; Towns and Daugherty 1994; Lomolino and Channel 1995, 1998; Gaston et al. 2000; O'Grady et al. 2004; Reed 2004; Collen et al. 2011; Seminoff et al. 2015). Indeed, in 2018, Hurricane Walaka demolished East Island, which was the index beach representing over 40 years of nesting trend for the population and supported about half of the nesting activity at French Frigate Shoals. Given the instability of East Island, in 2019 Tern Island was officially identified as the new index site at French Frigate Shoals for the Central North Pacific green sea turtle population. Fortunately comprehensive monitoring at Tern Island started in 2017 and therefore we have four nesting seasons of data for Tern (2017 – 2021, with no monitoring in 2020 due to COVID travel restrictions). During this time, nesting has fluctuated between 86 females in 2018 and 645 females in 2021, with an average of 323 females nesting annually (NMFS unpublished).

The collapse of their geographic nesting range, the concentration of nesting to a small geographic area, and the destruction of the index nesting area for the species has placed Central

North Pacific green turtles in a natural experiment to understand adaptability and resilience in response to climate change and habitat loss. Tiwari et al. (2010) suggest that other nesting beaches that could support substantially more nesting activity are available to Central North Pacific green turtles within their current distribution. While research is ongoing to understand how the population is responding to habitat loss at East Island, preliminary data is promising and indicative that animals are successfully utilizing alternate nesting habitat. In fact, increased nesting activity has been observed within the Main Hawaiian Islands. During the 2020 nesting season, approximately 231 nesting events were documented state-wide with 58 nests documented on Oahu compared to less than 10 nests in previous years (USFWS unpublished).

4.2.1.3 Threats to the Species

Historically, Hawaiian green turtles were subjected to intense harvesting pressure first by indigenous Polynesians, then by Europeans as they explored the region, then again during World War II (Kittinger et al. 2011, 2013; Van Houtan et al. 2014). By 1950, nesting was essentially extirpated everywhere except on a single remote atoll. Between 1948 and 1974, the cumulative harvest of green turtles was estimated at between 5,000 and 6,000 turtles, or 180 to 230 turtles per year. Before the population collapsed, these annual totals would have been collected in a single day (Amerson et al. 1974; Clapp and Wirtz 1975; Kittinger et al. 2011; Van Houtan et al. 2014). Since they were listed pursuant to the ESA in 1978, the harvest of green turtles has been illegal although anecdotal reports suggest that some harvesting continues (Seminoff et al. 2015).

Currently, the primary threats to the population include coastal gill net and hook-and-line fisheries, vessel strikes, and fibropapillomatosis disease (NMFS unpublished stranding data). Chaloupka et al. (2008) reported that approximately 7% of strandings were attributed to hook-and-line fishing gear induced trauma, and 5% for gillnet fishing gear-induced trauma between 1982 and 2002. However, fishery interactions have increased over time with at least 50% of strandings now attributed to coastal fisheries (hook-and-line and gillnet) (Francke et al. 2013). For example, in 2018 (the last year data was compiled), there were 120 hook-and-line related strandings out of approximately 320 strandings (NMFS unpublished stranding data). A modest number of green turtles (0.003 takes per 1,000 hooks) interactions occur in Western Pacific federally-managed commercial longline fisheries (WPRFMC 2020).

Vessel strikes can result in lethal and sub-lethal injuries (Kelly 2020; NMFS unpublished stranding data; Chaloupka et al. 2008). In Hawaii, as many as 200 green sea turtle strikes may occur annually (Kelly 2020). Vessel strikes are not evenly distributed throughout the islands but are concentrated in areas where small vessel activity is highest (e.g., near small boat harbors and boat launches), such as Kaneohe Bay and Pearl Harbor on Oahu (Kelly 2020). Green sea turtles are most vulnerable to small vessels (< 15 m), traveling at fast rates (>10 kts) (summarized in Kelly 2020). Increased vessel speed decreases the ability of sea turtles to recognize a moving vessel in time to dive and escape being hit, as well as the vessel operator's ability to recognize the turtle in time to avoid it. The average size of green turtles struck by vessels in Hawaii was 74 cm SCL (range 39.1 cm to 98.7 cm SCL) of which 65% of all strandings were over 70 cm SCL; 45% of all strandings were over 80 cm SCL; and 13% (n= 12) of all strandings were over 90 cm SCL. Given that the mean breeding size for CNP green turtles is 90.7 cm SCL (range is 74.6 cm to 105.5 cm SCL) (Balazs *et al.* 2015), at least half of all boat strike related strandings may have affected breeding adults. This pattern is also consistent with vessel related strandings observed in other areas, such as Florida and Australia (Foley *et al.* 2019; Hazel and Gyuris 2006). Vessel strikes disproportionately affecting large subadults or adult turtles is concerning because they are essential for recovery and maintaining reproductive capacity of the population (Heppell *et al.* 2000).

The turtles' main food source, macroalgae, is available in neritic areas throughout the main Hawaiian Islands, where coral reef habitats are exposed to land-based sources of pollution, overfishing, and recreational overuse (Friedlander et al. 2005). Such activities may result in siltation, sedimentation, sewage, and contamination of foraging areas (Bowen et al. 1992; NMFS and USFWS 1998; Friedlander et al. 2006; Wedding and Friedlander 2008; Wedding et al. 2008; Van Houtan et al. 2010). Discharges from agriculture, development, construction, and stormwater can have a significant effect on the taxonomic and chemical composition of algal communities (e.g., Lapointe and Bedford 2011; Dailer et al. 2010; Swarzenski et al. 2017).

Recreational and vessel activities, such as groundings and anchoring, damage seagrass beds and coral reefs, which provide substrate to algal communities. In addition to reducing food resources, environmental degradation may be linked to increased incidence of fibropapillomatosis (Hargrove et al. 2016), which was one of the threats identified in the listing of the Central North Pacific DPS (81 FR 20057, April 6 2016). Fibropapillomatosis primarily affects medium-sized immature turtles in coastal foraging pastures; it results in oral and internal tumors (often severe) that may reduce survivorship (Hargrove et al. 2016). While its incidence has declined over time (Chaloupka et al. 2009), it persists in the population (VanHoutan et al. 2010; NMFS unpublished stranding data). Military activities, including the explosion of unexploded ordinances, may also degrade or destroy reefs and seagrass beds.

Emerging concerns for habitat throughout the Hawaiian Archipelago are phenomena related to climate change, including changing storm dynamics and intensity, and loss of nesting habitat (Baker et al. 2006; Baker et al. 2020; Keller et al. 2009). Weather events, such as storms and seasonal changes in current patterns, can reduce or eliminate sandy beaches, degrade turtle nesting habitat, and cause barriers to adult and hatchling turtle movements on affected beaches. Effects of climate change include, among other things, sea surface temperature increases and the alteration of thermal sand characteristics of beaches (from warming temperatures), which could (and has) result in the feminization of populations (Hawkes et al. 2009; Poloczanska et al. 2009; Jensen et al. 2018). As described in Seminoff et al. (2015), Baker et al. (2006) examined the potential effects of sea level rise in the Northwest Hawaiian Islands and found that the primary nesting area for the Central North Pacific population is threatened by sea level rise through possible loss of nesting habitat. For example, Whale-Skate Island at French Frigate Shoals was formerly a primary nesting site for these green turtles, but the island has subsided and is no longer available for nesting (Kittinger et al. 2013). Trig, Gin, and Little Gin could lose large portions of their area (Baker et al. 2006). Additionally, habitat degradation resulting from the release of contaminants contained in landfills at Tern Island at French Frigate Shoals and other areas of the Northwest Hawaiian Islands could occur as the islands erode or are flooded from sea level rise (Keller et al. 2009).

4.2.1.4 Conservation

In the United States, NMFS and the U.S. Fish and Wildlife Service (USFWS) have joint jurisdiction for sea turtles, with NMFS having the lead in the marine environment and USFWS responsible for turtles when on land. Both federal agencies, along with state and U.S. territory agencies, work together to conserve and recover sea turtles and have issued regulations to eliminate or reduce threats to sea turtles.

The major recovery actions for green turtles include: Protecting sea turtles on nesting beaches and in marine environments; Protecting nesting and foraging habitats; Reducing bycatch in commercial, artisanal, and recreational fisheries; Reducing the effects of entanglement and ingestion of marine debris; Reducing vessel strikes in coastal habitats; Studying the impact of diseases on turtles; Working with partners internationally to protect turtles in all life-stages; and Supporting research and conservation projects consistent with Recovery Plan priorities. For the Central North Pacific population, the U.S. Pacific Populations of Green Turtle Recovery Plan applies and helps guide conservation and recovery actions.

The State of Hawaii's efforts to conserve green turtles include: Wildlife regulations; coordination of stranding response and specimen storage on the islands of Maui, Hawaii, and Kauai; issuance and management of special activity permits; statewide outreach and education activities; and nest monitoring on Maui (DLNR 2013). Hawaii Division of Aquatic Resources staff responds to stranded turtle reports and issues special use permits to researchers and educators. The Division of Conservation and Resources Enforcement investigates reports of illegal poaching, provides support and security at some nest sites and strandings, and addresses complaints from the public regarding turtle disturbances.

Conservation efforts and ESA protections over the past several decades are showing promising signs of success. The prohibitions on killing sea turtles in their MHI foraging habitats and collecting their eggs from nesting beaches were likely the primary measures that led to increasing numbers of green turtles nesting in Hawaii. Additionally, NMFS promotes responsible sea turtle viewing (of at least 10 feet (or 3 meters) on land and in the water) to reduce public disturbance, and a few community-based stewardship programs help to reduce negative human/turtle interactions at a number of popular basking areas. The State of Hawaii has also received ESA section 6 funding from NMFS over the past decade to raise awareness and capacity of recreational hook-and-line fishermen to help address (and hopefully reduce) accidental interactions. NMFS also collaborates closely with the State of Hawaii Department of Boating and Ocean Recreation to promote measures to reduce or prevent vessel strikes. Despite these efforts, threats to the population persist, including: disease (fibropapilloma), fishery interactions, vessel strikes, habitat loss and habitat degradation, and impacts from climate induced changes such as sea level rise and increasing temperatures.

4.2.2 Hawksbill Sea Turtle

4.2.2.1 Distribution and Population Structure

Hawksbill sea turtles are globally listed as endangered under the ESA and are globally distributed (Figure 22), occurring in at least the insular and western Caribbean, southwestern and eastern Atlantic, the southwestern, northwestern, and central/ eastern Indian Ocean, and the western, central, and eastern Pacific (NMFS 2022b).

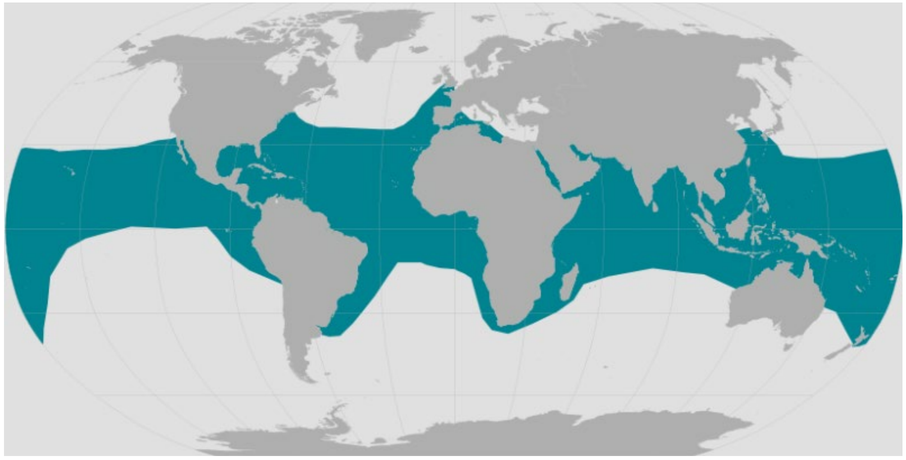

Figure 22. World map providing approximate representation of the hawksbill turtle's range.

Genetic research has demonstrated a deep bifurcation between hawksbill lineages in the Pacific and Atlantic Oceans (Vargas et al 2015; Okayama et al. 1999). Given that it is highly unlikely that hawksbill sea turtles from the Atlantic will occur in the Pacific, and therefore in Hawaii, we focus the rest of our assessment and analysis on hawksbill sea turtle populations across the Pacific and Oceania.

In the Pacific Ocean, Hawksbill sea turtles nest broadly throughout, with the largest nesting concentration occurring within Oceania on remote islands in Australia's Great Barrier Reef World Heritage Area (GBR), Australia's Torres Strait area, and Arnavon Islands in the Solomon Islands (NMFS and USFWS 2013). Based on known nesting, Wallace et al. (2010) suggest six Regional Management Units for hawksbill sea turtles in the Pacific: East Pacific, North Central Pacific (Hawaii), South Central Pacific, Southwest Pacific, West Central Pacific, and West Pacific/Southeast Asia. More recent research using mtDNA markers has shown several distinct hawksbill nesting populations in the West, Central, and East Pacific (Gaos et al. 2016, 2018; Vargas et al. 2016; Banerjee et al. 2019; Gaos et al. 2020) (Figure 23). These studies have also revealed an exceptionally large proportion of shared mtDNA haplotypes among nesting beaches in the Pacific Ocean, which complicates analysis and limits robust genetic assessments of nesting population contributions (Gaos et al. 2016). It is difficult to characterize the population structure and natal origins of hawksbills at foraging habitats in the Pacific Ocean.

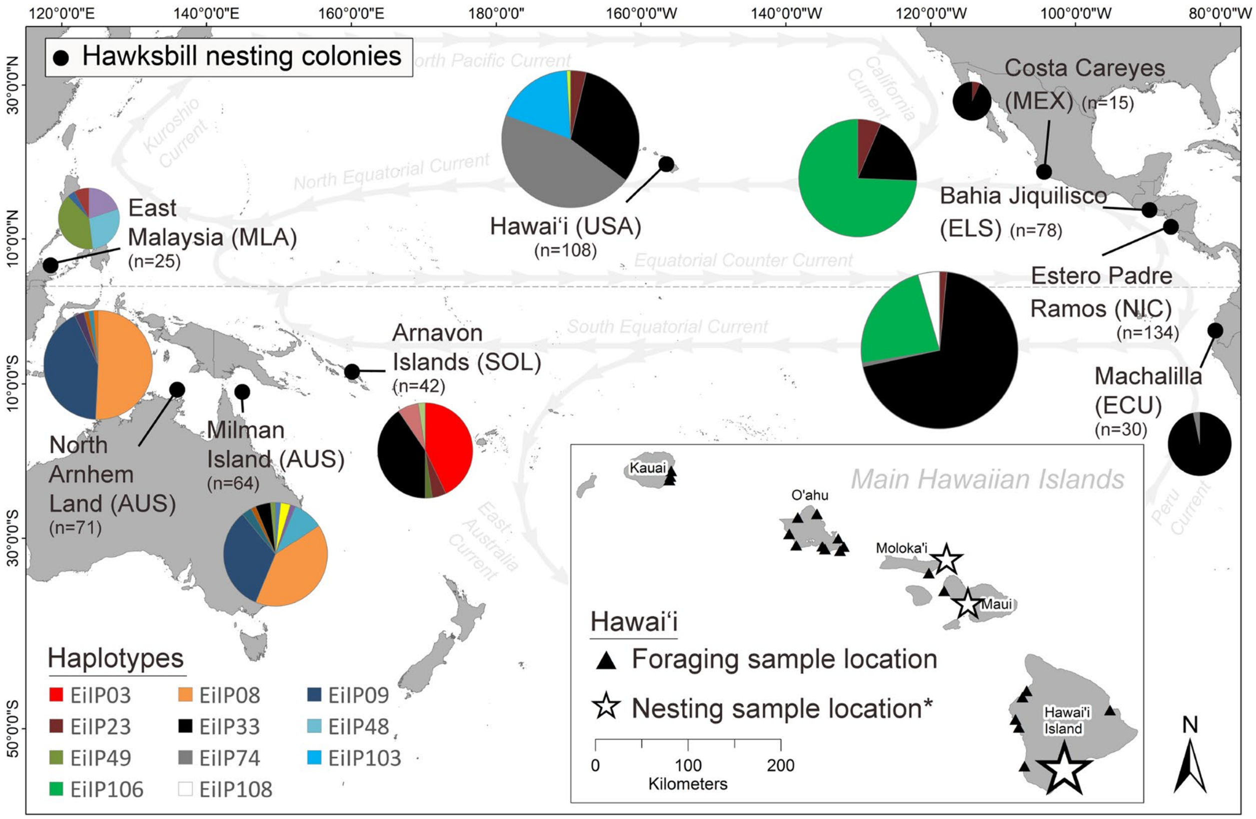

Figure 23. Hawksbill nesting colony locations and nesting stock structure and haplotype frequencies for each nesting colony in the Pacific Ocean, with node sizes corresponding to sample sizes for each given site (Gaos et al. 2020).

Gaos et al. (2020) found strong differentiation between the Hawaii hawksbill nesting colony and those in the West and East Pacific, indicating that the Hawaii nesting colony may be demographically isolated. Gaos et al. (2020) also found evidence that the Hawaii nesting colony is likely the primary source of juvenile hawksbills occurring at foraging grounds around the archipelago. Satellite telemetry results support this theory (see discussion below). However, hawksbill sea turtles in Hawaii have not been identified as a distinct population, and there is evidence of potential dispersal of turtles from the Hawaiian nesting colony to foraging grounds in the West Pacific (Gaos et al. 2020).

Hawksbill turtles use a variety of habitats during different stages of their life cycle, but neritic juveniles and adults largely inhabit nearshore foraging grounds, especially healthy coral reef habitats. Juvenile and adult hawksbills have been sighted in marine habitats throughout Hawaii, including in harbors (e.g., Koolina and Pearl Harbor) and more commonly, along the open coast. Numerous sightings have been reported at foraging habitats along west Maui (King 2015; www.HIhawksbills.org). In the Eastern Pacific, large hawksbill populations have been found in mangrove estuaries (Gaos et al. 2017).

Upon leaving their nesting beaches, most hawksbill hatchlings enter pelagic (open sea) habitat, where they take shelter in floating algal mats and drift lines of flotsam and jetsam for approximately 1 to 5 years. Eventually, juveniles migrate to shallower coastal feeding grounds, including their preferred coral reef habitats, where they mature to adulthood and spend the remainder of their lives. The ledges and caves of coral reefs provide shelter for resting hawksbills during the day and at night. Hawksbills are also found around rock formations, high energy shoals (sand bars in shallow water), and estuaries that provide good habitat for sponge growth.

While most sea turtle species demonstrate clear patterns of early pelagic development, direct evidence of a pelagic post-hatchling development phase for hawksbill turtles in Hawaii is lacking. Of the hawksbill sightings measuring 8–34 cm straight carapace length, corresponding to individuals 0-4 years of age, all came from the coastal waters surrounding Hawaii, which suggest that Hawaiian hawksbills may lack a pelagic post-hatchling phase (Van Houtan et al. 2016). The average home range size for hawksbill sea turtles is smaller (or tighter) than that of green turtles, generally less than 1 km^2 (0.39 mi^2; Seminoff et al. 2002; Gaos et al. 2018; Gaos et al. 2010, 2012a, 2012b).

Compared to green and loggerhead sea turtles, hawksbill sea turtles may exhibit faster growth rates and earlier maturation ages. Analysis using skeletochronology estimated that Hawaii hawksbills reach sexual maturity at 17–22 years, at a size of 78.6 cm SCL (Snover et al. 2013). However, using bomb ^{14}C dating technique, Van Houtan et al. (2016) estimated age at sexual maturity of hawksbills in Hawaii to be 29 years (range 23–36).

Limited data on habitat use exists for hawksbill turtles in Hawaii. Juvenile and adult hawksbills have been sighted in marine habitats throughout the state, including in harbors (e.g., three juveniles sighted in Koolina harbor in April 2017), but more commonly along the open coast. Numerous sightings have been reported at foraging habitats along west Maui, likely due to directed efforts by conservation organizations and collaborators in the area (King 2015; see www.HIhawksbills.org). In 2015, three adult females were captured and satellite tagged in foraging habitats off Kahekili, Maui. All three tracks indicated highly restricted foraging home ranges, and none of the turtles undertook nesting migrations during the two years the transmitters were active (NMFS unpublished data).

A total of 15 post-nesting female hawksbill turtles in Hawaii have been equipped with satellite telemetry tags to investigate post-nest migrations and habitat use (Parker et al. 2009; Graham 2009; Parker et al. 2014; NMFS unpublished data). Of these turtles, one female undertook a surprising migration, first heading north of the Main Hawaiian Islands, then traveling southwest approximately 2,000 km before transmissions ceased west of Johnston Atoll, and another turtle appeared to use pelagic habitats following a week in Kauai's nearshore waters (Parker et al. 2014). In contrast to the international long-distance migrations of south Pacific hawksbills (Hamilton et al. 2015; Hamilton et al. 2021), the majority (86.7%) of post-nesting hawksbill females equipped with satellite tags have remained within the Hawaiian archipelago, with 53.3% migrating to the Hamakua coast of Hawaii Island (Parker et al. 2009; Graham 2009; Parker et al. 2014; NMFS unpublished data).

Hawksbill diet can vary substantially by location. Studies in the western Pacific have demonstrated diets consisting largely of algae (Bell 2013), while in the eastern Pacific the species has been documented feeding on tunicates, sponges, mangrove shoots and various invertebrates (Carrion-Cortez et al. 2013; Rivas 2017). In Hawaii, hawksbills have been observed foraging on a variety of prey including octopus, algae, fireworms, black sponges, urchins, frogfish, and more (King 2011, 2015; King and McLeish 2016).

4.2.2.2 Status and Trends

Hawksbill sea turtles were listed globally as endangered in 1970. Hawksbills are one of the rarest of the seven extant species of marine turtles that has seen global population declines of > 80% during the 20th century (Mortimer and Donnelly 2008). Currently no global total population estimate exists for this species, however based on the mean annual reproductive effort reported in NMFS and USFWS (2013), an estimated total of 22,004 to 29,035 hawksbill females may nest each year among the 88 global nesting sites included in the 2013 ESA status review.

