Final

ENVIRONMENTAL ASSESSMENT

For

APRA HARBOR WATERFRONT REPAIRS

At

NAVAL BASE GUAM, APRA HARBOR, GUAM

August 2025

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Abstract

Designation:	Environmental Assessment
Title of Proposed Action:	Apra Harbor Waterfront Repairs
Project Location:	Naval Base Guam
Lead Agency for the EA:	Department of the Navy
Affected Region:	Apra Harbor, Guam
Action Proponent:	Naval Base Guam
Point of Contact:	Ryan Maynard NAVFAC SW, Environmental, Floor #12 750 Pacific Highway San Diego, CA 92132-0058 gbwea@us.navy.mil
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For purposes of this Environmental Assessment (EA), the Department of the Navy (DoN) has voluntarily elected to generally follow those Council of Environmental Quality regulations at 40 C.F.R. Parts 1500 – 1508 that were in place at the outset of this EA, in addition to DoN's procedures/regulations implementing NEPA at 32 C.FR Part 775, to meet the agency's obligations under NEPA, 42 U.S.C. §§ 4321 et seq. The Proposed Action is to make necessary long-term repairs to the Admiral Glass Breakwater (Glass Breakwater), Sumay Marina U.S. Coast Guard (USCG)/Port Operations/Navy Security docks and wave attenuator, and Sumay Point shoreline protection. As a result of Super Typhoon Mawar in May 2023 and other storm events, the Glass Breakwater, docks, wave attenuator, and shoreline protection are severely damaged and functionally deficient.

Work on the breakwater includes excavation and replacement of armor stone near the existing toe (the outermost and deepest submerged base of the breakwater), slope, and crest rock protection; restoration of the damaged core sections; placement of a bedding stone underlayer; and installation of concrete armor units (CAUs) along the toe, slope, and crest. Site preparations include earthwork, placement of gravel, and vegetation clearing to provide work areas to accommodate crane pads and heavy truck traffic on the breakwater crest roadway. Other site work includes installation of temporary mooring points along the inner breakwater, construction of a concrete casting yard at nearby construction laydown areas to fabricate the CAUs, and temporary relocation of an existing USCG aid to navigation (ATON; navigational tower) on the breakwater head section during construction. Relocation of the ATON to an alternative site within 200 feet of its charted location would be appropriately coordinated with the USCG, and the ATON would be placed back on the head section when construction is complete.

The Proposed Action also includes necessary repairs to the Sumay Marina USCG/Port Operations/ Morale, Welfare, and Recreation/Navy Security Forces and Emergency Response docks, which would include driving piles to provide lateral support for the floating docks. Additionally, several piles would be driven to construct a fixed wave attenuator within Sumay Marina to replace the previously constructed floating wave attenuator that failed during Super Typhoon Mawar. The existing engineered revetment along Sumay Point would be repaired by removing a deteriorated steel structure and restoring the rock revetment protection.

The goal of the Proposed Action analyzed in this EA is to make repairs to the Glass Breakwater, Sumay Marina docks and wave attenuator, and Sumay Point shoreline to restore these features to their original design condition and/or function and improve resiliency against wave activity associated with more frequent and larger storm events.

This EA comprehensively evaluates the potential environmental impacts associated with the one action alternative (Alternative 1) and the No Action Alternative to the following resource areas: air quality, greenhouse gases, biological resources, cultural resources, geological resources, hazardous waste and materials, infrastructure and transportation, noise, health and safety, socioeconomics, and water resources.