Hawksbill sea turtle nesting information for nine primary locations within Oceania (excluding Hawaii) includes GBR, Papua New Guinea (PNG), Solomon Islands, Vanuatu, Fiji, the FSM, Republic of Palau, and the Samoan Islands (Independent Samoa and American Samoa). Hawksbill sea turtle nesting may occur elsewhere within this region (such as in Hawaii), but any such nesting is thought to be in very low numbers. Thus, the total number of annual nesting females in Oceania is estimated based on information from the nine locations mentioned above at 5,400 – 6,160 females annually, with an overall downward trend (NMFS and FWS 2013), although there is indication of some positive trends such as in the Solomon Islands where the nesting population is showing early signs of recovery following the establishment of the Arnavons Community Marine Conservation Area in 1995 (Hamilton et al., 2015). We note that much of the information on abundance and trends in Table 16 are based on anecdotal information; however it represents the best available information that was available prior to 2013 (NMFS and FWS 2013).

Table 16. Summary of nesting information from 2013 ESA Status Review for hawksbill sea turtles in Oceania (NMFS and FWS 2013). NOTE: this table does not include more recent nesting data available for Hawaii.

Location	**Annual nesting females**	
	Estimate	**Trend**
Australia	4,000	Decreasing
Papua New Guinea	~500-1,000	Decreasing*
Solomon Islands	200-300	Increasing
Vanuatu	>300	Unknown
Fiji	100-200	Decreasing*
Palau	15-25	Decreasing*
Federated States of Micronesia	~300	Decreasing*
Samoan Islands	>10-30	Decreasing*
Mariana Islands**	5-10	Decreasing*
Total	5,430-6,165	Decreasing

*Trend information is based on documented anecdotal evidence from local residents, not on long term nesting beach monitoring data sets.
** The Mariana Islands is referenced in NMFS and FWS (2013) and therefore included in this summary table; however, no nesting activity has been documented in the Mariana's over the last decade.
+ Nesting activity in the Arnavon Islands is currently increasing but still a fraction of historic levels (Hamilton et al. 2015).

Since publication of the 2013 ESA status review, additional data on nesting hawksbills in Hawaii has become available. The nesting colony in Hawaii may constitute one of the smallest hawksbill nesting populations in the world, but the largest in the Central North Pacific (Gaos et al 2020) with approximately 14 +/- 4.3 (range: 5–26) nesting females per year and 48 +/- 19.0 (range: 12–93) annual nests (Gaos et al. 2021), with a cumulative total [at the time of publication] of 178 individual nesting females (Seitz et al. 2012). In Hawaii, the majority of nesting females (78.4%) and nests laid (86.5%) were recorded at four beaches along the southern coast of Hawaii Island, however, recent (2018) monitoring at a beach on Molokai Island revealed nest numbers similar to these important beaches on Hawaii Island (Gaos et al. 2021), and therefore there might be twice as many nesting females in the population. Additionally, the number of nesting females and nests have been positively trending since 2006, including a higher percentage (57.1% of annual cohorts) of neophyte (vs. remigrant) nesters (Gaos et al. 2021). Additional nesting occurs on Maui (1 to 2 females per year) and suspected nesting on Lanai.

We estimate the total population of the hawksbill sea turtles in Oceania (see Table 16) at 2,592,331 sea turtles (juveniles greater than one-year-old and adults). This estimate is based on the lower nester abundance level of 5,430 annual nesting females (see Table 16) per year, a remigration interval of 3.5 years, laying one to six clutches in a nesting year (average of 3.2 nests per year), with 175 eggs per nest, a nest survival rate of 0.69 (metrics from Seitz et al. 2012 for Hawaii hawksbill sea turtle nests), a sex ratio of 4.8:1 (females to males; Brunson et al. 2022), first year survival of 0.44, small juvenile survival of 0.64, and large juvenile survival of 0.85 (using survival rates estimated for green sea turtles in Australia as a proxy; Chaloupka 2002), and lastly 22 years to reach maturity (Snover et al. 2013). We estimated 2,098,152 hatchlings may emerge from nests in a year, but due to the high rate of mortality, we used juveniles (greater than one-year-old) and adults as our abundance metric.

4.2.2.3 Threats to the Species

A wide variety of human activities can adversely affect hawksbill turtles or their habitats, including: beach erosion from beach armoring and nourishment; artificial lighting; human presence on nesting beaches; beach driving; coastal construction that alter patterns of erosion and accretion on nesting beaches; fishery bycatch; vessel collisions; and poaching.

The primary threat to hawksbill sea turtles globally has been the direct exploitation and harvest of turtles for their shells (‘tortoiseshell’ or ‘bekko’) and eggs (Frazier 2003; Pita and Broderick 2005; Mortimer and Donnelly 2008; Hamilton et al. 2015; Miller et al. 2019; Humber et al. 2014; Senko et al. 2022). The largest source of mortality identified for south Pacific hawksbill sea turtles has been their harvest for food and tortoiseshell in the broader Coral Sea and Southeast Asian regions (Allen 2007; Limpus and Miller 2008; Miller et al. 2019; Lam et al. 2012). Recent estimates suggest that 9 million hawksbill turtles (or 60,000 turtles annually) were traded globally over an approximate 150-year period (1844 to 1992) for their shells (Miller et al. 2019). In the Solomon Islands specifically, hawksbill turtle shell exports peaked during the late 1980s with over 4000 adult hawksbills killed each year to supply Japanese ‘bekko’ markets (Limpus and Miller, 2008). Recently, The Nature Conservancy (TNC) surveyed the number of sea turtles taken at 10 coastal communities in the Solomon Islands and documented 1,107 marine turtles harvested of which 74% were green turtles and 26% hawksbill sea turtles (Vuto et al. 2019).

Fisheries bycatch in artisanal and industrial fishing gear also affects hawksbill sea turtles. Since hawksbills may not occupy pelagic waters for pronounced periods of time (Van Houtan et al. 2016), they are not primarily (or typically) impacted by high-seas commercial fisheries, but are particularly susceptible to bycatch in nearshore artisanal fisheries gear (Brunson et al. 2022; Liles et al. 2017; NMFS unpublished stranding data). These fishery practices include drift netting, set netting, hook-and-line, and trawl fisheries, and their adverse impacts on sea turtles have been documented in marine environments throughout the world (Lutcavage et al. 1997; Epperly 2003; Wallace et al. 2013; Liles et al. 2017).

In Hawaii, the primary threat to juvenile and adult hawksbill sea turtles is bycatch or interactions in nearshore coastal fisheries (hook-and-line fisheries, nets, and crab/lobster traps), or 49% of strandings (n=111) between 1984 and 2018 (Brunson et al. 2022). Additional threats include: emaciation, hatchling predation (by mongooses, cats, rats), vessel strike, automobile strike (of 2 adult females while crossing North Kihei Road, Maui), ingested plastics, and flood/ tsunami displacement (Brunson et al. 2022). Additionally, nesting habitat can be impacted by recreational activities (e.g., camping, driving on beaches, light pollution) that can negatively affect both nesting females and hatchlings (Gaos et al. 2021).

Vessel collisions are also a threat, with increasing boat traffic increasing the likelihood of boat strikes (NMFS and FWS 2007b, 2013). In Australia, five stranded hawksbill sea turtles in 2011 were determined to have injuries from boat strikes (Meager and Limpus 2012). In Hawaii, Brunson et al. (2022) reports three (3) vessel collisions between 1984 and 2018. A fourth hawksbill turtle vessel strike was documented in Port Allen harbor, Kauai in June 2020 (Kelly 2020).

Phenomena related to climate change, including changing storm dynamics and intensity, and loss of nesting habitat, are emerging concerns for sea turtle nesting habitats throughout the Hawaiian Archipelago (Baker et al. 2006; Keller et al. 2009; Baker et al. 2020). Weather events, such as storms and seasonal changes in current patterns, can reduce or eliminate sandy beaches, degrade turtle nesting habitat, cause barriers to adult and hatchling turtle movements on affected beaches, and increase nest inundation events and embryonic mortality. Many coastlines around Hawaii have already lost significant nesting area to erosion (e.g., impacts to the Kamehameha hawksbill turtle nesting beach) and the reduction of areas available for nesting is expected to continue under future climate scenarios (summarized in Gaos et al. 2021). Climate change also results in increased sea surface temperatures, and can alter the thermal sand characteristics of beaches (from warming temperatures). Warmer sand and warmer nests can result in a greater ratio of female to male hatchlings by reduction or cessation of male hatchling production, and therefore the feminization of populations (Hawkes et al. 2009; Poloczanska et al. 2009; Jensen et al. 2018). Given the skewed, female biased sex ratio in Hawaii (Brunson et al. 2022), anthropogenic climate change may already be affecting the population. Additionally, because hawksbill sea turtles typically inhabit and depend on coral reef communities for food and shelter, they are vulnerable to changes that affect these communities including bleaching events, increased occurrence of disease, and weakening of coral skeletons as a result of global climate change (NMFS 2022a; Langdon et al. 2000; Ohde and Hossain 2004; McWilliams et al. 2005).

4.2.2.4 Conservation

Numerous conservation programs are being implemented throughout the Pacific Ocean to monitor nesting activity, protect nesting habitat and reduce harvest and fisheries bycatch of hawksbill sea turtles (e.g., East Pacific Hawksbill sea turtle Initiative, Hawaii Island Hawksbill turtle Project, Arnavons (ACMCA), etc.; NMFS and FWS 2013; Hamilton et al. 2015; Gaos et al. 2021). Additionally, numerous regulatory mechanisms are in place at international, regional, national and local levels to protect sea turtles (including the South Pacific Regional Environment Programme and the Inter-American Convention for the Protection and Conservation of Sea Turtles). For example, the Solomon Islands hawksbill nesting population is showing early signs of recovery following the establishment of the Arnavons Community Marine Conservation Area in 1995 (Hamilton et al., 2015). While these programs may help hawksbill sea turtles, the species overall continues to decline in the Pacific and Indian Ocean areas due, in large part, to past and ongoing unsustainable harvest for food (eggs) and tortoiseshell, predation, habitat loss and climate change (Limpus and Miller 2008; Mortimer and Donnelly 2008; NMFS and FWS 2013; Miller et al. 2019; Humber et al. 2014; Senko et al. 2022; Vuto et al. 2019).

In Hawaii, numerous management and conservation actions have been implemented to date and many are ongoing state-wide due to a long history of involvement by federal and state institutions, non-governmental organizations and community members dating back to the early 1990s. As a result, the Hawaii nesting colony on the Island of Hawaii is showing modest signs of recovery or at least stability (Gaos et al. 2021). Key partners have included: the USFWS - Pacific Islands Fish and Wildlife Office (PIFWO) and USFWS Kealia Wildlife Refuge, NMFS PIRO and PIFSC, the State of Hawaiʻi Department of Land and Natural Resources (DLNR), the National Park Service's Hawaiʻi Volcanoes National Park (HAVO), Hawaiʻi Wildlife Fund (HWF), Hawaiian Hawksbill Conservation (i.e., www.HIhawsbills.org), various community members, and numerous volunteers (e.g., USFWS Dawn Patrol). This collective partnership – working under relevant USFWS and NMFS research permits – are critical in maintaining momentum and progressing research, conservation and management in Hawaiʻi. PIRO has issued NOAA grants to many of these partners, including HAVO which has received federal grants since 2007 to monitor nesting activity, protect nesting females, and bolster hatchling production along the Kau coast of Hawaii Island. Annual team/partner meetings (aka. the Hawaiʻi Hawksbill Turtle Network), convened by PIFWO and PIRO, facilitate communication, review and track progress, and develop recommendations for on-going and future research, conservation and management activities.

5 ENVIRONMENTAL BASELINE

By regulation, the Environmental Baseline refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The Environmental Baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process. The purpose of describing the Environmental Baseline in this manner is to provide context for effects of the proposed action on listed species.

While the action area for this consultation includes the transit route for the vessel caisson delivery from Norfolk, VA to Pearl Harbor, we focus on describing the environmental baseline in Pearl Harbor. This is where the green and hawksbill turtles addressed in this opinion are likely to be adversely affected by the proposed action.

5.1 Condition of the Species and Habitat within Pearl Harbor

5.1.1 Green Sea Turtle

The Navy has conducted various surveys and assessments of ESA-listed species including turtles in Pearl Harbor over the years. The survey findings, stranding records, and historical and anecdotal information indicate that green sea turtles are common in the harbor, with their distribution and density varying by location (Teresa 2021; UH-ARL 2021; DON 2017; Richie et al. 2016; NMFS unpublished stranding data; NMFS unpublished satellite tag tracks). Green sea turtle presence is considered to be uncommon within the vicinity of PHNSY & IMF, with greater concentrations of individuals occurring along the margins of the channel leading into Pearl Harbor and WP (Teresa 2021; Neyland et al. 2021; UH-ARL 2021; DON 2017). The majority (60 to 75%) of green turtles seen in Pearl Harbor are juvenile/sub-adult size class ranging from 50 cm to 1.0 m SCL (Richie et al. 2016; Teresa 2021). Site fidelity is suspected for turtles residing within the Harbor (Richie et al. 2016; UH-ARL 2021).

5.1.1.1 Distribution and Trends

Between 2013 to 2015 and 2016 to 2018 the Navy conducted monthly shore-based and boat-based surveys of Pearl Harbor as part of their JBPHH Integrated Natural Resources Management Plan (INRMP) monitoring plan. The shore-based surveys occurred at nine stations around Pearl Harbor, and boat-based transect surveys occurred throughout the Harbor. Sea turtles were observed predominantly at the harbor entrance, in the main channel, and in West Loch (Richie et al 2016). Between November 2013 and November 2015 there were 199 distinct sightings of green sea turtles and 36 sightings of unidentified sea turtles during shore station surveys. Additionally, from November 2013-December 2014 there were 74 distinct sightings of green sea turtles and 23 sightings of unidentified sea turtles during boat surveys (Richie et al. 2016).

During the 2016-2018 Marine Species Surveys, copulation events were observed on three occasions - once outside the harbor entrance channel and twice near the back of West Loch (NAVFAC 2018c). Collaboration with NMFS biologists confirmed that two reproductive adult turtles that were tagged in the NWHI during the 2017 nesting season were detected in Pearl Harbor in September. In summary, between December 2016 and March 2018, there was a range of about 10 to 40 green turtles seen in shore-based stations and transect boat surveys, with the greatest number of sea turtles seen per transect during boat-based surveys (NAVFAC 2018c).

To assess temporal and spatial patterns in habitat use of green turtles in Pearl Harbor, Teresa (2021) compiled data collected via linear dive transects from March 2000 to May 2011. Over the 10-year study period, sea turtles were sighted on 121 transects (26%), while the remaining 343 transects had zero turtle observations (n=464). A general increase was observed in the number of turtles documented over time (likely consistent with the increasing turtle population in Hawaii), and a non- uniform spatial distribution of green turtles was found within Pearl Harbor. The Entrance Channel locations had the greatest number of sightings (these locations accounted for approximately 76.7% of total turtles sighted in transects). Of sea turtles sighted (n=680), 345 green turtles (plus 1 hawksbill turtle) were observed on the west side of the Entrance Channel and 265 green turtles were observed on the east side of the Entrance Channel. Benthic surveys revealed these Harbor Channel locations to have diverse biotic cover that includes macroalgae, turf algae, and a notable amount of live coral (Wells et al. 2020b summarized in Teresa 2021). The lower number of turtles detected within the harbor was probably a combination of two factors: a true absence of turtles in this region (due to lack of adequate habitat) and a failure in turtle detection caused by poor visibility conditions.

Teresa (2021) found seasonality patterns in the presence of green turtles, with a slight decrease in turtle sightings during the early months of the year (between March and June), and a greater number of turtles sighted in the later months of the year. They also found distinct depth preferences of turtles based on size, with smaller turtles sighted at shallower transects and larger individuals at deeper locations. Of turtles observed, the behavior of 569 turtles was documented, with the majority observed swimming (50.4%) and resting (43.9%), and the rest hovering at cleaning stations (5.6%). Interestingly, no turtles were observed foraging across the sampling period.

A much lower number of turtles were detected in transects inside the harbor. Several locations had zero turtles sighted across the 10-year period, while other locations in the West Loch Channel area had greater and more regular turtle presence perhaps due to several freshwater springs found in these areas (Teresa 2021). The lower number of turtles sighted within the harbor can be due to the absence of suitable resting and foraging habitat (i.e., low habitat complexity within the harbor), but also due to high sedimentation and turbidity affecting underwater visibility limiting the detectability of sea turtles. Additionally, a significant increase in the number of turtles was recorded near the Fort Kamehameha Wastewater Treatment Outfall pipe which emerges from the seafloor. The pipe was installed in 2004 and became operational in January 2005. Turtles were observed congregating around the outfall pipe and their regular presence in this location may indicate this is a significant habitat feature for them.

To ensure compliance with United States regulations including the Endangered Species Act (ESA), the Navy performs quantitative analyses to estimate the number of sea turtles that could be affected by at-sea training and testing activities. A key element of this quantitative impact analysis is knowledge of the abundance and concentration (density — the number of individual animals found per square kilometer of area) of the species in specific areas where those activities will occur. Methods to estimate sea turtle density vary by species and region, and include counting nesting individuals or the number of eggs in nests, using information from tagging studies, or where data permit, using designed-based methods. The Navy's compilation (DON 2017b) of sea turtle densities for Pearl Harbor is provided in the Mapping Tool for the Navy Marine Species Density Database for the U.S. Pacific & Gulf of Alaska (MGEL 2021, https://seamap.env.duke.edu/models/mapper/PACGOA), and presented in Figure 24. These sea turtle guild density estimates may not be precise, specifically they likely under-represent the number of individuals that occur in Pearl Harbor based on anecdotal information, i.e. opportunistic observations of turtle presence at sites such as Ford Island and Middle Loch. We therefore consider the high end of the range to be the best estimate of density.

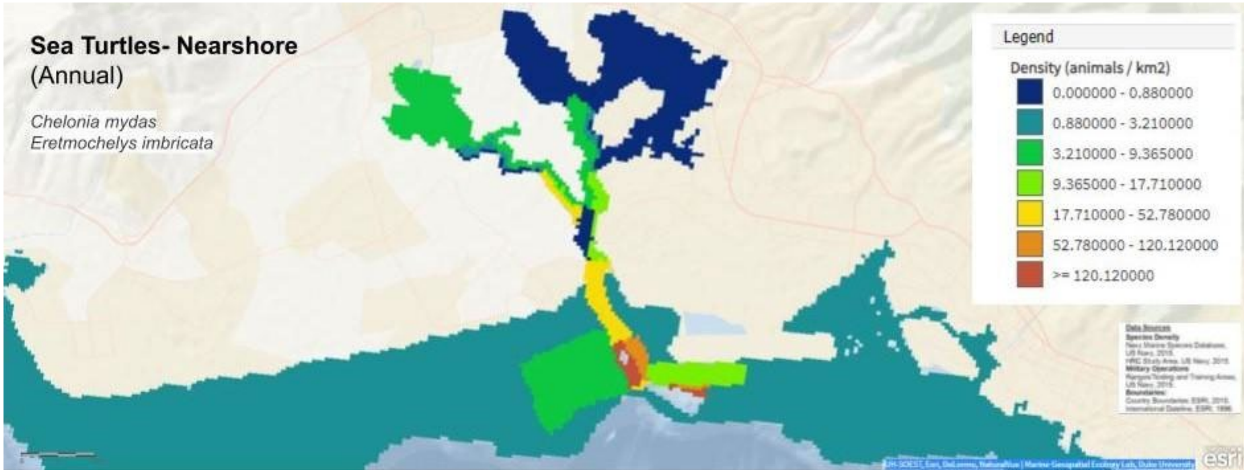

Figure 24. Sea turtle guild density estimates presented for Pearl Harbor in the Mapping Tool for the Navy Marine Species Density Database for the U.S. Pacific & Gulf of Alaska (Source: modified from MGEL 2022).

Since 2017, during the turtle nesting season, the Navy conducts nesting surveys along the beaches near the Harbor mouth (NAVFAC pers. com 2022). Originally the surveys were conducted at Nimitz and Iroquois Point Beaches, and in 2022 the Navy added Fort Kamehameha Beach, Ahua Reef, Hickam Beach and Honeymoon Beach as survey sites. The Navy's surveys are not targeted to survey basking turtles, but they observe basking behavior opportunistically. While the Navy has observed three (3) possible body pits indicating possible nesting, they have not recorded or confirmed turtle nesting events via these surveys (NAVFAC pers. com 2022). They have observed some basking behavior around the survey areas (specific locations and densities unknown).

5.1.1.2 Resting Sites (aka Turtle Caves)

Between July 2020 and January 2021, the Navy executed dive surveys to identify and catalog sea turtle resting sites in select areas in Pearl Harbor where the in-water construction and fill associated with this proposed action will occur (Figure 25). The surveys identified many structures that could function as resting habitat (Neyland et al. 2021), including specifically 97 turtle resting limestone caves with excavated roofs/sides, hereafter identified as "caves" (Figure 25). Through the use of SCUBA, divers collected in situ data, which included the global positioning system (GPS) coordinates, dimensions (i.e., length, width, and height), water depth, and physical composition of each cave within the surveyed areas. The resting caves were primarily found in undercut indentations at the base of the vertical limestone fossil reef walls that were dredged to create channels and inlets, and located seaward of the Entrance Channel up into the harbor lochs (Neyland et al. 2021). Additional resting caves in Pearl Harbor may occur outside of the surveyed locations.

Green sea turtles were physically observed within 16 of the 97 (16.5%) documented caves identified throughout the surveyed locations: two at the PHNSY & IMF; one at the SEFI; four at WP; two at Hospital Point, two at West Loch, five at the Entrance Channel, and zero at Victor Wharves (see Table 15: Sea turtle cave data comparing survey areas (Neyland et al. 2021).

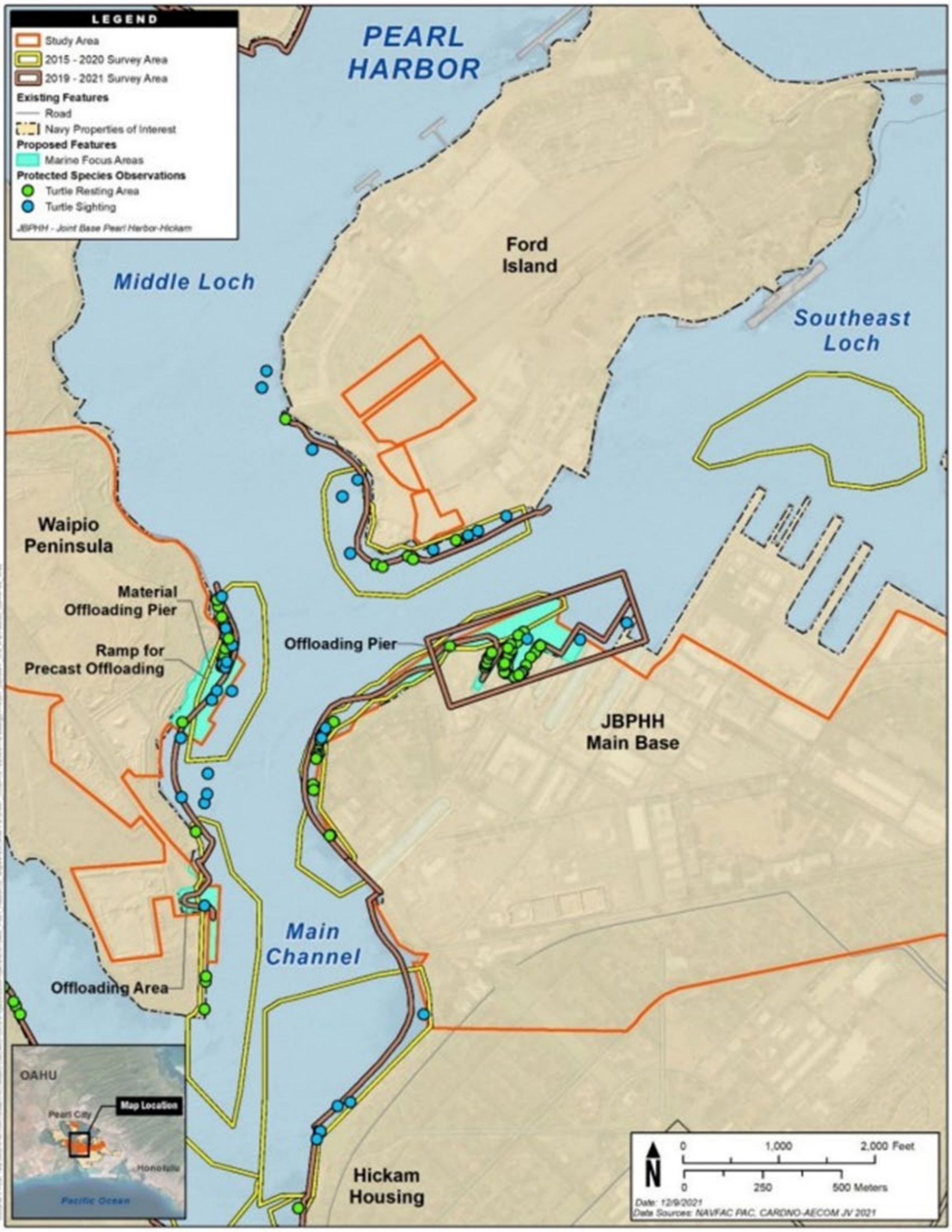

Figure 25. Locations of green sea turtle sightings and potential sea turtle resting areas observed during focused surveys in 2020 – JBPHH Main Base.

Between December 2020 and May 2021, the Navy executed another study to build on the previous work by Neyland et al. (2021) to better understand the frequency of green sea turtle resting habitat use and potential site preference within the caves observed (UH-ARL 2021). Six "turtlecams" (i.e., GoPro cameras equipped with light-emitting diodes [LEDs]) were deployed to document sea turtle use of suspected resting caves throughout the 24-hour cycle; two at PHNSY

& IMF, two at WP, and two at and SEFI. Of the total 9359 photos collected across sites over the six-month survey period, 308 photos (0.03%) showed a turtle occupying the caves. There was a turtle sighting at every station except the outer cave of PHNSY & IMF (Table 17). The majority (85%) of these turtle sightings were at Waipio Point, 10% of the sightings were at PHNSY & IMF, and 5% at SEFI.

Table 17. Summary of sea turtles present (turtle sightings) for each camera deployment location.

Location	Station	Total Photos	Total Turtle Sightings	Percentage of Turtle Sightings (%)
PHNSY	Inner	2047	30	1.47
PHNSY	Outer	1995	0	0
PHNSY	*Total*	*4042*	*30*	*0.74*
South Ford Island	East	1406	2	0.14
South Ford Island	West	1070	14	1.31
South Ford Island	*Total*	*2476*	*16*	*0.65*
Waipio Point	North	1393	164	11.77
Waipio Point	South	1448	98	6.77
Waipio Point	*Total*	*2841*	*262*	*9.22*
	TOTAL	**9359**	**308**	**3.29**

Although individual identification of sea turtles was generally not possible, a distinct barnacle and external fibropapilloma tumor pattern allowed for identification of a single sea turtle repeatedly visiting a cave within the PHNSY & IMF area (UH-ARL 2021). This turtle was observed making repeated visits to the inner resting cave within the PHNSY & IMF area from April 11 – 12, accounting for the total observed sea turtle sightings at the site. While this indicates site fidelity, it is very likely this individual may also be resting in other areas given the low frequency observance (all 30 of the total of 2047 photos with turtle sightings, were taken during the course of two consecutive days over the entire six-month study period).

During the study, complementary to camera deployment/redeployment, the Navy (ARL-UH) conducted boat-based visual surveys of turtles. These occurred approximately every two weeks, in the morning to early afternoon, between December 2020 and May 2021. During ten boat-based visual surveys conducted at each of the three survey locations (ARL-UH 2021) zero surfacing sea turtles were observed at PHNSY & IMF, eight sea turtles were observed at SEFI, and 31 sea turtles were observed at WP.

5.1.2 Hawksbill Turtle

Hawksbill sea turtle presence in Pearl Harbor could be characterized as infrequent and likely occurring in very low numbers. Documentation and records of hawksbill turtles in the harbor are limited. For example, a total of 680 sea turtles were observed via scuba transects between 2000 and 2011; all were green turtles, with the single exception of one positively identified hawksbill sea turtle seen in the west side entrance channel (adjacent to the entrance channel) of the Harbor

(Teresa 2021). There have also been two documented sightings of hawksbill sea turtles near or within the Entrance Channel of the Harbor (in 2004 and 2006), and one hawksbill turtle stranding in 2020 near the Hawaiian Electric (HECO) Waiau Power Plant (NAVFAC 2022a).

The estuarine habitat with mangroves associated with parts of Pearl Harbor has been shown to be prime resting/foraging habitat for hawksbills in the Pacific. As such, the NOAA stranding program has released two live stranded hawksbills into Pearl Harbor; the first in July 2018, and the second on November 12, 2021. Logistical expediency related to COVID was a primary driver for the second release. The turtle released in July 2018 was never sighted again after release. The turtle released in November 2021 (42.0 cm SCL; release location: 21.363787°N, 157.967377°W) was outfitted with a satellite tag, and the concentration of its GPS coordinate locations indicates the turtle remained primarily on the northwestern side of Ford Island (Figure 26).

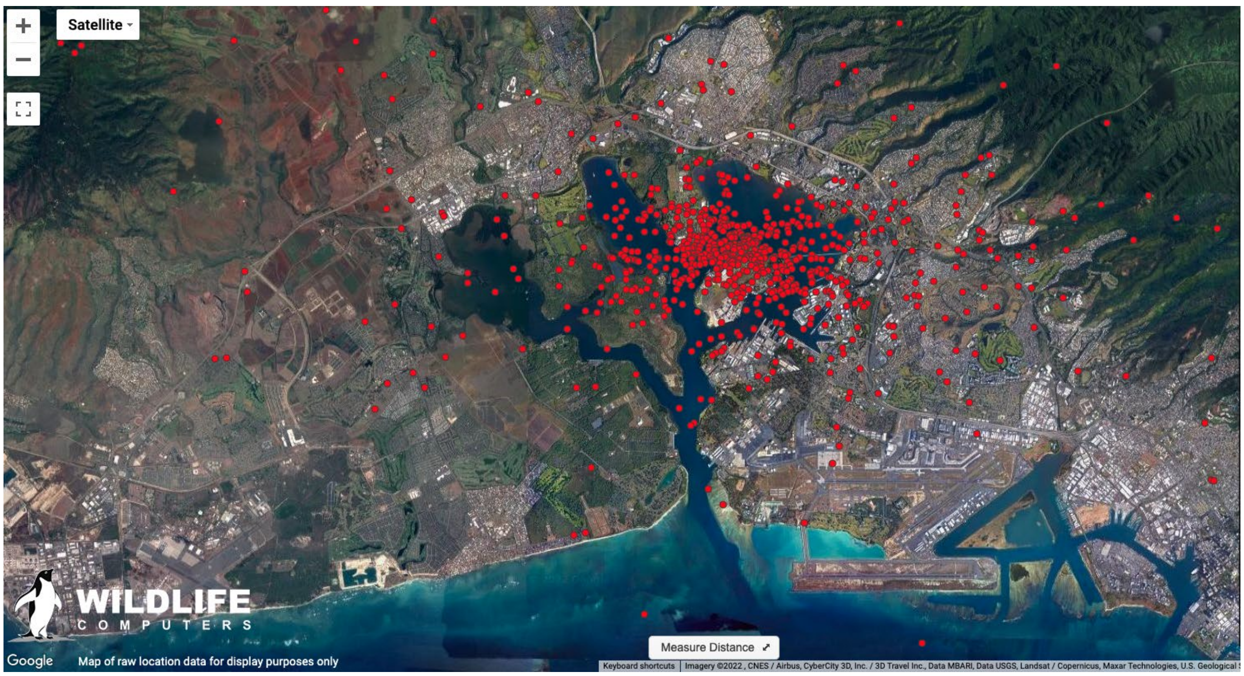

Figure 26. Map indicating satellite tag-based GPS coordinates (red dots) of a hawksbill released by the NOAA stranding program in Pearl Harbor. Note: the data points on land are due to Argos inaccuracy (~ 250-1500 m); the tag did not have GPS (has accuracy ~100m).

The Navy reports two recent sightings of hawksbills, one on July 9, 2021 seen swimming near Ford Island (21°21'26.8"N 157°57'36.1"W) and the second turtle seen in November 2021 (Nedved pers. comm. 2022 summarized in BA). Depending on the specific date of the sighting (currently unverified), the November 2021 sighting could have been the same turtle released by NOAA. The recent 2021 sightings may suggest a potential increase in Pearl Harbor presence over time as Nedved has noted a recent increase in abundance and size of sponges on pilings (Hanser per comms. 2022; Nedved per comms. 2022; UH-ARL 202).

No hawksbill sea turtles were observed in the resting caves identified and cataloged during the Navy’s dive surveys of sea turtle resting caves as discussed above in section 5.1.1.2 (Neyland et al. 2021). In addition, no hawksbill turtle nesting or basking has been documented by the Navy via their nesting surveys of beaches at the mouth of Pearl Harbor (NAVFAC pers. com 2022).

5.2 Factors Affecting the Species and Their Environment within Pearl Harbor

5.2.1 Military Activities

The Navy controls all waters and submerged land in Pearl Harbor, therefore the past and present in-water and waterfront actions and human activities influencing the species and environment in the Harbor are predominantly military actions and activities.

5.2.1.1 Disturbance from Human Activity and Equipment

5.2.1.1.1 In-Water Work

The Navy has, and continues to regularly conduct various types of in-water work throughout Pearl Harbor. Such work includes routine repair and maintenance of their facilities (dry docks, boat houses), and structures (piers, docks, outfall structures, moorings, aids to navigation, floating platforms); new construction to improve capabilities; maintenance dredging to remove accumulated sediment; technical and scientific surveys (geo-tech borings, bathymetric surveys, operation of UAVs, sediment sampling/testing, SCUBA surveys); and habitat restoration (maintenance and repair of fishponds, mangrove removal, marine invasive species removal, oyster transplantation) (NAVFAC 2022b, 2020c, 2011). The in-water activities associated with these actions include operation of various types and sizes of vessels including small boats, tugs and barges; pile driving, pile extraction; drilling; welding; use of power tools; operation of heavy machinery including mechanical and hydraulic dredges; placement of large heavy objects below the waterline; use of mooring lines and tethers; discharges of fill material on the seafloor; multibeam and side scan sonar from small boats; and grab-sampling or coring.

The sea turtles addressed in this Opinion are likely exposed to several of the stressors associated with these activities to different extents, and when exposed may respond to varying degrees. These human in-water activities may generally result in behavioral responses in the turtles such as individual animals approaching the disturbance for investigation, or more likely individuals fleeing or avoiding the area. However, vessel transit and operations of heavy machinery have the potential to result in direct physical contact with, or strikes to the sea turtles. Direct physical contact and vessel strike can cause injury and in severe cases, death of an animal (NMFS and USFWS 1998, 2013; Schoeman et al 2020). Vessel strikes are addressed in section 5.2.1.2 below. Use of lines and tethers, and discharge of debris (lines and trash) have the potential to result in turtle entanglement (Duncan et al. 2017, and addressed in section 5.2.1.3) and ingestion hazards. The activities also generate underwater sound (e.g. from pile driving), which can affect the turtles in a few different ways (Popper et al. 201), described in section 5.2.1.4.

The Navy's in-water work in recent years (starting around 2005, and in particular since 2017) that has the potential to adversely affect ESA-listed species in the harbor including the sea turtles addressed in this Opinion, has generally (we are unaware of actions that the Navy has not consulted on) undergone ESA section 7 consultations (NMFS 2022c, 2020a, 2020b, 2020c, 2019a, 2019b, 2019c, 2019d, 2019e, 2018a, 2018b, 2018c, 2017, 2005). Through these consultations, NMFS has determined that the ESA-listed green turtles and hawksbill turtles will not be adversely affected by these types of actions due to nature and extent of turtles' exposure and response to the stressors, in combination with Navy's implementation of standard BMPs to avoid and minimize impacts to the turtles. Via these consultations we concluded that these activities either do not result in any responses in the turtles, or in temporary behavioral responses where individuals avoid the area for a short time. In such cases the effects are unlikely to harm or harass individuals.

Because it is a very busy working environment, we assume turtles in Pearl Harbor are likely acclimated to the presence of humans and equipment. However, if turtles are displaced from important feeding or resting areas in the Harbor due to activities over a prolonged period it may come at higher costs to individual animals and ultimately potentially to the populations that they represent. Loss of habitat is addressed in section 5.2.1.5.

5.2.1.1.2 Military Training and Testing

The Navy continually conducts training and testing activities and other military readiness activities across the Hawaiian Range Complex, which includes Pearl Harbor. The range and variety of actions and activities are described in Navy's most recent Environmental Impact Statement (DON 2018), and include but are not limited to vessel activity, sonar, denotations, demolitions, pile driving, gunnery, and dive and salvage operations.

The sea turtles in Pearl Harbor are exposed to the stressors resulting from these activities to different extents, and may respond to varying degrees. The Navy training and testing activities have undergone iterations of section 7 consultations over time, with the last formal consultation concluded in 2018 (NMFS 2018a). During the 2018 consultation, NMFS determined that the primary impacts on sea turtles resulting from the Navy's training and testing undertaken across the entire Hawaiian Range Complex are from explosives and vessel strikes resulting in sublethal and lethal adverse effects to sea turtles. Note that effects occur largely outside Pearl Harbor. NMFS determined that other potential stressors analyzed, some that occur in the harbor, such as elevated sound from various acoustic sources (e.g., sonar, pile driving, small airguns, vessel and aircraft noise, and weapons noise), ingestion of expended materials, entanglement, energy stressors, and physical disturbance, are not likely to adversely affect ESA-listed green and hawksbill turtles (NMFS 2018a).

5.2.1.1.3 Recreation

Recreational activities in Pearl Harbor are ongoing, but are limited in scope and intensity. They are associated primarily with Military personnel and their families, and those with access to JBPHH given that public access to Pearl Harbor is restricted. Iroquois Point Beach, Hickam Beach and Kamehameha Beach, each located at or near the mouth of Pearl Harbor, are used for typical beach and nearshore activities (NAVFAC 2022b, 2011).

Recreational small boat use in Pearl Harbor is limited, and tied to transit to and from Hickam Harbor Marina at Hickam Harbor, Rainbow Bay Marina at Aiea Bay, and the Marina docks (including Kapilina Marina) in the lagoon behind Hammer Point (NOAA 2015). The potential effects of elevated underwater noise and vessel strike that may be associated with this boat activity, in combination with effects of other activities resulting in these same stressors, are addressed in sections below.

Legal fishing in Pearl Harbor is largely regulated, and restricted to pole-cast catch-and-release only from selected locations in the Harbor (NAVFAC 2022b, 2011). However, based on anecdotal information including our opportunistic observations, and as acknowledged by the Navy, illegal fishing may occur in the Harbor, such as in the inner reaches of West Loch. These fishing activities, and inadvertent abandoned fishing gear in general, such as traps, lines or nets may cause entanglement of sea turtles (addressed in Section 5.2.1.3). Given the unknown frequency of illegal fishing activities and resulting discharge (or loss) of fishing gear, we are unable to quantify the effects to listed sea turtles in the Harbor from this ongoing activity.

5.2.1.2 Vessel Collision and Strike

Pearl Harbor is the homeport for nearly 40 warships, service force vessels and submarines. Many vessels, of varying sizes, move in and through Pearl Harbor on a daily basis. The majority of vessel traffic involves commissioned Navy ships (NAVFAC 2022a), other vessels include tug boats, barges and numerous recreational crafts, including small speed boats transiting to and from the marinas. The Navy states that there are typically about 2,000 naval vessel movements (one-way trips) in the harbor annually, which translates to approximately 5 trips per day. In addition, every other year in June, due to Rim of the Pacific military training exercises, there are an additional 30–35 visiting vessels in the harbor (NAVFAC 2022a). Our anecdotal observations indicate that non-naval vessels movements in the harbor, i.e. from recreational small boat use as described above in Section 5.2.1.1, likely involve several (potentially ranging from 5-20) additional trips per day in, out, and within the harbor.

Vessel collision is a threat to the survival of many air breathing marine vertebrates such as marine mammals and sea turtles (Schoeman et al. 2020). Ship strikes are a known source of mortality for green sea turtles in Hawaiian waters (NMFS unpublished stranding data), and the various vessel movements in Pearl Harbor pose a real collision risk to green turtles that occur there (Kelly 2020). Effects of strike include injury or death of the animal (NMFS and USFWS 1998, 2013; Schoeman et al 2020).

Around Hawaii, it is estimated that between 200-250 green sea turtles are struck by vessels annually, and the mortality for vessel strikes is 95 to 100% (NMFS unpublished stranding data; Kelly 2020). There are a number of ‘hotspot’ areas of concern relative to vessel strikes on Oahu where a cluster of vessel collisions have occurred. These are all high density or high use boating areas typically associated with small boat harbors or boat ramps (Kelly 2020). Pearl Harbor is one of the hotspots: of 135 vessel strike-induced green sea turtle strandings on Oahu) between 2008 and 2018, 27 animals (20%) were found stranded in Pearl Harbor (NMFS 2019 report #IR-19-001; Figure 27). The stranded turtles in the harbor were concentrated in the main entrance channel, with a few observed in West Loch, a couple around Ford Island, and none observed in the inner reaches of the harbor in Middle Loch or East Loch. These turtle strandings in the harbor did not comprise of any hawksbill sea turtles.

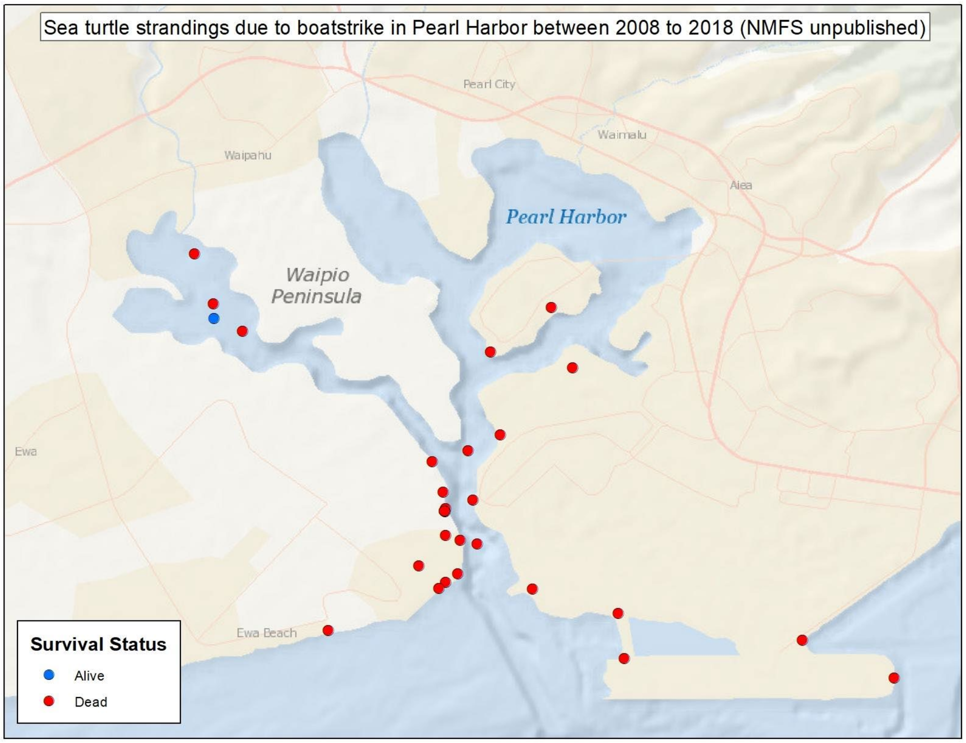

Figure 27. Sea turtle strandings (n=27) due to boat strike in Pearl Harbor from 2008-2018 (Kelly 2020 based on NMFS 2019 report #IR-19-001).