EXECUTIVE SUMMARY

ES.1 Proposed Action

The United States (U.S.) Navy Naval Facilities Engineering Systems Command Marianas (hereafter referred to as the Navy) commissioned the Special Project Program – Glass Breakwater Repairs. The Navy proposes to conduct repairs of the Admiral Glass Breakwater (Glass Breakwater) and waterfront infrastructure in Sumay Cove in Apra Harbor, Guam. Glass Breakwater repairs are needed due to extensive damage that occurred during Super Typhoon Mawar in May 2023. During subsequent engineering analysis, the Navy has determined failure of sections of the breakwater is accelerating, and multiple sections are at risk of catastrophic failure (i.e., a breach of the Glass Breakwater). In 2024, the Navy prepared a separate Environmental Assessment (EA) to address emergency repairs that would temporarily secure the breakwater until long-term repairs could be made. This subsequent EA addresses the Navy's plan for the completion of long-term repairs of the Glass Breakwater and other vital infrastructure in the harbor.

The Proposed Action would repair and rebuild the failing areas of the Glass Breakwater, Sumay Marina docks and wave attenuator, and Sumay Point shoreline protection to provide long-term stability and protection for vessel traffic and Naval Base Guam infrastructure in Apra Harbor.

Work on the Glass Breakwater includes excavation and replacement of the existing toe, slope, and crest rock protection; rebuilding of the damaged core sections; placement of a bedding stone underlayer; and installation of concrete armor units (CAU) along the toe, slope, and crest. Site preparations include earthwork, placement of gravel, and vegetation clearing to provide work areas to accommodate crane pads and heavy truck traffic on the breakwater crest roadway. Concrete would be hauled by truck from a local batch plant in southern Guam to a CAU casting yard within the project area. On the leeward side of the breakwater, a spud/jack-up barge, anchors, and/or temporary mooring points (secured via piles or anchors) may be used to position vessels for unloading CAUs and for other repair/construction support. Any spuds, anchors, or piles installed would be placed only into soft sediment and would be removed following completion. Other site work would require temporary relocation of an existing U.S. Coast Guard (USCG) aid to navigation (ATON) tower on the Glass Breakwater head section during construction to a site within 200 feet of its charted location. Notices to mariners would be issued for the duration that the ATON is temporarily relocated, and the ATON would be reinstalled on the breakwater head section when construction is complete.

The Proposed Action also includes necessary repairs to the Sumay Marina USCG/Port Operations/Morale, Welfare, and Recreation/Navy Security Forces and Emergency Response docks, which would include driving piles to provide additional anchoring and/or support for the floating docks and to replace existing deteriorated piles. A pile-supported fixed wave attenuator would also be constructed within Sumay Marina to replace the previously constructed floating wave attenuator that failed during Super Typhoon Mawar. The existing engineered revetment along Sumay Point would be repaired by removing a deteriorated steel structure and restoring the rock revetment protection.

ES.2 Purpose of and Need for the Proposed Action

The purpose of and the need for the Proposed Action is to repair Glass Breakwater and Sumay Marina floating dock pile supports, wave attenuator, and shoreline protection along Sumay Point to restore and/or enhance original function.

The Proposed Action is needed to prevent the imminent breach of the breakwater, thereby safeguarding the harbor, shoreline, and vital Navy and Port of Guam infrastructure that is essential to sustain critical military and civilian missions on Guam. Repairs to the Sumay Marina docks and wave attenuator would restore function to providing critical Security and Emergency Response Actions out of Sumay Marina (which provides the only vessel berthing to support this work), as well as safe USCG, Port Operations, and Navy Security Forces vessel operations within Sumay Cove. Repairs to the Sumay Point shoreline would restore revetment function to provide safe landside uses and to protect the adjacent navigation channel to/from the marina.

Breaching of the Glass Breakwater would have significant impacts on Navy mission readiness and operational capabilities, as well as on all citizens of Guam. The degraded condition of the breakwater, exacerbated by ongoing normal wave action, storms, and typhoons, contribute to the imminent likelihood of breach. Continued exposure to even normal wave action not only increases the risk of breach but also poses a risk of potential environmental damage to the underwater habitat areas and direct mortality impacts on individuals of the Endangered Species Act (ESA)-listed threatened *Acropora globiceps* hard coral species along the breakwater.