Given that green turtles have a fairly tight core foraging home range (Balazs et al. 2017), there is high potential for an animal to strand in/near where an impact might have occurred. In Pearl Harbor, dead or injured sea turtles within the harbor are very likely to be discovered and reported because the waters and shorelines are actively monitored by the Navy. Therefore strandings are likely a good representation of the overall level of vessel strike impact in or near Pearl Harbor (with the understanding that strandings recovered within the harbor may have occurred just outside or near the entrance channel and funneled into the harbor with incoming tides). Noteworthy is that a turtle struck by a vessel may not be observed as the impact event occurs, nor discovered immediately upon being struck. Therefore, while strandings in the harbor indicate the general level of impact by vessel strike in the area, a discrete stranding cannot be precisely tied to a strike event by a particular vessel, vessel activity type, or time of impact.

During NMFS's 2018 consultation with the Navy on their training and testing activities in the Hawaii and Southern California Range Complex (NMFS 2018a), NMFS estimated that across the entire Hawaii Range (i.e. of which Pearl Harbor makes up a small area) 20 green sea turtles and one hawksbill sea turtle will be killed per year due to vessel strikes resulting from these training and testing activities (NMFS 2018a), and that approximately seven green sea turtles and one hawksbill sea turtle will be harmed per year.

5.2.1.3 Entanglement and Entrapment

5.2.1.3.1 Mooring Lines and Tethers

The Navy's regular in-water work and activities are often associated with the use of mooring lines and tethers for barges/platforms and anchoring systems. However, to date, entanglement from equipment and gear typically used in construction and pile driving has not been reported by the Navy in Pearl Harbor. In addition, as addressed above in section 5.2.1.1, Navy's recent (at minimum since year 2017) actions involving in-water work that use lines, tethers etc., and that have the potential for adverse effects to ESA-listed species, have undergone ESA section 7 consultations (NMFS 2022c, 2020a, 2020b, 2020c, 2019a, 2019b, 2019c, 2019d, 2019e, 2018a, 2018b, 2018c, 2017, 2005). During these consultations NMFS determined that the ESA-listed green turtles and hawksbill turtles will not be adversely affected by these types of actions due to the nature and extent of turtles' exposure to the stressors, in combination with Navy's implementation of standard BMPs to avoid and minimize impacts to the turtles.

Entanglement in fishing gear is the most common cause of sea turtle stranding in Hawaii (NMFS unpublished stranding data). There are activities such as fishing in Pearl Harbor that result in turtle entanglement risk that fall outside the ESA section 7 consultation scope. While the Navy regulates fishing activities in the harbor, illegal fishing occurs in remote shoreline areas in shallow waters of the harbor (areas where the Navy cannot easily patrol) using hook and line, gill nets and crab traps. Based on monthly Navy surveys conducted in the harbor to document fishing violations in 2019, 2021 and ongoing in 2022 (NAVFAC pers. com 2022), one turtle was observed entangled in a gill net (note these surveys are not designed to quantify turtle presence). Entanglement in fishing gear has been observed in turtles stranded in Pearl Harbor (NMFS stranding data unpublished), and between 2006 and end of 2021, 57 turtles were recorded as entangled in fishing line and seven in nets.

5.2.1.3.2 Dry Dock Operations

As part of Naval facilities operations, the Navy regularly conducts depot-level maintenance (major repair, overhauling, or complete rebuilding) of submarine and surface vessels in their four 80-100 year-old operating dry docks (DD1-4) located at PHNSY & IMF. Each entry and exit of a Navy vessel into and out of a dry dock involves at minimum one cycle of the Navy flooding and dewatering the dry dock. The Navy has indicated that they currently undertake an average of ten flooding events per year, with a maximum of 16 flooding events per year in the operating DD 1 – 4. Each dry dock may experience approximately 2-4 flooding/dewatering events per year (NAVFAC 2022a), however vessels can be in the dry docks for depot maintenance for more than a year.

The flooding and dewatering of the dry docks can result in the entrapment of a turtle in the dry dock, as a turtle may be present within a dry dock when the ship has entered, and the basin is sealed and dewatered. Entrapment may result in injury or death of an animal if undiscovered or relocated without care. However, the Navy states that the turtles trapped in the existing dry docks to date were discovered by Navy personnel prior to the basin being drained fully, and were carefully removed from the dry dock and successfully relocated back into the marine environment (NAVFAC 2022a). While the Navy has not reported death or injury of individual turtles resulting from these entrapments and relocation events, we have no information to fully assess nor quantify the overall effect on the individuals trapped in the dry dock.

5.2.1.4 Elevated Sound

The Navy regularly conducts a range of actions in and around Pearl Harbor that generate varying levels and types of sound in the harbor. These actions include vessel operations, aircraft flights, sonar, dredging, and construction. The sources of sound specifically include transit of boats, tugs and barges in and out of the harbor; pile driving, pile extraction; drilling; welding; use of power tools; and operation of heavy machinery including mechanical and hydraulic dredges.

The sea turtles in Pearl Harbor are likely exposed to the sound generated from these activities to different degrees, and may respond in various ways. While the specific level of sound generated by all of the different vessels is unknown, sound generated by vessels are generally low frequency, which can travel long distances underwater (DOSITS 2022) and fall within the suspected hearing range of sea turtles. Unmitigated sound can cause direct physical harm to the turtles such as barotrauma and non-auditory damage to gas-filled organs, or hearing loss expressed in permanent threshold shift (PTS) or temporary threshold shift (TTS). Exposure to sound in the Harbor may also cause behavioral responses (Popper et al. 2014) including avoidance, cessation of feeding, resting, and/or social interactions, and changes in diving behavior (McCauley et al. 2000).

We have not quantified the level of exposure and response of sea turtles to all sound occurring in Pearl Harbor. However, the Navy's recent (since 2017, at minimum) in-water actions that generate sound that have the potential to adversely affect ESA-listed species in the harbor including turtles, have undergone ESA section 7 consultations (NMFS 2022c, 2020a, 2020b, 2020c, 2019b, 2019c, 2019d, 2019e, 2018a, 2018b, 2018c). Through these consultations, NMFS has determined that the ESA-listed green turtles and hawksbill turtles will not be adversely affected by resulting elevated noise due to nature and extent of turtles' exposure and response to this stressor, in combination with Navy's implementation of measures to mitigate the noise impacts to turtles. We have concluded that these activities either do not result in any responses in the turtles, or in behavioral responses where individuals primarily temporarily avoid the area of higher sound. In such cases the effects are unlikely to harm or harass individuals.

Because it is a very busy working environment, we assume turtles in Pearl Harbor are likely acclimated to the higher ambient sound. However, if turtles are displaced from important feeding or resting areas in the Harbor due to activities over a prolonged period it may come at higher costs to individual animals.

5.2.1.5 Habitat Disturbance and Loss

Over the last century, Navy's extensive dredging and filling operations have altered the shoreline and bathymetry of Pearl Harbor to provide navigation channels for large naval ships and waterfront Naval facilities. The dredging and filling activities have likely led to permanent changes to benthos and potentially to water quality in the harbor. It is therefore possible that these changes have affected sea turtles over time by altering their resting and foraging habitat, and influencing their home ranges and movement patterns. Our working assumption is that the ESA-listed turtles in Pearl Harbor are largely acclimated to the altered shorelines and bathymetry of Pearl Harbor, although it is likely turtles will recognize the loss or removal of habitat which they have become accustomed or acclimated to.

In recent years, while the Navy has conducted pile-driving, mooring installation and maintenance dredging resulting in temporary disturbance or minimal (on the scale of a few square feet/meters) permanent loss of habitat, they have not undertaken in-water fill, or new/construction dredging resulting in more than minimal permanent loss of in-water habitat. We are reasonably certain that ESA-listed green turtles and hawksbill sea turtles likely only temporarily avoid affected areas given the small footprints and/or temporary nature of disturbance to habitats in the harbor.

5.2.2 Pollution

Prior to the 20th century, water quality in Pearl Harbor was reportedly high, and sedimentation and turbidity low (Commander, Navy Region Hawaii [CNRH], 2008 as cited in NAVFAC 2022b). Since then, human activities, largely military within Pearl Harbor and both military and non-military in the surrounding watersheds, have resulted in several different types of anthropogenic pollution negatively affecting the water quality within Pearl Harbor (NAVFAC PAC 2020). The pollutants include oil-based products, contaminants, pesticides, sediment, nutrients, and marine debris.

Today, Pearl Harbor has naturally-persistent levels of high turbidity (NAVFAC 2022b), and the harbor waters (Pearl Harbor Estuary and Mamala Bay) have been listed by Hawaii Department of Health (HDOH) as impaired water bodies for failing to attain water quality standards for total nitrogen, total phosphorus, and chlorophyll a (DOH 2020). DOH has issued an advisory warning that humans should not consume fish and shellfish caught in Pearl Harbor (HDOH 2020; NAVFAC 2022b). A CERCLA feasibility study investigations conducted in Pearl Harbor between 1996 and 2017 has identified four (4) chemicals of concern in the harbor floor sediments to be remediated: total Polychlorinated biphenyls (PCBs), copper, lead, and mercury (NAVFAC 2018).

Various military activities within Pearl Harbor are the cause of the contamination of soil, sediment, and groundwater with metals, organic compounds, and petroleum hydrocarbons (NAVFAC 2018). In addition, Pearl Harbor is a natural sediment trap receiving a contaminant load from many non-military commercial, industrial, residential, and agricultural sources in the surrounding watershed discharged from the many tributary streams and storm drains (NAVFAC 2018; AECOM 2010 as cited in NAVFAC 2022a). Sediment-laden runoff enters the Harbor primarily due to poor erosion and sediment control in upland areas. Heavy metals and other chemical contaminants (pesticides, herbicides, etc.) frequently adsorb to the sediment particles and are transported to the harbor waters (AECOM 2010 as NAVFAC 2022ad in NAVFAC 2022a). After heavy rains, there is increased freshwater input in Pearl Harbor, and increased turbidity and suspended sediment (NAVFAC 2022a, b).

Waste, debris and other pollutants may be introduced, or elevated, in Pearl Harbor from the various military activities in the area including from vessels, facilities, materials, equipment and divers in the form of discharge of hydrocarbon-based contaminants from vessels or equipment, chemical spills, inadvertent disposal of debris/trash, and leaching of toxins from construction materials (NAVFAC 2022a, b). Vessel activity and in-water work (e.g., dredging, pile-drilling, pile removal, etc.) in the harbor can elevate ambient suspended sediment and turbidity levels by dislodging, re-suspending, and dispersing sediment in the water column exposing turtles to sedimentation (NAVFAC 2022a, b). Any contaminants associated with sediment particles may also be re-suspended.

The various pollutants mentioned above may affect turtles in Pearl Harbor in different ways. The sea turtles may avoid an affected area; their immunity and fertility may be compromised; they may have reduced ability to detect predators (Oliver et al. 2000); or their response may be serious injury or in severe cases, death (NMFS and USFWS 1998; NMFS and USFWS 2013). Changes to water quality may also influence the condition of the benthic communities that they rely on such as corals, algae and seagrass, and may negatively impact turtles' food sources (NMFS and USFWS 1998).

Currently the Navy implements various measures and strategies to control pollution in Pearl Harbor. Navy manages and treats occasional or intermittent Navy discharges into Pearl Harbor including from the existing dry docks, Navy WWTP, and storm drains, through stipulations of dozens of National Pollutant Discharge Elimination System (NPDES) permits issued to them by HDOH (NAVFAC 2022a). The Navy controls suspended sediment and turbidity levels associated with in-water work through implementation of various BMPs, and monitoring as per Clean Water Act regulations (NAVFAC 2022a). The Navy plans to undertake, under EPA and DOH oversight, CERCLA remediation of contaminants present in the sediment in multiple locations across the Harbor including at PHNSY & IMF (NAVFAC 2018). The Navy coordinated with NMFS regarding potential effects to ESA-listed species from these remediation actions, and NMFS determined that after implementation of BMPs, all stressors will be minimized to an insignificant or discountable level of concern (NAVFAC 2020). Note that the CERCLA site investigations indicate that there are no immediate threats to human health or the environment from these chemicals (NAVFAC 2018). Also, while HDOH has listed Pearl Harbor waters as impaired, it considers harbor waters as low priority for the establishment of total maximum daily load requirements (DOH 2020). In terms of marine debris, while ingestion of marine debris is a significant concern for sea turtles, it is a concern mostly to their early developmental stages spent in the open sea and not harbor waters, when and where they may eat plastic because it closely resembles natural prey items (Schuyler 2014; Lutcavage et al. 1997; Laist et al. 1999; Santos et al. 2015).

In conclusion, while it is likely that the turtles in Pearl Harbor are exposed to the polluted harbor waters and may exhibit various responses, they may be acclimated to the ambient water quality or largely unaffected given they are surface air breathers. However, the overall trend of water quality and effect of pollution on turtles in Pearl Harbor has not been quantified.

5.2.3 Climate Change

Climate change is a global issue and trend occurring as a result of collective regional emissions of greenhouse gasses with global and regional consequences. There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. The latest science on climate change is summarized by numerous agencies, with the most prominent being the Intergovernmental Panel on Climate Change (IPCC 2022). Climate impacts include increasing air and ocean temperatures, sea level rise, changes in ocean productivity, increased frequency of storm events, changes in precipitation patterns, and seasonal changes in current patterns (IPCC 2022; NOAA 2022).

Global climate effects have likely affected and continue to affect the military infrastructure at JBPHH and the resources and environment within Pearl Harbor. Corals in the harbor may experience bleaching, increased occurrence of disease, and weakening of coral skeletons as a result of ocean warming and ocean acidification (NMFS 2022; Erez et al 2011; Langdon et al. 2000; McWilliams et al. 2005). Sponge communities exposed to elevated temperatures may display decreases in buoyant weight, prevalence of diseases, and an increase in mortality (Webster 2007; Bennett et al. 2017; Laffy et al. 2019; Idan et al. 2020). Macroalgae may respond in varying and unpredictable ways (Yi and Gao 2020). Flooding of wetlands and erosion of shorelines may in the future increase due to sea-level rise and storm-surge (Marra and Kruk 2017 as reviewed in NAVFAC 2022b) leading to increased sediment in the environment and other associated contaminants. The freshwater input to Pearl Harbor via point and nonpoint sources from its multiple contributing watersheds may change due to decreased average rainfall, or increase from more frequent and intense storms (Zhang et al. 2016; Timm et al. 2015 as reviewed in NAVFAC 2022b). These changes may contribute to the spread of environmental contamination and affect water quality (increasing nutrients and turbidity levels) (NAVFAC PAC 2011; NAVFAC 2022a), and subsequently benthic conditions.

Since green turtles and hawksbill sea turtles inhabit and depend on the water column and benthic communities in the Harbor for food and shelter, they are vulnerable to changes that affect the condition of these habitats or foraging resources. However, we have not quantified these changes and potential effects to listed turtles in Pearl Harbor.

6 EFFECTS OF THE ACTION

Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

Furthermore, 50 CFR 402.17 defines reasonably certain to occur as "A conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available. Factors to consider when evaluating whether activities caused by the proposed action (but not part of the proposed action) or activities reviewed under cumulative effects are reasonably certain to occur include, but are not limited to: (1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed action;(2) existing plans for the activity; and (3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward."

As we described in the Approach to the Assessment section of this Opinion, we organize our effects' analyses using a stressor identification - exposure – response – risk assessment framework. The Integration and Synthesis section of this opinion follows the Effects of the Action and integrates information we presented in the Status of Listed Resources and Environmental Baseline sections of this biological opinion with the results of our exposure and response analyses to estimate the probable risks the proposed action poses to endangered and threatened species.

Because NMFS has previously concluded that the proposed action is not likely to adversely affect several listed species and areas designated as critical habitat for listed species, these listed resources are not considered in the analyses that follow. Species and critical habitat not likely to be adversely affected by the proposed action are discussed in Section 4.1 of this biological opinion, Status of Listed Resources Not Considered Further, and in Appendix A.

6.1 Potential Stressors

Potential stressors associated with the proposed action include:

- Elevated Underwater Sound
- Vessel Collisions
- Habitat Disturbance and Loss
- Entrapment in Dry Dock
- Increased Turbidity and Sedimentation
- Disturbance from Human Activity and Equipment Operation
- Wastes and Discharges
- Entanglement in Lines

We determined that increased turbidity and sedimentation; disturbance from human activity and equipment operation; wastes and discharges; and entanglement in mooring lines are stressors that are not likely to adversely affect any species (See Section 4.1; Listed Resources Not Considered Further and Appendix A for more details). As a result, in this section we focus primarily on the activities of in-water construction (pile driving, dredging, fill), vessel transit, and DD5 operations in Pearl Harbor. These result in the stressors of elevated underwater sound, habitat disturbance and loss, vessel collisions, and entrapment of animals that are likely to adversely affect ESA-listed green turtles and hawksbill sea turtles.

6.2 Green and Hawksbill Sea Turtle

6.2.1 Elevated Underwater Sound

6.2.1.1 Exposure Analysis

Sea turtles can hear low to mid-frequency sounds, best between 200 and 750 Hz, and do not exhibit significant responses to sounds above 1,000 Hz (Popper et al. 2014; DOSITS 2022). While sea turtle sensory biology is not well understood, information exists that sea turtles rely more on visual cues than auditory ones to react to their environment (NMFS 2016b; NMFS 2018). A few studies have demonstrated that sea turtles have limited reactionary behavior to sound below a certain level of intensity, roughly between 120 dB and 160 dB (reviewed in Kelly 2020), while sound levels above 160 - 166 dB RMS re 1 μPa can cause harm (NMFS 2002; Popper et al. 2014). Navy's pile-driving in Pearl Harbor will produce sound that falls within the green sea turtles' and hawksbill turtles' hearing ranges, and may occur at levels above the threshold considered to cause harm.

Turtles that are exposed to the elevated underwater sound from pile driving may respond in a few different ways: they may experience barotrauma and non-auditory damage to gas-filled organs; hearing loss expressed in some degree of permanent hearing loss, known as a permanent threshold shift (PTS) or temporary threshold shift (TTS); behavioral responses; and reduced hearing by masking (i.e. the presence of one sound affecting the perception of another sound) (Popper et al. 2014). The PTS, TTS, and behavioral thresholds for turtles exposed to impulsive and non-impulsive sounds are summarized in Table 18 below (Source: DON 2017a, 2018, NMFS Spreadsheet 2021, Version 1.0).

Table 18. Sound Thresholds for Sea Turtles Exposed to Impulsive and Non-Impulsive Sounds (Source: DON 2017a, 2018, NMFS Spreadsheet 2021, Version 1.0).

Auditory Effect	**Impulsive**		**Non-Impulsive/continuous**
	Unweighted SPL Threshold re 1 μPa	**Weighted SPL Threshold re μPa^2•s**	**Weighted SPL Threshold re μPa^2•s**
TTS	226 dB Peak	189 dB SEL_{cum}	200 dB SEL_{cum}
PTS	232 dB Peak	204 dB SEL_{cum}	220 dB SEL_{cum}
Behavior	175 dB RMS		175 dB RMS

The Navy will drive multiple pile-types (steel pipe, steel sheet, steel H-pile/king piles, concrete), of different sizes (42×18-inch, 36-inch, 28-inch, 24-inch, 20-inch, 18-inch diameter), using both vibratory and impact pile driving methods. Vibratory pile driving produces a continuous sound usually concentrated between 20-40 Hz, while impact pile driving produces a loud impulse sound usually concentrated below 500 Hz (DOSITS 2022; NAVFAC 2022a).

The Navy compiled underwater proxy sound source levels in their BA (NAVFAC 2022a) to characterize the sound levels they expect to be produced from their various pile driving and pile extraction activities in Pearl Harbor. They expect a sound level of around 118 dB Peak for pre-drilling of piles; sound levels between 165-184 dB Peak, and 150-151 dB SEL for vibratory pile driving and extraction; and sound levels between 189-204 dB Peak, and 164-171 dB SEL for impact pile driving (measured at a distance of 10 m).

Turtles in Pearl Harbor are currently only intermittently exposed to sound produced by routine short-term pile driving activities at specific sites in the harbor (see Environmental Baseline Section 5). When the Navy initiates impact pile driving for the proposed action, the turtles at pile driving sites will be exposed to sound for up to 10 hours per day, 7 days per week, for weeks to months at a time. During Stage 1 DD5 construction at PHNSY & IMF the Navy will undertake daily pile driving for a total duration of approximately 14 months; at WP for 3-4 months; PCP for nearly 1 month; and at FI for approximately 14 days. Once the Navy continues with Stage 2 WPF construction, the turtles may be exposed to sound from pile driving for a total of approximately 5 months at PHNSY & IMF; approximately 3-4 months at WP; and nearly 1 month at PCP. At times, the Navy will undertake multiple pile-driving activities simultaneously within or between sites.

Given the various pile types, sizes and installation methods to be used, we evaluate effects to turtles based on the pile-type and/or installation method with the largest effect radius and assume all other pile driving noise effects will fall within that radius. We have summarized the Navy's calculations of the turtles' exposure to elevated underwater sound from pile driving, i.e. effect distances aka isopleths, where thresholds may be exceeded below in Table 19. The Navy developed these calculations partly based on technical assistance provided by NMFS[4] (NAVFAC 2022a).

Table 19. Propagation distances of pile driving for turtles where pile driving thresholds may be exceeded for the largest, loudest pile and/or highest number of strikes or longest duration.

Vibratory pile driving		**Distance to SEL isopleth for PTS (220 dB re 1 µPa^2•sec)**	**Distance to SEL isopleth for TTS (200 dB re 1 µPa^2•sec)**	**Distance to Peak & Behavioral Isopleths (175 dB RMS re 1 µPa)**
36-inch steel pipe piles	6 piles/day	0.3 m	5.5 m	0.3 m
42x18 and 18x18-inch steel H-piles	9 piles/day	0.4 m	9.2 m	0.2 m
Impact pile driving		**Distance to SEL isopleth for PTS (204 dB re 1 µPa^2•sec)**	**Distance to SEL isopleth for TTS (189 dB re 1 µPa^2•sec)**	**Distance to Peak & Behavioral Isopleths (175 dB RMS re 1 µPa)**
36-inch steel pipe piles	6 piles/day	30.9 m	308.5 m	34.1 m
42x18 and 18x18-inch steel H-piles	9 piles/day	68.5 m	685.2 m	21.5 m
20-inch concrete piles	6 piles/day	5.9 m	58.8 m	13.6 m

The Navy's calculations use turtle-specific acoustic thresholds (shown in Table 19 above) coupled with the worst-case scenario of the largest pile (i.e. loudest), the maximum number of piles to be driven per day, and either the maximum number of strikes per pile for impact pile driving or maximum duration (minutes) to drive a pile using vibratory pile driving. The Navy made several standard assumptions for estimating the effect distances (isopleths) that include: the source of sound from pile driving is stationary; the source levels do not vary between pile strikes; the spreading coefficient is $15_{log}R$; the receiver i.e. turtle remains stationary during the duration of the activity and is neither attracted to nor avoids the source of sound; there is no recovery between intermittent sounds regardless of time between sounds (i.e., all sounds within the accumulation period are counted); and the total duration of sound exposure accumulation is over

[4] During pre-consultation NMFS provided the Navy guidance on calculations provided in the Navy BA referencing and using NMFS Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2018), the Technical Report on Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al 2014), NMFS' multispecies pile driving calculator Version 1.0 (NMFS 2021), the Caltrans guidance (Caltrans 2015 and 2020) for proxy source levels for sound, and wherever appropriate, best estimates based on previous experience.

a 24-hour period (i.e. even though pile driving will occur for 10 hours per day not 24 hours). For sound levels generated by pile driving occurring simultaneously, the Navy analyzed the sound from the three pieces of equipment with the loudest noise levels, adding the two lowest levels together using the rules of decibel addition, then adding the result to the third noise level using the same rules.

Given the number of factors that influence propagation loss at a particular location, and in the absence of site-specific data for pile-driving at Pearl Harbor, we recommended that the Navy use $15_{log}R$ as the spreading coefficient for their calculations, which is the value NMFS defaults to in these calculations. The Navy may update this coefficient during the course of the proposed action as they are proposing to undertake in-water acoustic monitoring once they start pile driving to better identify the site-specific propagation of sound from their specific pile-driving activities, and may thereafter adapt the monitoring and shut-down zones accordingly (in coordination with us). Regardless of the specific value of the spreading coefficient used, we assume a decrease in acoustic intensity (due to spreading and/or attenuation) as an underwater sound wave propagates outwards from the different pile driving locations in the harbor. We assume that a direct line-of-sight provides a clear path for sound to travel, but that significant attenuation losses will occur as sound interacts with structures and land that are common in Pearl Harbor.

The Navy proposes an acoustic monitoring protocol and 100-m work shut-down zones at PHNSY & IMF, WP, and PCP, and the 60-m work shutdown zone at FI for the duration of the construction. Due to these, we are reasonably certain the probability of turtles being exposed to sound levels produced by pile driving above the PTS threshold during pile driving at any site to be extremely unlikely. However, we are reasonably certain that turtles will be exposed to sound at levels above (189 dB SEL_{cum}) those expected to cause some degree of temporary hearing loss, known as the temporary threshold shift (TTS) threshold during Navy’s impact pile driving at PHNSY & IMF (from driving of 36-inch steel pipe piles, 42x18-inch H-piles, and 18x18-inch H-piles), and at WP and PCP (from driving of 36-inch steel pipe piles) as the 100-m shutdown zones will not extend the full distance to the outer boundary of the 308.5-m and 658.2-m TTS SEL isopleths (see Figure 28, Table 19).

Figure 28. Effect distances to TTS thresholds (189 dB SELcum) from impact driving of 36-inch steel pipe piles, 42x18-inch H-piles, and 18x18-inch H-piles, and 100-m shut-down zones at PHNSY & IMF, WP and PCP.

In Table 20 below, we summarize our estimate of the extent of the in-water area where sound from pile driving may exceed the TTS threshold outside of the 100-m shut-down, i.e. "TTS exposure area", for each pile type and site, and the total number of Navy's proposed pile driving days per pile type. We calculate in-water area within TTS thresholds (TTS exposure area) by subtracting the area of a circle with a 100 m radius (shut-down zone) from the area of circle with a radius of the 308.5-m, respectively 658.2-m TTS SEL isopleths. To account for the area of the circle that is on land and therefore is not relevant to the turtle exposure analysis, we assume roughly 50% of our calculated total TTS exposure area overlaps with harbor waters at PHNSY & IMF, and that roughly 60% of the circle overlaps with harbor waters at WP and PCP.

Table 20. The estimated extent of the in-water area where sound from pile driving may exceed the TTS threshold (189 dB SELcum) outside of the 100-m shut-down, and number of impact pile driving days at PHNSY & IMF, WP and PCP.

Pile Types	Calculated TTS exposure area (km^2)	# Days of impact pile driving at PHNSY & IMF (Stage 1 & 2)	# Days of impact pile driving at WP (Stage 1 & 2)	# Days of impact pile driving at PCP (Stage 1 & 2)
36-inch steel pipe piles	0.16[1]	50	242	14

42x18 and 18x18-inch steel H-piles	0.72[2]	331	-	-

[1] area exceeding TTS threshold sound levels = (0.29 km^2 [π x 308.5^2]) - (0.03 km^2 [π x 100^2]) x 60%
[2] area exceeding TTS threshold sound levels = (1.47 km^2 [π x 685.2^2]) - (0.03 km^2 [π x 100^2]) x 50%

As shown in Table 21, we characterize the extent of potential exposure of turtles to sounds that exceed the TTS thresholds (189 dB SEL_{cum}) at each site using the upper end of the Navy's year-round sea turtle guild density estimates presented for Pearl Harbor (MGEL 2021; see Environmental Baseline Section 5.1.1.1).

Table 21. Characterization of the extent of potential exposure of turtles to sounds that exceed the TTS thresholds at each site using sea turtle guild density estimates.

Sites	**Upper Limit Sea turtle guild density estimate[1] (km^2)**	**# Turtles in TTS exposure area (Mean density x total TTS area)**
PHNSY & IMF	0.88	0.63[2]
WP	9.37	1.46[3]
PCP	0.88	0.14[2]

[1] Density estimates are the year-round estimate, i.e. average for winter/spring and summer/fall estimates.
[2] Density of turtles in area where sound levels will exceed TTS threshold/pile driving day = 0.88 x 0.72 km^2
[3] Density of turtles in area where sound levels will exceed TTS threshold/pile driving day = 9.37 x 0.16 km^2

Our calculations (Table 21) indicate that on any given day of pile driving no more than one turtle may be exposed to elevated underwater sound at PHNSY & IMF and WP exceeding the TTS threshold, and no more than two turtles at WP. We estimate that the likelihood of a turtle's TTS exposure will be more than two times as great at WP than at PHNSY & IMF, and 10 times greater at WP than at PCP. These patterns are driven by the higher concentration of turtles present at WP. This estimated probability of turtle exposure to TTS will continue daily for a duration of 381 days at PHNSY & IMF, for 242 days at WP, and 14 days at PCP.

Given that turtle surveys in Pearl Harbor indicate a majority of turtle sightings as green sea turtles (85% of turtles in the November 2013 to November 2015 turtle surveys were confirmed as green sea turtles, and 76% of turtles in the November 2013-December 2014 surveys), and based on the estimates that there are on average 14 nesting hawksbill females per year in Hawaii (Gaos et al. 2021), and a mean of 464 nesting green sea turtle females in Hawaii (Seminoff et al. 2015), we estimate that approximately 97% of all turtles in Pearl Harbor are green sea turtles and approximately 3% hawksbill turtles. We are therefore reasonably certain that the vast majority of individuals exposed to sound exceeding the TTS threshold will be green sea turtles.

6.2.1.2 Response Analysis

The Navy will employ several mitigation measures (see exposure analysis) to reduce exposure of turtles to underwater sound produced by the various pile driving activities in Pearl Harbor. Assuming these are effectively implemented, we do not expect turtles to get close enough to the sound source of any of the pile driving activities to experience physical injury or permanent hearing loss.

Of the turtles exposed to sound levels that exceed TTS thresholds across sites, we expect only a subset will experience temporary hearing loss. The Navy will pile drive for 10 hours per day, and not the full duration of 24 hours as used in the sound exposure calculations. These calculations of exposure are also based on the assumption that the turtle remains stationary during the 24 hour duration of the activity, which is highly unlikely for such a mobile species. We expect a turtle to more likely move away from the sound source than towards it. Additionally, the exposure calculations do not factor in potential recovery between intermittent sounds regardless of time between sounds. Furthermore, the calculations are based on the assumption that sound will propagate out equally in all directions, which is unlikely as attenuation losses will occur differently in different directions from the source as the sound interacts with structures and land that are common in Pearl Harbor.

For turtles that do experience temporary hearing loss, there may be energetic effects on the individuals. We anticipate that individual green sea turtles may be exposed to sound levels above TTS thresholds from daily pile driving on multiple occasions within a given year. However, the turtles primarily use visual cues, and we expect their hearing impairment to be relatively short term with their hearing returning back to normal after a healing duration.

We expect that turtles that occur in the TTS exposure areas will exhibit primarily behavioral responses. These will likely include short term responses such as individuals becoming startled or alarmed, halting their activities briefly, and avoiding areas temporarily. Given the relatively long duration of exposure (381 days at PHNSY & IMF and 242 days at WP) these responses may also include longer-term behavioral responses such as an individual abandoning an area long-term, even permanently (including foraging and resting sites). Such displacement may result in reduced foraging success, or may increase a turtle's risk of exposure to other existing stressors in the harbor if these occur at higher rates in the new areas.

In conclusion, we expect the turtles' behavioral, and sublethal responses to range from being temporary and recoverable, to potentially long term. The latter which we consider to be harassment.

6.2.2 Vessel Collisions

6.2.2.1 Exposure Analysis

Vessel collisions with turtles, who are surface air-breathers, is a known source of mortality to green and hawksbill sea turtles (NMFS and USFWS 1998, 2013; Schoeman et al 2020; Kelly 2020; Brunson et al. 2022; NMFS unpublished stranding data, see Environmental Baseline Section 5.2.1.2). In Hawaii, the majority of vessel strikes (between 1982 and 2018) have involved green turtles, although vessel strike injuries have been identified for other species including hawksbill sea turtles (Kelly 2020; Brunson et al. 2022). Green turtles are at higher risk of vessel strike compared to hawksbill turtles likely due to their higher abundance and density in nearshore shallow reef habitats including Pearl Harbor and likely due to surface basking behavior, which increases their time at the surface (Kelly 2020). In 2008 we estimated 37.5 vessel strikes of sea turtles per year from an estimated 577,872 trips from vessels of all sizes in Hawaii. More recently, we estimated as many as 200 green sea turtle strikes annually in Hawaii (Kelly 2020). If these turtle strikes are evenly distributed around the islands, the probability of a green sea turtle strike from any one vessel trip is extremely low (on average 0.035% [i.e. 200 turtles/577,872 vessel trips]).

Green sea turtles in Pearl Harbor are currently at risk of being struck by vessels operating in the harbor from approximately 5 vessel trips per day, resulting in up to 1 turtle strike per year[5]. At the onset of Stage 1 DD5 construction, the Navy will operate an additional 65 vessel trips per day in Pearl Harbor for the first 15 months of Stage 1 DD5 construction, including in areas of the harbor such as the main channel and WP considered to have higher concentrations of green sea turtles (Teresa 2021; Neyland et al. 2021; UH-ARL 2021; DON 2017). After 15 months (after dredging completion), the vessel activities will drop to approximately 15 vessel trips per day for the rest of the duration of the project (92 months).

Pearl Harbor is considered to be a "hot spot" area of concern representing 20% of all sea turtle strandings relative to vessel strikes on Oahu (Kelly 2020, see Environmental Baseline). However, of the 27 stranded turtles in Pearl Harbor with vessel strike injuries (NMFS 2019 report #IR-19-001), the majority were located in the main channel close to the mouth of the harbor, with four strandings in west loch, four around PHNSY & IMF and WP, and none in the inner reaches of the harbor by PCP (see Figure 26).

These patterns may be explained by the observed higher concentrations of turtles in the main channel and West Loch compared to PHNSY & IMF and PCP (Teresa 2021; Neyland et al. 2021; UH-ARL 2021; DON 2017) in combination with frequency of vessel transit in those areas. Turtles are also most vulnerable to being struck by small vessels (<15 m, < 50 ft), traveling at fast rates (>10 knots) (Hazel et al.2007; Work et al.2010; Schoeman et al. 2020 summarized in Kelly 2020). There is evidence that increased vessel speed decreases the ability of sea turtles to recognize a moving vessel in time to dive and escape being hit, as well as the vessel operator's ability to recognize the turtle in time to avoid it (Hazel et al. 2007). We assume that vessels transiting in and out of Pearl Harbor through the main channel generally travel at faster speeds compared to around the active work area of PHNSY & IMF.

[5] 5 vessel trips/day x 365 days x 0.035 probability of vessel strike.

Based on the above, and considering that the majority of vessel activity associated with the proposed action will be concentrated around the central construction site of PHNSY & IMF, that the Navy will limit vessel speeds to below 10 knots across the harbor, and less than 5 knots in areas with known concentrations of turtles, and that the Navy will implement BMPs to maintain distance with turtles (e.g. lookouts on vessels), we conclude that the general estimate of 0.035 % probability of a turtle vessel strike per vessel trip is reasonable for the purposes of our calculation of collision risk in this Opinion. We therefore estimate that a total of 25 turtles may be struck by vessels in the harbor over the near 9-yr duration of the Navy's construction of DD5 and WPF (65 vessel trips/day x 30 days x 15 months [= 29,250 vessel trips] + 15 vessel trips/day x 30 days x 92 months [= 41,400 vessel trips] x 0.035%); 10 turtles during the first 15 months of the project, thereafter 15 turtles over the course of the next 92 months.

As discussed in Section 6.2.1.1 above, we are reasonably certain that approximately 97% of all turtles in Pearl Harbor are green sea turtles and approximately 3% hawksbill turtles, and therefore that of the 25 turtles that will be struck, 24 will be green sea turtles and one will be a hawksbill sea turtle.

6.2.2.2 Response Analysis

Of the total 24 green sea turtles, and one hawksbill sea turtle that may be struck by transiting vessels in Pearl Harbor resulting from the near 9-yr duration of the Navy's proposed action, we expect that all (100%) will be severely injured or killed. Based on the mortality for vessel strikes around Hawaii being 95 to 100% (NMFS unpublished stranding data; NMFS 2018d; Kelly 2020), we are reasonably certain that the majority (95 to 100%) of the turtles struck will result in their death.

6.2.3 Habitat Disturbance and Loss

6.2.3.1 Exposure Analysis

Green sea turtles are documented to use benthic communities in Pearl Harbor for resting (see Environmental Baseline Section 5.2.1.5). While documentation of green sea turtle foraging in the harbor during Navy turtle surveys has been limited (Teresa 2021), the resources that green sea turtles feed on such as marine macroalgae, seagrass, and marine invertebrates (Russell et al. 2003; McDermid et al. 2015) have been observed throughout Pearl Harbor during multiple Navy surveys (Neyland et al 2021, 2020). While far less common in Pearl Harbor, we assume that hawksbill turtles likely also use the benthic habitats in the harbor for foraging and resting.

While Pearl Harbor was historically subject to significant dredging and in-water fill altering the shorelines and bottom habitat, the turtles that occur in Pearl Harbor are currently only exposed to relatively minor levels of permanent disturbance/loss of benthic habitat. The Navy's proposed in-water dredging and in-water fill from the proposed action will, in contrast, result in a relatively large permanent removal/loss compared to recent Navy projects. Approximately 16 acres of habitat in Pearl Harbor will be lost due to the proposed action: 10 acres at PHNSY & IMF, and 6 acres at WP. A large proportion of this habitat lost will be converted from waters to dry-land. In addition, the Navy has calculated that 36 out of 97 (37%) documented turtle resting caves within the construction/impact footprints in the harbor will be lost/removed. All 33 (100%) identified resting caves at PHNSY & IMF will be permanently lost, and 3 out of 24 (13 %) resting caves identified at WP will be either temporarily affected or permanently removed (NAVFAC 2022a). Other documented benthic resources within these impact footprints such as corals, algae and non-coral invertebrates that are generally known to provide resources to turtles will also be removed/lost due to the dredging and fill activities (Neyland et al 2021; NAVFAC 2022a).

We estimate how many sea turtles may be affected by the habitat loss using the Navy's sea turtle guild density estimates presented for Pearl Harbor (MGEL 2022; DON 2017b) as summarized in Table 22. These calculations indicate that no more than 1 turtle may be using each of the benthic habitat disturbance footprints at PHNSY & IMF and WP. The likelihood that a turtle is using the habitat that will be lost at WP is approximately five times greater than at PHNSY & IMF, which is driven by the higher concentrations of turtles present at WP (Teresa 2021; Ritchie et al. 2016). As discussed in Section 6.2.1.1 above, we are reasonably certain that approximately 97% of all turtles in Pearl Harbor are green sea turtles and approximately 3% hawksbill turtles. Based on this, and that no hawksbill sea turtles were observed in the resting caves, we are reasonably certain the loss of this small amount of foraging and resting habitat will not rise to the scale of harm or harassment of hawksbill turtles.

Table 22. Estimated extent of turtle exposure to proposed habitat loss at PHNSY and WP (NAVFAC 2022a).

Sites	**Upper Limit Sea turtle guild density estimate (km^2)**	**Total # turtles that may be using the area lost/removed**
PHNSY & IMF	0.88	0.04[1]
WP	9.37	0.19[2]

[1] Mean year-round density 0.88 x total area lost (0.04 km^2)
[2] Mean year-round density 9.37 x total area lost (0.02 km^2)

Using the mean minimum home range estimate for green sea turtles (7.2 km^2 ± 7.7 km^2, as per Balazs et al. 2017), we estimate that the proposed action will permanently impact approximately 0.6% of a green sea turtle's mean minimum home range at PHNSY & IMF, and approximately 0.3% of their minimum home range at WP.

6.2.3.2 Response Analysis

Since there is evidence that green turtles show strong fidelity to preferred foraging areas (Balazs 1976; Bennett et al. 2000; Balazs et al. 2017), and the Navy has documented that turtles use resting caves in the impact footprint that will become unavailable to them, we expect that a response of turtles to the permanent loss/removal of habitat at PHNSY & IMF and WP will be a long term behavioral response, specifically displacement and use of other areas and resources nearby.

If a turtle is displaced from their resting habitat by the removal of the 33 caves within the PHNSY & IMF, the shortest average distance to a nearby unaffected cave (SEFI) will be approximately 863 m. The average distance from PHNSY & IMF to an Entrance Channel cave, a region which has been characterized as a potentially preferred habitat (NAVFAC 2020), is approximately 2505 m. If a sea turtle is displaced from one of the 3 (out of 24) impacted WP caves, the shortest average distance to a nearby unaffected cave will be 382 m. The average distance from WP to a Main Entrance Channel cave, an area which may be close to preferred habitat, is 2,013 m.

As described in the exposure analysis, given that the permanent loss/removal of habitat represents a fraction of the turtles' home range sizes (0.3% of a green sea turtle's mean minimum home range at PHNSY & IMF, and approximately 0.6% at WP), we expect that green sea turtles may be able to swim the distances to other suitable resting and foraging habitats. It is also possible that new potential resting caves may be created, similar to how the current resting caves were created via dredging to create channels and inlets from the proposed dredging.

However, we expect that a displaced turtle may expend greater energy in locating new resting areas and foraging habitat, may experience reduced feeding and sheltering, greater competition with other individuals, and may lose some fitness benefits from resting, or from foraging in the specific habitat that will be lost. Additionally, the displacement and necessary use of different/new resting and foraging sites has a potential to place turtles at greater risk of being exposed to higher intensities of existing stressors, or entirely new stressors at the new sites. This may result in sub-lethal effects (e.g. an individual exhibiting increased respiration, energy expenditure or reduced feeding success due to habitat displacement).

Considering that we expect green sea turtles to exhibit behavioral and sublethal responses to displacement, we conclude that exposure of green sea turtles to habitat loss in Pearl Harbor from the proposed action will result in their harassment.

6.2.4 Entrapment in Dry Dock

6.2.4.1 Exposure Analysis

The Navy has indicated that turtles (green sea turtles) become trapped in their existing operating dry docks in the harbor (see Environmental Baseline Section 5.2.1.3), and NMFS has been notified on occasion in the past on such occurrences. We are therefore reasonably certain that turtles will become trapped in the new DD5 once it is operational.

Currently, the Navy information indicates that on average one turtle becomes entrapped across the existing four dry docks (#1-4) for every four flooding/dewatering cycles. Once the new DD5 is constructed, the Navy estimates it will undertake on average four flooding/dewatering cycles per year at this new dry dock. Despite Navy's proposed BMPs to mitigate the risk, turtles that are present in or immediately near DD5 risk becoming entrapped within the dry dock during each DD5 flooding/dewatering cycle. We are reasonably certain that an average of one turtle will be trapped every four dewatering cycles in DD5, i.e. one per year. Given that DD5 will be constructed adjacent to the existing DD3 (which will be decommission and filled as part of Stage 2 of the proposed action), it is likely that the overall number of turtle entrapments in a dry dock at PHNSY & IMF in Pearl Harbor will remain close to baseline levels.