The degraded condition of the Sumay Marina docks has impacted operations and created a potentially unsafe situation for USCG, Port Operations, and Navy Security Forces personnel using the docks. Further, the lack of a functional wave attenuator could lead to extensive and costly damage to moored vessels and/or dangerous conditions entering and leaving the Sumay Marina. Repair of the Sumay Point revetment is needed to provide safe land use at Sumay Point and to protect the adjacent navigation channel to the marina.

ES.3 Alternatives Considered

The Navy is considering one action alternative (Alternative 1) that meets the purpose of and need for the Proposed Action, and a No Action Alternative. Alternative 1 would place CAU on failing and/or damaged areas of the breakwater. The Sumay Cove repairs would include the installation of piles for the marina docks, the replacement of the wave attenuator, and the restoration of shoreline protection at Sumay Point. The No Action Alternative would not repair the eroded areas of the breakwater, thus increasing the likelihood of a breach with subsequent impacts to both island supplies and Navy operations, nor would it perform repairs within Sumay Cove or along Sumay Point, thus increasing the risk of unsafe USCG, Port Operations, and Navy Security Forces vessel operations.

An alternative using a floating instead of a fixed wave attenuator was also considered. Because the floating wave attenuator that was in place prior to Super Typhoon MAWAR failed, this was determined to be a non-viable solution to withstanding future storm events and was not considered further.

ES.4 Summary of Environmental Resources Evaluated in the EA

The National Environmental Policy Act (NEPA) and Navy instructions for implementing NEPA specify that an EA should address those resource areas potentially subject to impacts. Additionally, the level of analysis should be commensurate with the anticipated level of environmental impact. The following resource areas will be addressed in detail in this EA: air quality, greenhouse gases, water resources, geological resources, cultural resources, biological resources, health and safety, noise, socioeconomics, infrastructure, transportation, hazardous materials and waste, and visual resources. Because potential impacts would be negligible or nonexistent, the following resources were not evaluated in this EA: airspace and land use.

ES.5 Summary of Potential Environmental Consequences of the Action Alternatives

Table ES-1 provides a tabular summary of the potential environmental impacts of the alternatives analyzed. In this table and throughout this document, "short-term" is generally defined as only occurring during or immediately following the construction period and "long-term" is following construction over an extended period of time, e.g. years. BMPs to avoid or minimize potential for impacts to biological resources, air quality, noise, health and safety, and water resources resulting from construction activities would be incorporated into the proposed action. **Section 2.5** provides **t**he comprehensive list of proposed BMPs.

Table ES-1. Summary of The Potential Environmental Impacts of the Alternatives Analyzed

Resource Area	No Action Alternative	Alternative 1
Air Quality	Less than significant to potentially significant beneficial No change to baseline air quality or air resources while the breakwater remains in its current condition. In the event of impending breakwater breach, port operations would be halted resulting in the reduction in vessel and equipment emissions.	Less than significant adverse Short-term, temporarily emitted air emissions (e.g., fugitive dust, combustion of fossil fuels) during construction relating to operation of construction vehicles, equipment, and vessels.
Biological Resources	Less than significant to significant adverse Continued erosion of rock along the slope of the breakwater would significantly damage native and protected species, as well as associated EFH, resulting in adverse impacts on biological resources. Without repair of the breakwater, even under normal wave action, sections of the crest and slope on the outer and leeward sides of the breakwater will continue to break away and fall into the water destroying protected species and habitats in the affected underwater areas. In these conditions, impacts would range from moderate to significant over time. A breach of the breakwater would result in substantial loss of corals, coral habitat, and EFH in the harbor, significantly and adversely affecting those resources.	Mitigated to less than significant adverse and beneficial A total of 37 (up to 47) colonies of *Acropora globiceps* would be translocated to avoid and minimize effects on the species. There could be a permanent loss of up to 83 colonies of the ESA-listed threatened hard coral, which would not affect the continued existence of the species. Impacts would be reduced through implementation of mitigation measures and conservation measures developed in consultation with NMFS and would be further minimized by avoiding in-water work during coral spawning periods to avoid sensitive spawning times and to maximize reproductive success. Short-term, minor, adverse impacts to all marine species from construction-associated noises, suspended sediments in the water, and reduced water quality during rock removal and CAU placement, pile driving, and vessel use associated with construction activities; to native fish, and ESA-listed endangered turtles and threatened scalloped hammerhead sharks during in- and out-of-water construction activities; and on EFH from construction and repair activities occurring directly within or around the EFH. Short-term, negligible, adverse impacts on marine species from potentially leaked pollutants and sediment plumes associated with construction