Based on our discussion in Section 6.2.1.1 above, i.e. that approximately 97% of the turtles in Pearl Harbor are green sea turtles, we are reasonably certain that the vast majority of turtles that will be trapped in DD5 will be green sea turtles. Since the green sea turtle population in Hawaii has been increasing, and may continue into the future, we expect that the green sea turtle population also in Pearl Harbor will increase over time. A general increase was observed in the number of turtles documented in linear dive transects from March 2000 to May 2011 (Teresa 2021). We estimate that an increasing green sea turtle population in Pearl Harbor will be associated with an increasing probability of turtle entrapment in the dry docks, including in DD5. While we do not know the rate of population increase of green sea turtles in Pearl Harbor, data on counts of nesting female green turtles in Hawaii indicate an average annual increase of 5.4% (Balazs et al. 2015; Figure 21, NMFS unpublished). We therefore use this green sea turtle population growth estimate for calculating entrapment risk in DD5.

Assuming an annual 5.4 % increase in probability of green sea turtle entrapment during DD5 operations, and a 0.97 probability of an individual entrapped being a green sea turtle, we expect the number of green sea turtles trapped in the dry dock to increase over 5-year periods after the start of DD5 operation as per the estimates outlined in Table 23. Note that we have calculated these numbers using an annual running sum, and have rounded all fractions to the next higher whole number.

Table 23. The estimated annual number of green sea turtles trapped in the dry dock over 5-year periods of DD5 operations during the first 50-year period of its operations.

5- Year Periods	# Turtles trapped per 5-year period
Years 1-5	6
Years 6-10	8
Years 11-15	10
Years 16-20	13
Years 21-25	16
Years 26-30	21
Years 31-35	28
Years 36-40	36
Years 41-45	47
Years 46-50	62
Total # turtles over 50 yrs.	**247**

While the hawksbill population size in Hawaii is trending up (Gaos et al. 2021), we do not have sufficient data to estimate a population rate of change, therefore assume that a hawksbill turtle's entrapment risk will remain the same over time. Based on our estimate that approximately 3% of the turtles in Pearl Harbor currently are hawksbill sea turtles, i.e. using a 0.03 probability that a turtle entrapped in DD5 at the onset of dry dock operations will be a hawksbill sea turtle, we estimate that one hawksbill turtle may become trapped in DD5 approximately every 33 years of operations.

In summary, based on the above calculations, we estimate that a total of 247 green sea turtles and up to two hawksbill sea turtles will be trapped in DD5 during its first 50-year operational period. The Navy will continue operating DD5 beyond 50 years, likely for the 100-year design life of the DD5 and potentially beyond. While our calculations can be projected out for this duration and beyond, Pearl Harbor has a maximum carrying capacity for green turtles, i.e. there will be a point where the green sea turtle population in the harbor will no longer increase. We cannot determine what this carrying capacity might be, and when it will be reached, but we are reasonably certain it will occur within the first 50 years at a 5.4% rate of increase. At that rate, the population would double three times in 50 years (it would be eight times greater than what it is now). Because it is not reasonable to expect a greater increase than that, we estimate the number annually entrapped in years 51-100 to be the same as in years 46-50 (62 per 5-year period).

6.2.4.2 Response Analysis

The Navy will implement their proposed mitigation measures to carefully handle and relocate 100% of the entrapped turtles in consultation with NOAA's Marine Wildlife Stranding Program. Therefore, we are reasonably certain the probable response of the individuals to be primarily behavioral in nature, specifically temporary displacement. The Navy indicates that historical turtle entrapments in the existing dry dock have not led to injury or death. Therefore, we are reasonably certain turtle entrapments will not result in death. We expect that there is a low potential for injury, but are unable to quantify what this probability will be. We anticipate that some individual green sea turtles could be entrapped on multiple occasions over their lifetime.

Of the estimated 247 green sea turtles and up to two hawksbill turtles entrapped in DD5 over the first 50 years of operations, we are reasonably certain the entrapment and subsequent handling and release will only injure a few turtles and not kill any. Of note: since DD5 will replace DD3 operations (i.e. DD3 will be decommissioned), it is possible that the overall entrapment risk and effect to turtles in Pearl Harbor after DD5 is constructed and operational, will remain close to current baseline levels.

6.2.5 Summary of Exposure and Response

We are reasonably certain that green sea turtles will be exposed to four stressors, i.e. elevated underwater sound, vessel collisions, removal/loss of habitat, and entrapment in DD5 from the proposed action as discussed and estimated above. Based on the turtle survey data in Pearl Harbor (Richie et al. 2016; Teresa 2021), we anticipate that the majority (60 to 75%) of the green turtles that will be exposed to the various stressors will be juveniles (<1.0 m SCL), below reproductive age given that average size at first reproduction for green turtles in Hawaii is 89 cm SCL (Balazs et al. 2015). Given that juveniles have no external sexual features till they reach adulthood, the gender of the individuals in Pearl Harbor are not identified. However, based on Balazs et al. (2015) reporting that 61.6% adults are female we assume an approximately 3:2 female biased ratio. While there is some evidence of seasonality from turtle surveys in the harbor, i.e. fewer turtle sightings between March and June, and a greater number in the later months of the year (Teresa 2021), we assume this does not influence individuals level of exposure to stressors as the stressors will span the entire year, and occur for a duration of several years. Since the Navy has not documented nesting in Pearl Harbor (NAVFAC 2022a; NAVFAC pers. com 2022), behavioral responses to pile driving, habitat loss and entrapment in DD5 are not expected to appreciably impact green sea turtle reproductive behavior or nesting success.

We are also reasonably certain that hawksbill turtles will be exposed to these stressors, albeit at much lower levels due to their uncommon occurrence. We do not have sufficient information on hawksbill sea turtles in Pearl Harbor to identify the life stage, reproductive phase, age, or sex of individuals that may be exposed to the stressors. However, we are reasonably certain that hawksbills in Pearl Harbor are likely primary juveniles, since this is the primary life stage in Pearl Harbor of green sea turtles and the two turtles released by the NOAA stranding program were juveniles (see Environmental Baseline Section 5).

The exposure of green and hawksbill sea turtles to the stressors associated with the proposed action, i.e. elevated underwater sound, vessel collisions, removal/loss of habitat, and entrapment in DD5 will result in harm, harassment, entrapment and injury to these animals.

6.2.6 Risk Analyses

As described in the Exposure Analysis, the best available information suggests that the majority of green sea turtle individuals affected by the stressors resulting from the proposed action will be juveniles, below reproductive age, and that more females than males will be affected (3:2 female to male ratio). Due to a lack of data, we are unable to identify the age, reproductive stage or sex of hawksbill sea turtles that may be affected by the proposed action; although we suspect that affected hawksbills will be juveniles similar to the green turtle's life stage that occurs within Pearl Harbor.

In our risk analysis we assume (i) turtles that are killed or that experience severe, non-recoverable injuries will be removed from the population; (ii) individuals that sustain severe, recoverable injuries or long-term behavioral effects will experience fitness consequences during the time it takes them to fully recover and resume normal behavioral activities; (iii) turtles that experience short term behavioral responses will recover fully after exposure to the stressor, with little long-term effects to individuals.

For the purposes of our analysis we assume that all turtles struck by vessels from the proposed action will die, or be severely injured and subsequently die. We do not have data to estimate what proportion of entrapment of turtles will result in injury. We only have anecdotal information indicating that the probability of death is extremely low. For the vast majority of the individuals that become entrapped in dry docks, we expect that while they may experience stress during Navy's handling and relocation, they will thereafter resume activities relatively quickly with little to no long-term consequence to their fitness.

We are reasonably certain that the turtles affected by elevated underwater sound and habitat loss will not be severely injured or die. Effects on individuals such as temporary hearing loss and behavioral disruption due to displacement can have fitness consequences during the time it takes the turtles to fully recover or find and exploit similar resources elsewhere within their home range. Given that turtles do not rely on acoustic cues for most important life functions, we are reasonably certain that temporary hearing loss will not result in long term fitness consequences to individuals. We are also reasonably certain that fitness consequences due to displacement will be short term given the availability of similar resources elsewhere within their home range. We do not expect short term behavioral responses in turtles from elevated underwater sound and habitat loss/displacement to have long-term fitness consequences.

Based on the above, we conduct our risk analysis for green sea turtles and hawksbill sea turtles by calculating the total estimated number of individuals predicted to be severely injured or killed by the proposed action. Thereafter, we calculate the proportion that these individuals represent of the total population. We assess the risk to the species by evaluating whether any population level effects result in a measurable effect on reproduction, numbers, or distribution of the species. Since genetic studies indicate subpopulation structure of hawksbill sea turtles within their global range (see Status of Listed Resources Section 4.2.2), we focus our risk assessment on specifically Oceania hawksbill populations rather than global species range.

Using the population estimates provided in the Status of Listed Species (Section 4.2) and estimates of severe injury/death described in the Effects Analyses (Section 6.2) and as summarized in Table 24 below, we calculate that 24 deaths of green sea turtles will equal 0.004% of the CNP population. Using an estimate of one death of a hawksbill turtle, this will make up 0.00004% of the total Oceania hawksbill population.

Table 24. Estimated total species population and number of green sea turtles and hawksbill turtles severely injured/killed from the proposed action over approximately 9 years.

Species Population Estimates	Estimated total species population	Estimated # individuals killed by vessel strike (rounded up)
CNP green sea turtles	682,296 (range: 460,965 to 1,145,988)	24
Oceania hawksbill sea turtles	2,592,331	1

Since the majority of turtles in Pearl Harbor affected will likely be below reproductive age, the main effect of death of the turtle individuals will be lost reproductive potential that might not be realized for several years (or decades). However, while the loss will contribute to a reduction in reproduction of their respective populations, these numbers constitute only minor fractions of their total populations.

6.3 Cumulative Effects

“Cumulative effects”, as defined in the ESA, implementing regulations are limited to the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this opinion (see 50 CFR 402.02). For an action to be considered reasonably certain to occur, it must be based on clear and substantial information, or otherwise have a firm basis to support a conclusion that a consequence of an action is likely. Some factors we consider when evaluating an action for potential cumulative effects and whether those effects are reasonably certain to occur include our past experiences from similar actions, existing plans for the activity or action, and hurdles, like economic and legal requirements, that must be met before the action can go forward (see 50 CFR 402.17). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

We searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area. We did not find any information about non-Federal actions other than what we described in the Environmental Baseline (Section 5), most of which we expect will continue in the future. An increase in these activities could similarly increase their effect on ESA-protected resources and for some, an increase in the future is considered reasonably certain to occur. Given current trends in global population growth, threats associated with climate change are likely to continue to increase in the future. Given Pearl Harbor receives a contaminant load from many non-military commercial, industrial, residential, and agricultural sources in the surrounding watershed, threats associated with pollution from discharges from point and nonpoint sources of pollution in harbor waters are likely to continue.

For the illegal non-federal fishing and associated threats identified in the Environmental Baseline, the magnitude of increase and the significance of any anticipated effects remain unknown. The best scientific and commercial data available provide little specific information on any long-term effects of these potential sources of disturbance on ESA-protected resources. Thus, this consultation assumed effects in the future will be similar to those in the past and, therefore, are reflected in the anticipated trends described in the status of listed resources (Section 4) and Environmental Baseline sections.

7 INTEGRATION AND SYNTHESIS OF EFFECTS

The Integration and Synthesis section is the final step in our assessment of the risk posed to species as a result of the Navy implementing the proposed action. In this section, we add the Effects of the Action (Section 6.2) and the Cumulative Effects (Section 6.3) to the Environmental Baseline (Section 5) and in light of the status of the species, formulate the agency's biological opinion as to whether the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of a ESA-listed species in the wild by reducing its numbers, reproduction, or distribution.

The following discussions separately summarize the probable risks the proposed action poses to threatened green sea turtle and endangered hawksbill sea turtle species that are likely to be exposed. These summaries integrate the exposure profiles presented previously with the results of our response analyses for each of the activities considered in this opinion.

7.1 Central North Pacific Green Sea Turtle

As described in the Status of Listed Species Section the CNP green sea turtle is listed as threatened, with its abundance increasing by about 5.4% per year over the past 40 years (Balazs et al. 2015). While the nesting population trajectory is positive, more than 96% of nesting occurs at one site in the NWHI that is highly vulnerable to loss of nesting habitat. This is exemplified by the impacts to the green sea turtles' main nesting beach on East Island in French Frigate Shoals due to Hurricane Walaka in 2018. While recent monitoring suggests that the species is successfully using alternate nesting habitat on nearby Tern Island, this hurricane event placed the CNP green turtles in a natural experiment whose outcome remains uncertain.

The historical decline of green sea turtles is primarily attributed to intense harvesting. The positive increasing population trend is attributed to increased survivorship (since harvesting of turtles in foraging areas was prohibited in the mid-1970s) and cessation of habitat damage at the French Frigate Shoals rookeries beginning in the early 1950s (Balazs and Chaloupka 2004). Currently, the primary threats to the population include habitat loss due to sea level rise and climate change, coastal gill net and hook-and-line fisheries, vessel strikes, and Fibropapillomatosis disease. The concentrated nature and relatively small size of the population make it vulnerable to random variation and stochasticity in the biological and physical environment, including natural catastrophes and anthropogenic threats. Emerging concerns for turtle habitat throughout the Hawaiian Archipelago are phenomena related to climate change, including changing storm dynamics and intensity, and loss of nesting habitat (Baker et al. 2006; Baker et al. 2020; Keller et al. 2009) were key considerations in the recent population assessment and ESA listing status (Seminoff et al. 2015).

As described in the Environmental Baseline Section, past and present military activities, pollution and climate change have, and continue to affect CNP green turtles within Pearl Harbor (the action area). CNP green turtles may also interact with illegal fishing activity and pollution in the harbor. As described in the Cumulative Effects Section, these activities are reasonably likely to continue into the future, with environmental changes associated with anthropogenic threats likely to increase due to human population growth.

From our Effects Analysis, we anticipate that green sea turtles in Pearl Harbor will experience behavioral responses, potential injury, and TTS from exposure to sound generated from pile driving, habitat loss, and entrapment in DD5. Based on our analysis, we expect the majority of individuals to experience behavioral response rather than physical injury or temporary hearing loss. We anticipate that some individual green sea turtles will be exposed to elevated sound from pile driving on multiple occasions over the total duration of pile driving, and exposed to entrapment in DD5 on multiple occasions over their lifetime.

We are reasonably certain the Navy will release green turtles entrapped in DD5 without injury. Although TTS and behavioral responses could result in fitness impacts on individual sea turtles, we expect such effects to occur in only a very small number of individuals and that they will recover. We expect that individuals that sustain recoverable injuries or long-term behavioral effects will experience fitness consequences during the time it takes them to fully recover and resume normal behavioral activities, and turtles that experience short term behavioral responses will recover fully after exposure to the stressor, with little long-term effects to individuals. We are reasonably certain effects will not result in an appreciable reduction in the survival or reproductive potential of these individual sea turtles, and given the small number of individuals affected it is unlikely to have an appreciable impact at the population level of CNP green sea turtles. Since no nesting has been recorded in Pearl Harbor (NAVFAC 2022a; NAVFAC pers. com 2022), behavioral responses to pile driving, habitat loss, and entrapment in DD5 are not expected to appreciably impact green sea turtle reproductive behavior or nesting success.

Based on our Effects Analysis (Section 6), we estimate there will be 24 vessel strikes of CNP green sea turtles in Pearl Harbor during the near 9-year proposed action. For the purpose of this analysis we assume they will all be lethal. Using the population estimates provided in the Status of Listed Species (Section 4), we calculate that 24 deaths of green sea turtles will equal 0.003% of the CNP population. We are reasonably certain the loss of 0.004% of green sea turtles over the next nine years will not measurably affect the long-term 5.4% positive trend in nesting abundance.

We are reasonably certain the green sea turtle population trend will continue to be positive with the proposed action. Thus, we are reasonably certain the proposed action will not cause material changes having appreciable biological consequences to the species' numbers, reproduction, or distribution. In accordance with Section 6 (Jeopardy Analyses) above, we do not anticipate the proposed action will reduce appreciably the likelihood of the survival or recovery of green sea turtles in the wild by reducing their reproduction, numbers, or distribution.

7.2 Hawksbill Sea Turtle

In the Status of Listed Species Section, we describe that hawksbill sea turtles are listed as endangered throughout their global range. We also address that genetic studies indicate subpopulation structure within this global range, and therefore focus our risk assessment on the Pacific and specifically Oceania hawksbill populations rather than global species range.

The historical decline of hawksbill sea turtles is primarily attributed to centuries of exploitation for the species' ornate shell (Parsons 1972). The continuing demand for the hawksbills shells, as well as other products derived from the species, represents an ongoing threat to its recovery. Due to their preference to feed on sponges associated with coral reefs, hawksbill sea turtles are particularly sensitive to losses of coral reef communities. Threats from other manmade and natural sources remain, including poaching, incidental capture in commercial and artisanal fisheries, climate change, and coastal development.

As described in the Environmental Baseline Section (Section 5), past and present military activities, pollution and climate change likely have been, and likely continue to affect hawksbill turtles in Pearl Harbor (the action area). As described in the Cumulative Effects Section (Section 6.3), these activities are reasonably likely to continue into the future, with environmental changes associated with climate change likely to increase due to human population growth.

In our Effects Analysis, we expect there to be a potential that hawksbill turtles in Pearl Harbor will experience behavioral responses and TTS from exposure to sound generated from pile driving, and from entrapment in DD5. Based on our analysis, we expect there to be a greater likelihood that individuals will experience behavioral response rather than injury or temporary hearing loss.

We are reasonably certain the Navy will release hawksbill turtles entrapped in DD5 without injury. Although TTS and long-term behavioral responses could result in fitness impacts on individual sea turtles, such effects are only predicted to occur in very few if any individuals. We do not expect these effects to result in an appreciable reduction in the survival or reproductive potential of individual sea turtles, and given the small number affected it is unlikely to have an appreciable impact at the population level of Oceania hawksbill turtles.

In our Effects Analysis (Section 6), we estimate that one hawksbill turtle in Pearl Harbor will be affected by vessel strike over the course of DD5 and WPF construction (nearly 9 years) and that this effect will be lethal. Using the population estimates provided in the Status of Listed Species (Section 4), we calculate that one death of a hawksbill sea turtle will equal 0.00004% of the total

Oceania hawksbill population. We are reasonably certain the loss of 0.00004% of Oceania hawksbill sea turtles will not measurably affect the long-term trend in the Oceania hawksbill sea turtle population. In addition, we are reasonably certain that the removal of one hawksbill individual over the next nine years due to the proposed action will not change the population trend of Hawksbill sea turtles in Hawaii, which has been positively trending since 2006.

Given the above, we are reasonably certain the proposed action will not cause material changes having appreciable biological consequences to the species' numbers, reproduction, or distribution. In accordance with Section 6 (Jeopardy Analyses) above, we do not anticipate the proposed action will reduce appreciably the likelihood of the survival or recovery of hawksbill sea turtles in the wild by reducing their reproduction, numbers, or distribution.

8 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the Navy's proposed action to construct and operate a dry dock and WPF in Pearl Harbor is not likely to jeopardize the continued existence of the Central North Pacific green sea turtle or hawksbill sea turtle.

9 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the "take" of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. 16 U.S.C. 1532. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. 50 CFR 222.102. NMFS had not yet defined "harass" under the ESA in regulation, but has issued interim guidance on the term "harass," defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering."

"Incidental take" is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity (50 CFR 402.02). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the reasonable and prudent measures and terms and conditions of the Incidental Take Statement. In the case of threatened species, section 4(d) of the ESA leaves it to the Secretary's discretion whether and to what extent to extend the statutory 9(a) ''take'' prohibitions, and directs the agency to issue regulations it considers necessary and advisable for the conservation of the species. The 2016 Final Rule to list eleven distinct population segments of the Green sea turtle (81 FR 20057) included listing the Central North Pacific DPS as threatened. The 2016 listing left in place the longstanding protective regulations applied to threatened sea turtles (50 CFR 17.42(b)(1); 50 CFR 223.205).

9.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions. Where it is not practical to quantify the number of individuals that are expected to be taken by the action, a surrogate (e.g., similarly affected species or habitat or ecological conditions) may be used to express the amount or extent of anticipated take. A surrogate that is coextensive with the proposed action is permissible when the ITS requires monitoring and reporting of project impacts to the surrogate during the course of the action so that reinitiation of consultation will be triggered if the extent of anticipated incidental take is exceeded (80 FR 26832).

When using a surrogate, we must describe the causal link between the surrogate and take of the listed species, explain why it is not practical to quantify the number of individuals or to monitor take in terms of individuals of the listed species, and set a clear standard for determining when the level of anticipated take has been exceeded. We use a surrogate for the incidental take of turtles exposed to elevated sound, habitat loss and vessel strikes.

Take caused by elevated sound cannot be accurately quantified as a number of turtles because the presence and abundance of turtles near the pile driving locations when the impact hammer operates is unpredictable. Turtle presence in these areas is variable throughout the year and over time. Monitoring the number of turtles taken by sound in the entire TTS exposure areas (i.e. from source level of pile driving to the outer limit of 189 dB SEL_{cum}) is also impractical. Observing turtles underwater is difficult, especially at the construction sites in Pearl Harbor where the water is turbid, and a turtle within the range of sound may or may not show signs of harm or harassment.

The best available surrogate for elevated sound is: the distance from source level of pile driving to the outer limit of 189 dB SEL_{cum} at PHNSY & IMF, WP and PCP for the duration of the proposed action (see Table 19). This surrogate is connected causally to the amount of take that will occur because an exceedance of the distance to 189 dB SEL_{cum} translates into a proportional increase in the impact to listed species. This distance can also be easily monitored, allowing the surrogate to serve as a clear reinitiation trigger.

Take caused by habitat loss cannot be accurately quantified as a number of turtles because we lack historical data on the numbers of turtles foraging and sheltering in the area to precisely predict how many would be using it in the future. Furthermore, the number of individuals exposed will be affected by other factors we cannot fully predict, such as competition and abundance of forage in the affected areas, as well as throughout Pearl Harbor where turtles may disperse. Monitoring the number of turtles taken by habitat loss is also impractical. Observing turtles underwater is difficult, especially in Pearl Harbor's turbid waters, and determining which were displaced and which were not would be impossible.

The best available surrogate for habitat loss is: total acreage of in-water area in the harbor removed, including number of resting caves, at PHNSY & IMF and WP. This surrogate is connected causally to the amount of take that will occur because an increase in area filled translates into a proportional increase in the impact to listed species. The area filled can also be easily monitored, allowing the surrogate to serve as a clear reinitiation trigger. Although this surrogate is somewhat coextensive with the proposed action, it nevertheless serves as a meaningful reinitiation trigger because implementation monitoring will document any exceedance and if reinitiation is warranted.

Take caused by vessel strike cannot be accurately quantified as a number of turtles because the presence and abundance of turtles in paths of vessels when the vessel passes by is unpredictable. Turtle presence and abundance in these areas is variable throughout the year and over time. Furthermore, the number of individuals exposed will be affected by factors we cannot fully predict, such as the detection rate of the look out on the vessels, the captain's ability to avoid an animal, or the animal's ability to avoid the vessel. Monitoring the number of strikes is not realistic, as many of the Navy vessels are so large that a strike is not detectable. While dead and injured turtles are likely to be observed and found by the Navy as they float in water, or as they strand on the shores of Pearl Harbor, it is impossible to determine if that turtle was struck by a vessel from the proposed action, a Navy vessel unrelated to the proposed action, or any of the other non-naval vessels transiting Pearl Harbor every day.

The best available surrogate for vessel collision is: The number of vessel trips. This surrogate is connected causally to the amount of take that will occur because an increase in vessel trips translates into a proportional increase in the impact to listed species. The number of vessel trips can also be easily monitored, allowing the surrogate to serve as a clear reinitiation trigger. Although this surrogate is somewhat coextensive with the proposed action, it nevertheless serves as a meaningful reinitiation trigger because implementation monitoring will document any exceedance and if reinitiation is warranted.

The amount and extent of incidental take is summarized in Table 25 below.

Table 25. The amount and extent of anticipated take of threatened and endangered sea turtles due to the proposed action. Note: where it is not practical to quantify the number of individuals that are expected to be taken by the action (elevated sound, vessel collision and habitat loss), we use a surrogate to express the amount or extent of anticipated take.

<table>
<tr><th>Stressor</th><th>Green sea turtle</th><th>Hawksbill sea turtle</th></tr>
<tr><td>Elevated Sound</td><td colspan="2">Distance from source level of pile driving to the outer limit of 189 dB SEL_{cum}:

At PHNSY & IMF:
● 308.5 m for 50 days (i.e. related to 36-inch steel pipe pile driving)
● 685.2 m for 331 days (i.e. related to 42x18 and 18x18-inch steel H-pile driving)

At WP:
● 308.5 m for 242 days (i.e. related to 36-inch steel pipe pile driving)

At PCP:
● 308.5 m for 14 days (i.e. related to 36-inch steel pipe pile driving)</td></tr>
<tr><td>Vessel Collision</td><td colspan="2">Number of vessel trips:

● A total of 29,250 vessel trips (on average 65 vessel trips/day) during the first 15 months of DD5 construction</td></tr>
</table>

Stressor	Green sea turtle	Hawksbill sea turtle
	• A total of 41,400 vessel trips (on average 15 vessel trips/day) during the remaining 92 months of the project	
Habitat Loss	Permanent loss of marine benthic habitat: At PHNSY & IMF: • 10 acres • 33 resting caves At WP: • 6 acres • 3 resting caves	
DD5 Entrapment	Entrapment and capture of green sea turtles during the first 100 years of DD5 operations: • Years 1-5: 6 individuals • Years 6-10: 8 individuals • Years 11-15: 10 individuals • Years 16-20: 13 individuals • Years 21-25: 16 individuals • Years 26-30: 21 individuals • Years 31-35: 28 individuals • Years 36-40: 36 individuals • Years 41-45: 47 individuals • Years 46-50: 62 individuals • Years 51-100: 62 individuals per 5-year period.	Entrapment and capture of hawksbill turtles: • 1 individual every 33 years

As provided in the text of the statute and legislative history, an additional purpose of an ITS is to serve as a reinitiation trigger (see Section 9.5 "Reinitiation of Consultation") that provides clear signals that the level of anticipated take has been exceeded and, therefore, will require reexamination of the Federal agency action through a reinitiated consultation.

9.2 Reasonable and Prudent Measures

Reasonable and prudent measures are non-discretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). We determine that the following reasonable and prudent measures, as implemented by the terms and conditions that follow, are necessary and appropriate to minimize the impacts of Navy's DD5 and WPF construction and operations, as described in the proposed action, on threatened and endangered species and to monitor the level and nature of any incidental takes. These measures are non-discretionary, they must be undertaken by the Navy for the exemption in ESA Section 7(o)(2) to apply.

1. The Navy shall minimize incidental take from elevated sound associated with pile driving in Pearl Harbor.
2. The Navy shall minimize incidental take from sea turtle entrapment in the dry dock throughout the dry dock's operational lifespan.
3. The Navy shall minimize take from vessel collisions within Pearl Harbor.
4. The Navy shall ensure the proposed action has a monitoring and reporting program sufficient to confirm the amounts and extents of take are not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

9.3 Terms and Conditions

The Navy shall undertake and comply with the following terms and conditions to implement the reasonable and prudent measures identified in Section 9.2 above. These terms and conditions are non-discretionary, and if the Navy fails to adhere to these terms and conditions, or fails to implement measures requiring their contractors to comply with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse.

1. The following terms and conditions implement Reasonable and Prudent Measure No. 1:
    a. The Navy shall use an underwater hydrophone to measure sound levels produced by each type and event of pile driving with an impact hammer to verify that the actual distance to SEL isopleths for PTS and TTS does not exceed the estimated distances provided in Table 19 and 25.
2. The following terms and conditions implement Reasonable and Prudent Measure No. 2:
    a. The Navy shall, throughout the dry dock's operational lifespan, explore and implement effective methods to reduce the incidence of entrapments in DD5.
    b. The Navy shall develop a NMFS PRD approved protocol for responding to, handling, and relocating ESA-listed turtles trapped in the DD5 in coordination with the NMFS stranding response program in advance of the start of DD5 operations to be appropriately prepared prior to the first entrapment of an individual.
3. The following terms and conditions implement Reasonable and Prudent Measure No. 3:
    a. The Navy shall develop a map (as permitted by Navy Operations Security), and associated GIS coordinates for use in GPS, identifying the areas in Pearl Harbor known to have greater concentrations of turtles, and shall provide these to all vessel operators associated with the vessel activities resulting from the DD5 and WPF construction.
    b. The Navy shall assign dedicated lookouts on all transiting vessels to help avoid sea turtle vessel strikes.
4. The following terms and conditions implement Reasonable and Prudent Measure No. 4:
    a. The Navy shall ensure the following monitoring will occur:

i. Sound levels at the distances in Table 25 using a hydrophone during all types and events of impact driver use.
ii. Number of vessel trips by day, including the vessel type, maximum speed attained, and if they entered a high density turtle area.
iii. Number of acres permanently lost and number of resting caves eliminated.
iv. Number of turtles by species entrapped in DD.

b. The Navy shall report to NMFS immediately if any of the take indicators in Table 24 are exceeded.
c. The Navy shall provide annual reports by March 1 that detail the results of the monitoring above for the previous calendar year.
    i. The first year report shall include the map from Terms and Conditions C 3a above.
    ii. Prior to the first dewatering event in DD5, an annual report shall include the protocol from Terms and Conditions 2b above.
    iii. After completion of construction of DD5 and WPF the Navy may report every 5 years.

9.4 Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. The Navy should undertake or support studies on ecology, habitat use, fecundity, genetics, and post interaction survivability of turtles, and other ESA-listed marine species in Pearl Harbor.
2. The Navy should explore how climate change may affect habitat quality, prey abundance and distribution, and the physiological ecology (e.g. thermal tolerance) of the ESA-listed species present in and immediately around Pearl Harbor.
3. The Navy should enforce the vessel speed limits in and at the mouth of Pearl Harbor, and explore additional mitigation measures to reduce risk of vessel collision with sea turtles.
4. The Navy should develop an outreach and education campaign for the public to increase awareness of the fishing regulations in Pearl Harbor, and enhance capacity to monitor and regulate illegal fishing to reduce entanglement risk with sea turtles.

In order to keep us informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Navy should notify us of any conservation recommendations they implement in their final action.

9.5 Reinitiation Notice

This concludes formal consultation on the construction and operation of a Navy DD5 and WPF in Pearl Harbor. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law, and if:

1. The amount or extent of incidental take for any species is exceeded;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;
3. The agency action is subsequently modified in a manner that may affect listed species or critical habitat to an extent in a way not considered in this opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

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APPENDIX A: LISTED RESOURCES AND STRESSORS NOT CONSIDERED FURTHER

As addressed in the Listed Resources Not Considered Further section (Section 4.1) of this Opinion, we have determined that the Navy's construction, operation and maintenance of DD5 and WPF is not likely to adversely affect the following threatened and endangered species: East Pacific Green Sea Turtles; North Atlantic Green Sea Turtles; Leatherback Sea Turtle; North Pacific Loggerhead Sea Turtle; Northwest Atlantic Loggerhead Sea Turtle; Olive Ridley Sea Turtle (Mexican breeding population); Olive Ridley Sea Turtle (all other populations); Kemp's Ridley Sea Turtle; Hawaiian Monk Seal; Blue Whale; Fin Whale; Sei Whale; Sperm Whale; Mexico Humpback whale; Central America Humpback whale; Main Hawaiian Island Insular[2] False Killer Whale; North Pacific right whale; North Atlantic Right Whale; Giant Manta Ray; Central & Southwest Atlantic Scalloped Hammerhead Shark; Eastern Pacific Scalloped Hammerhead Shark; Oceanic Whitetip Shark; Carolina Atlantic sturgeon; Chesapeake Bay Atlantic sturgeon; New York Bight Atlantic sturgeon; and South Atlantic Atlantic sturgeon. We have also determined that the proposed action is not likely to adversely affect critical habitat designated for Northwest Atlantic Loggerhead Sea Turtle, the Hawaiian Monk Seal, the Main Hawaiian Island Insular False Killer Whale, and the North Atlantic Right Whale in the action area. We also determine that the proposed action is not likely to adversely affect critical habitats designated for any of the above listed species (see Table 13). The reasons for our determinations are detailed below.

The general exposure profiles of the listed resources in the action area that may be affected by the proposed action are summarized in Table 26 below. In the table we have indicated the potential stressors associated with the proposed action that may affect each of these listed resources, organized by the geographic location of potential exposure. Most of the species occur outside of Pearl Harbor, and may be exposed to stressors (elevated underwater sound and vessel collision) associated with only a single transit of a heavy-lift vessel transporting and delivering the dry dock caisson from Norfolk, VA, to Pearl Harbor, Hawaii.

Table 26. Presence of the listed species in the action area that may be affected by the proposed action.

ESA-listed Species	**Action Area**	
	Along the Open Ocean Vessel Transit Path	**Inside and Immediately Outside Pearl Harbor**
Central North Pacific Green Sea Turtles *Chelonia mydas*	X	X
East Pacific Green Sea Turtles *Chelonia mydas*	X	
North Atlantic Green Sea Turtles *Chelonia mydas*	X	
Hawksbill Sea Turtle *Eretmochelys imbricata*	X	X

ESA-listed Species	Action Area	
	Along the Open Ocean Vessel Transit Path	**Inside and Immediately Outside Pearl Harbor**
Leatherback Sea Turtle *Dermochelys coriacea*	X	
North Pacific Loggerhead Sea Turtle *Caretta caretta*	X	
Northwest Atlantic Loggerhead Sea Turtle *Caretta caretta*	X	
Olive Ridley Sea Turtle (Mexican breeding population)* *Lepidochelys olivacea*	X	
Olive Ridley Sea Turtle (all other populations) *Lepidochelys olivacea*	X	
Kemp's Ridley Sea Turtle *Lepidochelys kempii*	X	
Hawaiian Monk Seal[1] *Neomonachus schauinslandi*	X	X
Blue Whale *Balaenoptera musculus*	X	
Fin Whale *Balaenoptera physalus*	X	
Sei Whale *Balaenoptera borealis*	X	
Sperm Whale *Physeter macrocephalus*	X	
Mexico Humpback whale *Megaptera novaeangliae*	X	
Central America Humpback whale *Megaptera novaeangliae*	X	
Main Hawaiian Island Insular False Killer Whale *Pseudorca crassidens*	X	
North Pacific right whale *Eubalaena japonica*	X	
North Atlantic Right Whale *Eubalaena glacialis*	X	

ESA-listed Species	Action Area	
	Along the Open Ocean Vessel Transit Path	Inside and Immediately Outside Pearl Harbor
Giant Manta Ray *Manta birostris*	X	
Central & Southwest Atlantic Scalloped Hammerhead Shark *Sphyrna lewini*	X	
Eastern Pacific Scalloped Hammerhead Shark *Sphyrna lewini*	X	
Oceanic Whitetip Shark *Carcharhinus longimanus*	X	
Carolina Atlantic sturgeon *Acipenser oxyrinchus*	X	
Chesapeake Bay Atlantic sturgeon *Acipenser oxyrinchus*	X	
New York Bight Atlantic sturgeon *Acipenser oxyrinchus*	X	
South Atlantic Atlantic sturgeon *Acipenser oxyrinchus*	X	

For green sea turtles and hawksbill turtles, we analyze the stressors likely to cause trapping, harm, or harassment in the Opinion. In this Appendix, we analyze effects to the species where we conclude exposure to stressors is extremely unlikely, or an adverse response will not rise to the level of harm or harassment, i.e. they are not likely to adversely affect.

1 STRESSORS NOT LIKELY TO ADVERSELY AFFECT LISTED SPECIES IN THE VESSEL TRANSIT PATH

The Navy will transport a pre-constructed dry dock caisson from Norfolk, VA, to Pearl Harbor via a special, heavy-lift vessel. The vessel will transit through the Atlantic Ocean and the Caribbean Sea to cross through the Panama Canal to the Pacific Ocean (see Figure 7). The two stressors resulting from the vessel transit that listed resources occurring in the vessel transit path may be exposed to include elevated underwater noise produced by the engine and collision with the vessel.

1.1 Elevated Underwater Sound

Sound from the heavy-lift vessel may be detectable to ESA-listed mammals, sea turtles, and fish, although the density of species in the open ocean is so low that they are unlikely to be encountered. Nearshore species are more likely to be encountered in transit in the Norfolk and Pearl Harbor estuaries where origination and destination ports occur. However, these areas are already heavily trafficked by ships and the single transit by the heavy-lift vessel is not expected to substantially increase noise levels above background or ambient conditions.

We are reasonably certain the response elicited from ESA-listed marine mammals, sea turtles, or fish due to the vessel noise will be in the form of behavioral avoidance or interruption in behavior. Any behavioral response of ESA-listed species to the vessel noise will be of limited duration and magnitude, only as the vessel passes by. The temporary (minutes) disturbance of marine mammals, sea turtles, or fish associated with the single transit of the heavy-lift vessel interaction as part of the proposed action are not expected to result in injury or reduced fitness as we do not anticipate any significant disruption of breeding, feeding, or sheltering to occur. Therefore, the effects from vessel sound resulting from the proposed action will not rise to the scale of harm or harassment, and thus will be insignificant.

1.2 Vessel Collision

Vessel strike could potentially affect ESA-listed marine mammals, sea turtles, and fish species occurring within the caisson vessel transit path. Turtles may use auditory cues to react to approaching ships rather than visual cues, making them more susceptible to strike as ship speed increases (Hazel et al. 2007). In the rare event they are encountered by the heavy-lift vessel, sea turtles are expected to exhibit avoidance behavior. Similarly, whales, and monk seals will be expected to avoid the slow moving vessel. Given the relatively slow speed and single vessel trip, a marine mammal or sea turtle strike occurring as a result of the proposed action is extremely unlikely to occur and thus will be discountable.

Large ships that transit through shipping channels typically draft close to the bottom of the channel, which increases the likelihood of interactions with bottom-dwelling fish such as the ESA-listed sturgeon species considered in this appendix. Ships towed out of Norfolk may overlap with sturgeon migratory routes to and from the James River. While ship strike remains a general threat to sturgeon within portions of the vessel transit path, the likelihood that the proposed action will result in a vessel strike remains very low given the low vessel speed, single trip, and the minimal time that the vessel will be in areas where a strike may occur.

The single vessel will represent an extremely small fraction of the total ship traffic within the Norfolk estuary. The 50- foot deep Port of Virginia, which includes three marine terminals (Norfolk International, Portsmouth Marine and Newport News Marine), is one of the major commercial shipping areas along the U.S. Atlantic coast. In 2017, total import/export throughput at the Port of Virginia was 2.84 million TEUs (twenty-foot equivalent unit) (POV 2018). In addition to commercial traffic, Norfolk's naval facility is one of the largest shipyards in the world; the one vessel trip represents a very small fraction of the total large ship activity at this port. Given the relatively small number of ESA-listed sturgeon that are struck by ships each year, a ship strike resulting from the heavy-lift caisson vessel is extremely unlikely to occur and thus will be discountable.

Our information indicates that ESA-listed species have not been struck by Navy's towed inactive Navy ships in the past (NMFS 2019a). Although the heavy-lift vessel may affect ESA-listed species encountered along the proposed vessel transit path, the probability of a vessel strike is extremely unlikely from the single vessel transit trip.

In summary, given the low speeds, single transit, and the expected low density of ESA-listed species along the vessel transit path, the likelihood of the heavy-lift vessel encountering ESA-listed species and posing a strike risk is extremely unlikely to occur and thus will be discountable.

2 STRESSORS NOT LIKELY TO ADVERSELY AFFECT LISTED SPECIES IN PEARL HARBOR

Except for the single heavy-lift vessel trip across open ocean as described above, all activities associated with the Navy's proposed action will occur in Pearl Harbor. Below we provide the effects analyses for the stressors associated with these activities that we consider will not likely adversely affect the ESA-listed species (CNP green sea turtle, Hawksbill sea turtle and the Hawaiian monk seal) that occur in or near the harbor.

The Hawaiian monk seal is the only ESA-listed marine mammal that may occur in Pearl Harbor. While Pearl Harbor is not known to contain important foraging or resting habitats for monk seals, hundreds of sightings of monk seals have been documented near the main entrance channel of the harbor over the last 20 years (NMFS PIFSC unpublished). They are historically known to enter Pearl Harbor only on occasion.

2.1 Elevated Underwater Sound

2.1.1 Vessel Transit

The Navy will increase the number of daily vessel trips in the harbor 13 times above baseline (65 vessel trips/day compared to the baseline of 5 vessel trips/day) for 15 months during dredging, and three (3) times above baseline for the remainder of the project (approximately 7.5 years). Underwater sound produced by a vessel engine is primarily concentrated at low frequencies, below 500 Hz (DOSITS 2020; NAVFAC 2022a). The three types of vessels that will operate most frequently in Pearl Harbor around the PHNSY & IMF, WP and PCP construction sites are tug boats to move barges and scows, crew boats, and small support boats such as Boston Whalers (Table 27). They will all produce slightly different noise fields depending on their size, speed and load. Assuming that all vessel speeds in Pearl Harbor will travel at no more than 10 knots, we expect the sound levels produced by the vessels to range from < 170 to 189 dB RMS (NAVFAC 2022a).

Table 27. Vessels to be operated during the proposed action, and their underwater proxy sound source levels from similar in-situ monitored vessels (source: NAVFAC 2022a).

Vessels	RMS (dB re 1 µPa)	Information
Scows	N/A	No power of its own – moved by tugboat.
Flat Barges	N/A	No power of its own – moved by tugboat.
Tug Boat w/container ship	189	Reine et al. 2014. Source level was estimated at 1 yard (0.9 m). Sound level was for two tugboats assisting a container ship in New York Harbor. Level was likely high for a single tug, because two tugs and container vessels were operating.
Tug Boat w/ barge	184	Kipple & Gabriele 2007. Source level was estimated at 1 yard (0.9 m). The vessel was operating at 10 knots. Value was visually estimated from Figure 1.
Survey vessels 17-ft (5.2 m) Boston Whaler	<170	Kipple & Gabriele 2007. Survey vessels were examples of likely vessels already used for past surveys in Pearl Harbor. Source level was estimated at 1 yard (0.9 m) when operating at 10 knots. Value was visually estimated from Figure 1 based on size class of the vessel.
Survey vessels 22-ft (6.7 m); 27-ft (8.2 m) Boston Whaler 43-ft (13 m) Delta Marine twin screw workboat	<175	
Crew boats From 40-75-ft (12.1 and 22.7 m) long	<180	Kipple & Gabriele 2007. Vessel size was a working assumption. Source level was estimated at 1 yard (0.9 m) when operating at 10 knots. Value was visually estimated from Figure 1 based on the size class of the vessel.
Large industrial vessel (for delivering caisson) > 600 ft (182.8 m) long	165-175	Kipple & Gabriele 2007. Source level was estimated at 1 yard (0.9 m). Vessels were operating at 10 knots. Value was visually estimated from Figure 2.

Our calculations indicate that vessel operation sound source levels are below the threshold of effect for turtle hearing, and the effect distance to behavioral response from the sound source is about 5 m (using NMFS July 2018 calculator-modified September 2020, with a maximum sound source of 189 dB RMS and max speed of 10 knots). Given the short effect distance to the vessel produced sound source, and that the vessel sound will be moving, we expect that turtles exposed will respond by becoming startled, alarmed, halting activities briefly, and/or potentially moving away from the sound. We do not expect that the same individuals, especially for uncommon hawksbill turtles, will be exposed repeatedly to the 65 trips per day because the vessels will occur along multiple different vessel paths within Pearl Harbor. Therefore, these behavioral responses are temporary and recoverable. In addition, there is evidence that green turtles are increasingly able to flee to avoid an approaching vessel as vessel speed decreases (Hazel et al. 2007).

Based on the above information, and that the Navy will implement BMPs (BMPs Section 2.4) including ensuring vessel speeds will not exceed 10 knots across the harbor, and 5 knots in areas with a greater concentration of turtles, in combination with maintaining a distance between vessels and turtles using lookouts, we are reasonably certain that the elevated sound produced by vessels will not cause harm or harassment to green sea turtles or hawksbill turtles.