		activities; from vegetation clearing and earthwork around the project areas; and on MBTA-protected species that could be flying above or foraging near the project areas and could be disturbed by construction-associated noises. Short- and long-term, minor, adverse impacts on native corals and clams that are not ESA-listed, similar to those described for marine vegetation and non-coral benthic invertebrates. Short-term, negligible, adverse, and long-term, moderate, beneficial impacts on NMFS proposed green turtle (*Chelonia mydas*) critical habitat, if green turtle critical habitat is designated, would be anticipated from increased protections from the Apra Harbor repairs.
Cultural Resources	Less than significant adverse to significant adverse In the impending event of breakwater breach, significant adverse impacts on cultural resources would occur because failure to provide repairs would lead to further degradation and failure of the entire breakwater, which is an eligible historic property.	No adverse effects on cultural, historical, or archeological resources. The Guam SHPO concurred with the Navy's determination of no adverse effect on March 21, 2025. Beneficial impacts to the NRHP-eligible Glass Breakwater would result from restoration of its historic integrity. No appreciable impacts are expected on eligible terrestrial or submerged archaeological resources or TCPs.
Geological Resources	Less than significant to significant adverse There would be continued long-term adverse effects on adjacent substrates from the steady deterioration of the Glass Breakwater and marina infrastructure in Sumay Cove. In the event of impending breakwater breach, severe wave action and siltation/erosion of the Outer Apra Harbor would continue to occur, damaging and possibly destroying geological resources under water and on land.	Less than significant adverse and beneficial Minor to moderate temporary sedimentation impacts during deconstruction and reconstruction of the Glass Breakwater and piledriving and shoreline restoration activities at Sumay Cove. Long-term, moderate beneficial impacts from restored harbor protection and shoreline stabilization, supporting minimized erosion and sedimentation into nearby waters of Apra Harbor.
Hazardous Materials and Waste	Less than significant No change to baseline HAZMAT and HAZWASTE conditions.	Less than significant adverse Hazardous and petroleum wastes generated during construction would be negligible and construction methods would be established to properly handle any hazardous and petroleum wastes. No impacts on HAZMAT and HAZWASTE management would be anticipated following construction.
Infrastructure and Transportation	Less than significant to significant adverse	Less than significant adverse

	There would be long-term, significant, adverse impacts on USCG, Navy Security and Emergency Response Forces, Port, and public infrastructure and transportation, which would be damaged or destroyed in the impending event of breakwater breach.	Short-term, negligible to minor, adverse impacts on potable water, wastewater, and energy utility demand would be expected due to the use of utilities during the construction period. Short-term, minor, adverse impacts on solid waste management may occur from the generation of construction and demolition waste. Short-term, minor, adverse impacts on maritime and road traffic would occur from the increased construction trucks, equipment, and vessels operating in the area to transport repair/construction equipment and aggregate materials. These impacts would cease following the completion of construction.
Noise	Less than significant No change to the baseline noise environment would be anticipated as long as the breakwater remains in its current condition. In the impending event of breakwater breach, it is likely that port operations would be halted resulting in appreciably reduced in-air and in-water noise from reduced or stopped vessel traffic and related equipment operation to load/unload cargo vessels.	Less than significant adverse Short-term, minor, adverse effects on marina users and terrestrial wildlife from temporary construction noise. Pile driving at Sumay Cove might produce short-term, minor to moderate, adverse impact on marina users from temporary construction noise. Exposure to construction and vessel noise could cause aquatic species, including marine mammals, fish, and sea turtles, to avoid the area, producing a short-term, minor, adverse impact on these species. If used, an impact hammer would drive one pile per day, resulting in generated noise for approximately 10 minutes per day over an anticipated total of 72 days. Alternatively, if used, vibratory hammer noise would last for 8 hours per day for the approximately 72-day-period.
Health and Safety	Less than significant to significant adverse In the impending event of breakwater breach, harbor access and port operations would be severely affected, yielding devastating impacts on Port of Guam operations, including inability to import food, household goods, and medical supplies.	Less than significant adverse and beneficial Short-term, minor, adverse impacts on contractor, personnel, and marina user safety during breakwater and related waterfront repairs may include potential slips, falls, unfamiliar working environments, noise exposure, and specific hazards such as handling power tools and working with heavy equipment, trucks, and machinery, and exposure to increased roadway traffic. Long-term, beneficial impacts on safety would occur from the repairs safeguarding the shore facilities and infrastructure within the harbor from severe wave action during typhoons and other heavy weather events.
Socioeconomics	Less than significant to significant adverse In the impending event of breakwater breach, harbor access and port operations would be severely affected, yielding potentially devastating impacts on public services and shipment of goods to or from the island. Halting of Port of Guam	Less than significant adverse and beneficial Although the anticipated 56 off-island workforce would add to housing demand, no appreciable shift or change in socioeconomic conditions, housing, population, or a notable effect on local industries would be expected. Construction-related socioeconomic impacts would be positive

	operations would threaten the economic and community health stability of Guam and the broader Pacific region. Impacts from such an event would be potentially catastrophic.	and temporary. Long-term, maintaining a safe, accessible port would ensure economic stability for Guam and the region. Short-term, adverse effects on local populations from increased construction-related traffic, potential for degraded roadway infrastructure, increased air emissions from construction vehicles, vessels, and equipment, and construction-related noise. Short-term, negligible, beneficial impacts on the local economy would be anticipated from construction-related and workforce spending in the local area, as well as the anticipated temporary jobs that would be required for the project.
Water Resources	Less than significant to potentially significant adverse Long-term, adverse effects on marine waters, floodplains, and the coastal zone from the steady deterioration of the Glass Breakwater and marina infrastructure in Sumay Cove. In the event of breakwater breach, harbor access and port operations would be severely affected, yielding potentially devastating impacts on water resources.	Less than significant adverse and beneficial Short-term, minor, localized adverse impacts on the marine waters surrounding the Glass Breakwater from site preparations for construction and repair activities. Long-term, beneficial impacts to water quality and surrounding marine habitats throughout Apra Harbor once repairs to the Glass Breakwater are complete.

Key: EFH = essential fish habitat; GHG = greenhouse gases; HAZMAT = hazardous materials; HAZWASTE = hazardous wastes; MBTA = Migratory Bird Treaty Act; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NRHP – National Register of Historic Places; NMFS = National Marine Fisheries Service; SHPO = State Historic Preservation Office.

ES.6 Public Involvement

The Navy has prepared this EA to inform the public of the Proposed Action and to allow the opportunity for public review and comment. A 15-day Draft EA review and comment period began with a public notice published for three consecutive days (March 25 through 27, 2025) in the *Pacific Daily News* indicating the availability of the Draft EA, the comment period start date on March 28, 2025, and the locations where public review copies of the document were available. The Draft EA was also made available on the following website: **https://pacific.navfac.navy.mil/About-Us/National-Environmental-Policy-Act-NEPA-Information** and at the Nieves M. Flores Hagåtña Public Library.