For monk seals, our calculations indicate that vessel operation sound source levels are below the threshold of effect for permanent hearing loss, and the effect distance to TTS approximately 2.5 m (using NMFS July 2018 calculator-modified September 2020, with a maximum sound source of 189 dB RMS and max speed of 10 knots). Given the rarity of monk seals in the harbor, and the low probability that an animal will occur immediately by a vessel, we do not expect the vessel operations will cause hearing impacts to monk seals.

The effect distance to behavioral response, based on our calculations using the sound source from the range of vessels is quite large ranging from approximately 300 m (using 170 dB RMS) to 2,800 m (189 dB RMS). However, monk seals occur rarely inside the harbor, and the vessel activity that will occur in closest proximity to where monk seals may swim or haul out (in entrance channel and near harbor mouth), will be crew vessels transiting to the EOD small boat landing at IP briefly to pick up and drop off personnel twice a day. We expect these vessels to produce a sound level (180 dB RMS) that has a behavioral effects distance of approximately 1000 m, which is the approximate distance from the IP wharf to the location where the monk seals are most likely to occur.

Monk seals that occur at or near the mouth of Pearl Harbor are regularly exposed to ambient vessel sound, therefore likely habituated to it. We expect that a seal that swims within the behavioral exposure distance of sound generated by the crew vessels associated with the proposed action to have limited behavioral response. While masking monk seal communication is a possible effect of vessel traffic, Sills et al. (2021) documented in captivity that monk seals vocalization underwater appeared to be correlated with the period of annual reproductive activity. Hawaiian monk seal breeding behavior has not been observed by or in Pearl Harbor, nor any other social activity for which in-water sound production or detection will be highly important. Given the relatively low level of sound from the type of vessels most likely to operate near a monk seal, the low level of frequency of this activity (twice/day), and the transient nature of the sound, we expect any behavioral responses of monk seals to be temporary and recoverable, and below a level that causes harm or harassment to the animals.

In conclusion, the effects on green sea turtles, hawksbill sea turtles, and Hawaiian monk seals from exposure to underwater sound produced by vessels in Pearl Harbor from the proposed action will not rise to the scale of harm or harassment, and thus will be insignificant.

2.1.2 Dredging

Dredging at PHNSY & IMF will occur continuously 24 hours per day, 7 days per week, for 15 months. Dredging at WP, respectively PCP, will also occur at this frequency but for a shorter duration of two months at each site. The Navy has not specified the exact duration of dredging for Stage 2 WPF construction, but very likely the duration will be shorter compared to dredging during Stage 1. Sound produced by dredging is generally continuous, and concentrated at or below 1 kHz (DOSITS 2022). We expect dredging activities in Pearl Harbor to produce sound levels between 164 to 179 dB RMS based on data compiled by the Navy (see Table 28).

The maximum estimated impact-based sound from the proposed dredging of coarse sediment is not expected to exceed SPL_{PEAK} of 124 dB re 1 µPa (see Table 28, NAVFAC 2022a). Our calculations for turtles, based on the loudest excavator activity (179 dB RMS) indicate distances from the source to effects to their hearing (PTS and TTS) and behavior to be less than 26 m (using NMFS July 2018 calculator-modified September 2020). For monk seals our calculations indicate that the effect distance for PTS threshold is approximately 23 m, TTS threshold is approximately 232 m, and a behavioral response approximately 891 m.

Table 28. Dredging equipment that may be used, and their underwater proxy sound source levels from similar in-situ monitored construction activities (source: NAVFAC 2022a).

Dredging Equipment	PEAK (dB re 1 µPa)	RMS (dB re 1 µPa)	Justification/ Information
Winch Noise	116.6	-	Dickerson et al. 2001. Published sources for dredging sound measurements are limited. Levels measured during bucket deployment and retrieval events from dredging operations in Cook Inlet, Alaska.
Impact Sound (coarse sediments)	124	-	
Impact Sound (soft sediments)	107	-	
Grinding Sound	113.2	-	
Snap/Clank Sound	99.25	-	
Dumping Sound (empty barge)	108.6	-	
Excavator- Engine/generator	-	167	Reine et al. 2014. Source levels were estimated at 1 m. Dredging occurred in New York Harbor. The hydraulic ram is the mechanism that moves the arm of the excavator.
Excavator- Bottom impact	-	179	
Excavator- Barge loading	-	166	
Excavator- Hydraulic ram	-	164	
Excavator- Anchoring spud	-	173	
Backhoe dredge- bottom impact	-	179	

Given that (a) the surrounding substrate in the harbor is soft silt-covered rubble and sandy seabed that will likely generate less sound than the hard substrates used for the estimates above; (b) the Navy will surround the dredge activity area with full-length full-surround silt curtains (after ensuring ESA-listed species do not occur within), which will serve to dampen sound; and (c) the Navy will continuously monitor for listed species presence and shut down work if a turtle or monk seal is observed within 50 m of the dredging activity, we are reasonably certain that turtles will not be exposed to sound from dredging. In the event that a turtle is exposed, we expect the individual to respond by becoming startled, alarmed, halting activities briefly, and/or potentially moving away from the sound, with no injury caused to the individual. Therefore, we are reasonably certain the effect on sea turtles from exposure to underwater sound produced by dredging in Pearl Harbor from the proposed action is insignificant.

Given the Navy's work shut-down BMPs, we do not expect monk seals to swim close enough to the dredging activity to be exposed to sound at levels that can cause physical impacts or permanent hearing loss. Since the distance from the sound source of dredging to TTS threshold and behavioral effects exceeds the work-shut down zone distance, any seals that swim within these areas may experience temporary hearing loss and a behavioral response. However, our sound effects calculator assumes exposure lasts for 24 hours. We are reasonably certain that the likelihood of a monk seal venturing into the harbor to WP, PHNSY & IMF or PCP during the 15-17 months of dredging, getting close enough to dredging activities, and staying there for 24 hours is extremely low, and therefore discountable.

2.1.3 Pile Driving

We analyzed pile driving effects to sea turtles in the above opinion. This section will only address monk seals. The Navy will drive multiple pile-types (steel pipe, steel sheet, steel H-pile/king piles, concrete), of different sizes (42×18-inch, 36-inch, 28-inch, 24-inch, 20-inch, 18-inch diameter), using both vibratory and impact pile driving methods, generating sound for up to 10 hours per day, 7 days per week, for weeks to months at a time. Vibratory pile driving produces a continuous sound usually concentrated between 20-40 Hz, while impact pile driving produces a loud impulse sound usually concentrated below 500 Hz (DOSITS 2022; NAVFAC 2022a). As described in the Exposure Analysis (Section 6.2), based on Navy's compilation of sounds, we expect a sound level of around 118 dB Peak for pre-drilling of piles; sound levels between 165-184 dB Peak, and 150-151 dB SEL for vibratory pile driving and extraction; and sound levels between 189-204 dB Peak, and 164-171 dB SEL for impact pile driving (measured at a distance of 10 m).

The hearing abilities of Hawaiian monk seals are poorly understood. Results of the two 2021 studies (Ruscher et al. 2021, Sills et al. 2021) demonstrated that Hawaiian monk seals hear better at lower frequencies than previously documented (in-water between 200 Hz - 33 kHz, but with capabilities to perceive sound higher than 60 kHz, and in-air between 100 Hz to 33 kHz). They also indicated that monk seals display elevated underwater thresholds and a narrower frequency range of hearing than previously understood, therefore may be more vulnerable to the effects of anthropogenic sounds (such as pile driving activities) in the environment than previously known (Sills et al. 2021). Monk seals hearing ranges and acoustic exposure criteria are summarized in Table 29.

Table 29. Hearing Range and Acoustic Exposure Criteria for Hawaiian Monk Seals (Source: NAVFAC 2022a, NMFS 2018).

Auditory Effect	Impulsive		Non-Impulsive/continuous
	Unweighted SPL Threshold re 1 µPa	Weighted SPL Threshold re $\mu Pa^2 \cdot s$	Weighted SPL Threshold re $\mu Pa^2 \cdot s$
TTS	212 dB Peak	170 dB SEL_{cum}	181 dB SEL_{cum}
PTS	218 dB Peak	185 dB SEL_{cum}	201 dB SEL_{cum}
Behavior	160 dB RMS		120 dB RMS

Given the various pile types, sizes, and installation methods to be used, we evaluate effects to monk seals based on Navy's calculations[6] (NAVFAC 2022a) of effect distances related to the pile-type and/or installation method with the largest effect radius and assume all other pile driving noise effects will fall within that radius (Table 30). We focus on 36-inch steel pipe piles to be driven at WP, as it is the location with most probability of generating sound that monk seals may be exposed to given its location in the main channel. The values in Table 29 reflect the maximum number of piles to be driven per day, and either the maximum number of strikes per pile for impact pile driving or maximum duration (minutes) to drive a pile using vibratory pile driving. As described in the Effects of Action for sea turtles (Exposure Analysis Section 6.2.1.1), the Navy made several standard assumptions for estimating the effect distances (isopleths) that include: source levels do not vary between pile strikes; the spreading coefficient is $15_{log}R$; the receiver i.e. animal remains stationary during the duration of the activity; there is no recovery between intermittent sounds regardless of time between sounds (i.e., all sounds within the accumulation period are counted); and the total duration of sound exposure accumulation is over a 24-hour period (i.e. even though pile driving will occur for 10 hrs. per day not 24 hours).

[6] During pre-consultation NMFS provided the Navy guidance on calculations provided in the Navy BA referencing and using NMFS Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NMFS 2018), the Technical Report on Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al 2014), NMFS' multispecies pile driving calculator Version 1.0 (NMFS 2021), the Caltrans guidance (Caltrans 2015 and 2020) for proxy source levels for sound, and wherever appropriate, best estimates based on previous experience.

Table 30. Propagation distances of pile driving for monk seals where pile driving thresholds may be exceeded for the largest, loudest pile and/or highest number of strikes or longest duration.

Vibratory pile driving		**Distance to SEL isopleth for PTS (201 dB re 1 µPa²•sec)**	**Distance to SEL isopleth for TTS (181 dB re 1 µPa²•sec)**	**Distance to Peak & Behavioral Isopleths (120 dB RMS re 1 µPa)**
36-inch steel pipe piles	6 piles/day	3.9 m	83.8 m	1359.4 m
Impact pile driving		**Distance to SEL isopleth for PTS (185 dB re 1 µPa²•sec)**	**Distance to SEL isopleth for TTS (170 dB re 1 µPa²•sec)**	**Distance to Peak & Behavioral Isopleths (160 dB RMS re 1 µPa)**
36-inch steel pipe piles	6 piles/day	413.8 m	4138.4 m	341.5 m
20-inch concrete piles	6 piles/day	78.8 m	788.3 m	135.9 m

Given that the Navy will ensure that all pile driving will stop if a monk seal is observed within a shutdown zone of 1,400 m (4,593 ft) from vibratory and impact pile driving of 36-in.steel piles at WP, we are reasonably certain monk seals will not get close enough to the sound source of this pile driving activity to experience physical injury, permanent hearing loss, or behavioral responses.

While the distance to SEL isopleth for TTS reaches farther than the behavioral effects distance based on the calculations, and into the area of the mouth of the harbor where monk seals are most often observed when near Pearl Harbor, we expect the probability of exposure of the monk seals to sound levels that can result in temporary hearing loss to be extremely low. Importantly, the sound effect thresholds are based on the assumption that pile driving will occur for 24 hours, when these will in fact occur for only 10 hours per day. In addition, the Navy will use vibratory methods first to drive each pile, reducing the duration of sound from impact driving even further. It is very unlikely that a highly mobile individual monk seal will remain stationary within the TTS isopleth for 10 hours, and impossible for exposure to last 24 hours. Additionally, the exposure calculations do not factor in potential recovery between intermittent sounds regardless of time between sounds. Furthermore, the calculations are based on the assumption that sound will propagate out equally in all directions, which is unlikely as attenuation losses will occur differently in different directions from the source as the sound interacts with structures and land that are common in Pearl Harbor.

In conclusion, given the Navy's monitoring protocol to track monk seal activity in the harbor, their 1400-m work shut-down zones for the entire duration driving of 36-in steel piles (vibratory and impact) at WP, and ensuring that monk seals do not enter the harbor to approach all other pile-driving activities, we are reasonably certain that the likelihood of monk seals being exposed to elevated sound from pile driving from the proposed action is extremely unlikely, and therefore discountable.

2.2 Vessel Collisions

At the onset of Stage 1 DD5 construction, the Navy will operate an additional 65 vessel trips per day in Pearl Harbor for the first 15 months of construction. After 15 months (after dredging completion), the vessel activities will drop to approximately 15 vessel trips per day for the rest of the duration of the project (approximately 7.5 years). Given Navy's implementation of BMPs including species monitoring, slow vessel speeds, vessel look outs, and based on the rare occurrence of monk seals in Pearl Harbor, we are reasonably certain that the probability of a vessel colliding with a monk seal is extremely unlikely, and therefore discountable.

2.3 Habitat Disturbance and Loss

The Navy's proposed in-water dredging and in-water fill from the proposed action will result in approximately 16 acres of habitat in Pearl Harbor: 10 acres at PHNSY & IMF, and 6 acres at WP. Using the mean minimum home range estimate for hawksbill turtles (less than 1 km^2 as per Gaos et al. 2018; Gaos et al. 2012a, b; 2010; Seminoff et al. 2002), we estimate that the proposed action will permanently impact approximately 4% of a hawksbill turtle's home range at PHNSY & IMF, and approximately 2.4% of a hawksbill turtle's home range at WP. Given the low occurrence of hawksbill sea turtles in Pearl Harbor, and the low level of exposure and undocumented use of resting caves that will be lost, we conclude the effect on hawksbill turtles from exposure to habitat loss in Pearl Harbor from the proposed action will not rise to the scale of harm or harassment, and thus will be insignificant.

2.4 Entrainment and Entrapment in Dry Dock

Once the new DD5 is constructed and operational, the Navy estimates it will undertake on average 4 flooding/dewatering events per year at this new dry dock. Due to the rare occurrence of Hawaiian monk seals within Pearl Harbor, there being no Navy reports of monk seal entrapments in the existing 4 (four) dry docks to date, we are reasonably certain that the likelihood of monk seals being trapped in DD5 to be extremely unlikely to occur, and therefore discountable.

2.5 Increased Turbidity and Sedimentation

The Navy's in-water construction activities (e.g., dredging, pile-drilling, pile removal, etc.) that will occur for months at a time, for the duration of years, will elevate ambient total suspended solids (TSS) and turbidity levels in Pearl Harbor within and immediately adjacent to areas of construction at PHNSY & IMF, WP, PCP and FI by dislodging, re-suspending, and dispersing sediment in the water column. We expect increased sedimentation to occur primarily as a result of and during dredging operations planned for approximately 15 months. The elevated turbidity can reduce a turtle's ability to detect predators (Oliver et al. 2000), and sedimentation effects on communities such as coral reef and seagrass can negatively impact turtles' food sources (NMFS and USFWS 1998).

The Navy's dredge plume modeling (NAVFAC 2022) has indicated the importance of using a silt curtain to minimize effects of dredging on the surrounding environment. We therefore expect that the Navy's implementation of full-length and full-surround silt curtains around each and all dredging, pile removal and pile installation activities to help contain re-suspended sediment from these activities and to minimize the spread and settling of suspended sediments beyond the area contained within the silt curtains. The Navy will also develop and implement a monitoring and assessment plan to minimize construction and operation-related degradation of water quality. The Navy will for example monitor and stop the activity to take corrective action immediately if a plume is observed outside of the silt curtain as caused by the construction activity. They will resume work only after corrections have been made and the cause of the excess turbidity is corrected. In addition, the Navy will remove all silt and debris deposited in drainage facilities, roadways and other areas and protect all storm drains and deck openings to prevent the discharge of foreign materials to the harbor. The navy will also prepare a turbidity management plan outlining all of the above measures and a contingency plan if measures fail, and will curtail operations/work in the event of high wind or adverse weather conditions.

Assuming the Navy will effectively implement the above mentioned measures (and others related to controlling water quality), we expect that green sea turtles, and any hawksbill turtles that occur in the work areas will experience relatively low levels of increased turbidity above baseline levels (temporary, largely confined to work area with small quantities of suspended sediments outside work areas). As sea turtles are highly motile, we expect that they may avoid any temporary turbid areas. Based on the above, and given that the Navy will additionally employ work-shutdown zones around work activities to maintain distance between activities and any observed turtles (BMPs Section 2.4), we expect any behavioral responses to be temporary and recoverable, and below levels that cause harm. Given the low consequence of the response, we conclude the effect on sea turtles from this increased turbidity and sedimentation to be insignificant.

Due to the relatively limited spatial extent of increased turbidity as discussed above and the rare likelihood of Hawaiian monk seals occurrence within the harbor, we are reasonably certain that the likelihood of monk seals being exposed to elevated turbidity is extremely unlikely, and therefore discountable.

2.6 Disturbance from Human Activity and Equipment Operation

The proposed action will increase the amount of in-water human activity and construction (close to 9 years from start to finish) in Pearl Harbor and has the potential to result in direct physical contact with or strikes to ESA-listed marine species (note that vessel collision is discussed separately), and behavioral responses such as avoidance.

The Navy will implement BMPs (Section 1.3) to ensure intentional interactions with ESA-listed species are avoided and that unintentional interactions are minimized to the greatest extent practicable. This includes the Navy employing biological observers throughout construction activities who will remain constantly vigilant of the presence of ESA-listed species within activity effects distances, and will record the success and effectiveness of in-water BMP. The

Navy will expressly prohibit all personnel from attempting to or disturbing, touching, riding, feeding or otherwise -intentionally interacting with ESA-listed species.

Given the above, we are reasonably certain that there will be no physical injury or direct contact with any listed turtles in the harbor, and that those exposed to disturbance from human activity and heavy equipment will respond by becoming startled, alarmed, halting activities briefly, and/or potentially moving away from the activity. We expect these behavioral responses to be temporary and recoverable, and below levels that cause harm. Given the low consequence of the response, we conclude the effect on sea turtles from this disturbance from human activity and equipment operation to be insignificant.

Given the implementation of Navy's BMPs, and that Hawaiian monk seals are rarely present in Pearl Harbor, we are reasonably certain that the likelihood of monk seals being exposed to disturbance from human activity and equipment operation is extremely unlikely, and therefore discountable.

2.7 Wastes and Discharges

Project wastes may include plastic trash and bags that may entangle or be ingested by a marine species, which is a major anthropogenic threat to the recovery of sea turtles and Hawaiian monk seals that results in both lethal and non-lethal effects (NMFS 2016; NMFS & USFWS 1998a, 1998b). Debris may include plastic bags, rubber, balloons, plastic fragments and confectionery wrappers, all of which may be confused with prey species and ingested by marine fauna, which can block digestive systems and cause internal injuries and starvation. A long-term concern for plastic debris is that it could be a source of toxic chemicals that could compromise immunity and cause infertility in animals, even at very low levels. Stranding data and necropsies provided evidence that sea turtle mortalities resulted from poisoning or obstruction of the esophagus after ingesting garbage (NMFS & USFWS 1998a).

The Navy will implement BMPs (Section 1.3), to ensure that no debris will enter and/or remain in the water. To further reduce the potential for action-related waste and discharges affecting marine species adversely, the Navy will control and dispose of all waste into trash dumpsters or roll-off bins in the project base yard or storage area. The Navy will not discharge wastewater from demolition work into the sanitary sewer system, the storm drainage system, or the harbor. During DD5 operations, the Navy will process the water that collects in the dry dock after it is dewatered through the new BWTS and existing Navy WWTP, and not discharge this directly into the harbor (except during extreme storm events). Navy construction personnel will capture all pollutants and dispose of them off-site at an approved disposal facility. The Navy will maintain and check all equipment and vehicles prior to commencing daily activities to reduce any risk of leaks or discharge.

Given Navy's implementation of the above mentioned BMPs, we are reasonably certain that monk seals, green sea turtles, and hawksbill sea turtles exposure to wastes and discharges resulting from the proposed action will be extremely unlikely, and therefore discountable.

2.8 Entanglement in Lines

ESA-listed marine species could be inadvertently entangled by two different elements of proposed work activities associated with the proposed action in Pearl Harbor: 1) trash and debris, and 2) equipment (such as anchor lines and tethers). Materials could be accidentally encountered by and have the potential to entangle turtles and monk seals at the surface, in the water column, and along the seafloor. Potential impacts depend on how the animal encounters and reacts to the items that pose an entanglement risk, which also depend on risk factors such as animal size, sensory capabilities, and foraging methods. Most entanglements are attributable to encounters with fishing gear or other materials that float or are suspended at the surface. Smaller entangled animals are inherently less likely to be detected than larger ones, but larger animals may subsequently swim off while still entangled, towing lines or fishing gear behind them.

The Navy will implement BMPs to control trash and debris entering Pearl Harbor as a result of the proposed action as described in Section 2.6 above. The navy will also implement BMPs to minimize entanglement risk with equipment such as lines and tethers. The proposed action will not introduce fishing gear above baseline levels. Therefore, we are reasonably certain that the entanglement risk to Hawaiian monk seals, green sea turtles, and hawksbill sea turtles is extremely low, therefore discountable.

3 EFFECTS TO DESIGNATED CRITICAL HABITAT

Critical habitat has not been designed for any species in the action area in Pearl Harbor. In the action area outside Pearl Harbor, i.e. overlapping with the open ocean vessel transit path, critical habitat has been designated for the Northwest Atlantic Loggerhead Sea Turtle, the Hawaiian Monk Seal, the Main Hawaiian Island Insular False Killer Whale, and the North Atlantic Right Whale. The two stressors resulting from the single vessel transit that the designated critical habitat in the vessel transit path may be exposed to include elevated underwater noise produced by the engine, and collision with the vessel. We are reasonably given the nature of the vessel activity (e.g. relatively slow vessel speed, infrequency of activity to a single trip, low contribution compared to ambient levels of vessel activity), that the physical or biological features of critical habitat are not likely to be exposed to these stressors. We therefore conclude that there will be no adverse effects to any critical habitat designated in the action area from the proposed action.