The Draft EA public review and comment period initiated on March 28 and concluded on April 12, 2025; no comments were received from the public. Additionally, a public notice was posted from April 24 through May 23, 2025 on the U.S. Army Corps of Engineers – POH website (https://www.poh.usace.army.mil/Missions/Regulatory/Public-Notices/) for a 30-day public review and comment on the Navy's application for applicable permitting under the Clean Water Act and/or Rivers and Harbors Act.

Environmental Assessment

Apra Harbor Waterfront Repairs

Naval Base Guam, Apra Harbor, Guam

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Abbreviations and Acronyms

Acronym	Definition
°F	degrees Fahrenheit
AAQS	Ambient Air Quality Standard
AFFF	aqueous film forming foam
AIS	Aquatic Invasive Species
APE	area of potential effects
ATON	aid to navigation
BO	Biological Opinion
BMP	best management practice
BRAC	Base Realignment and Closure
BSP	Bureau of Statistics and Plans
CAA	Clean Air Act
CATEX	Categorical Exclusion
CAU	concrete armor unit
CCA	crustose coralline algae
CCD	Coastal Consistency Determination
CDP	Census Designated Place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CH_4	methane
CMP	Coastal Management Program
CNMI	Commonwealth of the Northern Mariana Islands
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	equivalent emissions of CO_2
CWA	Clean Water Act
CY	cubic yard(s)
CZMA	Coastal Zone Management Act
dB	decibel
dB re µPa at 1 m	dB referenced to 1 micro-Pascal at 1 meter

Acronym	Definition
dBA	A-weighted decibel
DERP	Defense Environmental Restoration Program
DLADS	Defense Logistics Agency Disposition Services
DoD	Department of Defense
DoN	Department of the Navy
DPS	Distinct Population Segment
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ERP	Environmental Restoration Program
ESA	Endangered Species Act
ESS	Explosive Site Survey
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FEP	Fishery Ecosystem Plans
FONSI	Finding of No Significant Impact
FR	Federal Register
FUDS	Formerly Used Defense Sites
FY	fiscal year
GAR	Guam Administrative Record
GARR	Guam Administrative Rules and Regulations
GDPW	Guam Department of Public Works
GHG	Greenhouse Gas
GHPI	Guam Historic Properties Inventory
Glass Breakwater	Admiral Glass Breakwater
GPA	Guam Power Authority
GCA	Guam Code Annotated

Acronym	Definition
Guam EPA	Guam Environmental Protection Agency
GWA	Guam Waterworks Authority
GWP	global warming potential
HACCP	Hazard Analysis and Critical Control Point
HAP	hazardous air pollutants
HAPC	Habitat Areas of Particular Concern
HAZMAT	hazardous materials
HAZWASTE	hazardous wastes
HEA	Habitat Equivalency Analysis
HWMP	Hazardous Waste Management Plan
INRMP	Integrated Natural Resources Management Plan
IRP	Installation Restoration Program
ITS	Incidental Take Statement
IWPS	Island-Wide Power System
JRM	Joint Region Marianas
LF	linear feet
LMN	Lima, Mike, and November
MBTA	Migratory Bird Treaty Act
MEC	munitions and explosives of concern
MGD	million gallons per day
MHHW	Mean Higher High Water
MITT	Mariana Islands Training and Testing
MMPA	Marine Mammal Protection Act
MMRP	Military Munitions Response Program
MOU	Memorandum of Understanding
MPPEH	material potentially presenting an explosive hazard
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSC	Military Sealift Command

Acronym	Definition
MUS	Management Unit Species
MW	megawatt
MWR	Morale, Welfare, and Recreation
N_2O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAVFAC Marianas	Naval Facilities Engineering Systems Command Marianas
Navy	United States Navy
NBG	Naval Base Guam
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
No.	number
NO_2	nitrogen dioxide
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOTMAR	Notice to Mariners
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWTP	Navy Water Treatment Plant
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
PAG	Port Authority of Guam
Pb	Lead
PFAS	per- and polyfluoroalkyl substances
PFOS	perfluorooctane sulfonate
$PM_{2.5}$	fine particulate matter less than or equal to 2.5 microns in diameter
PM_{10}	suspended particulate matter less than or equal to 10 microns in diameter

Acronym	Definition
POL	petroleum, oils, and lubricants
ppb	parts per billion
PPE	personal protective equipment
ppm	parts per million
PSD	Prevention of Significant Deterioration
PSI	Project Screening Level
RCRA	Resource Conservation and Recovery Act
RHA	Rivers and Harbors Act
RMS	root mean square
ROD	Record of Decision
ROI	Region of Influence
SEL	Sound exposure level
SHPO	State Historic Preservation Officer
SI	Site Inspection
SIP	State Implementation Plan
SO_2	sulfur dioxide
SOP	standard operating procedure
SPCC	Spill Prevention, Control, and Countermeasure
SPL	Sound pressure level
SSI	Supplemental Site Inspection
SWPPP	Storm Water Pollution Prevention Plan
TBD	To Be Determined
TCP	traditional cultural properties
TEMES	Taiwan Electrical and Mechanical Engineering Services
tpy	tons per year
U.S.	United States
U.S.C.	United States Code
UFC	Unified Facilities Criteria
USACE	U.S. Army Corps of Engineers
USACE-POH	USACE-Honolulu District
USCB	U.S. Census Bureau
USCG	U.S. Coast Guard
USD	U.S. Dollars
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USMC	U.S. Marine Corps
WOTUS	Waters of the U.S.
WQC	Water Quality Certification
WPRFMC	Western Pacific Regional Fishery Management Council
WWII	World War II
WWTP	Wastewater Treatment Plant
yd^2	square yards
$\mu g/m^3$	micrograms per cubic meter
µPa	Micro-Pascal

1 Purpose of and Need for the Proposed Action

1.1 Introduction

For purposes of this Environmental Assessment (EA), the Department of the Navy (DoN) has voluntarily elected to generally follow those Council of Environmental Quality regulations at 40 Code of Federal Regulations (CFR) Parts 1500 – 1508 that were in place at the outset of this EA, in addition to DoN's procedures/regulations implementing the National Environmental Policy Act (NEPA) at 32 CFR Part 775, to meet the agency's obligations under NEPA, 42 U.S.C. §§ 4321 et seq. in addressing its proposal to repair Apra Harbor Waterfront infrastructure, the Special Project Program – Glass Breakwater Repairs (Project), including the Admiral Glass Breakwater (Glass Breakwater), Sumay Marina docks and wave attenuator, and Sumay Point shoreline protection. As a result of the May 2023 Super Typhoon Mawar and other storm events, the breakwater, docks, wave attenuator, and shoreline protection are severely damaged.

Work on the breakwater includes excavation and replacement of the existing toe, slope, and crest rock protection; rebuilding of the damaged core and toe sections; placement of a bedding stone underlayer; and installation of concrete armor units (CAUs) along the toe, slope, and crest. Site preparations include earthwork, placement of gravel, and vegetation clearing to provide work areas to accommodate crane pads and heavy truck traffic on the breakwater crest roadway. Other site work includes construction of a concrete casting yard at an established laydown area to fabricate the CAUs and temporary relocation of the existing U.S. Coast Guard (USCG) aid to navigation (ATON) tower on the Glass Breakwater head section during construction. Removal and temporary relocation of the ATON to a site within 200 feet of the existing location would be appropriately coordinated with the USCG. For awareness, notices to mariners would be issued for the duration that the ATON is temporarily relocated, and the ATON would be reinstalled on the breakwater head section when construction is complete.

The Proposed Action also includes repairs to the docks at Sumay Marina as well as construction of a new fixed wave attenuator within Sumay Marina to replace the previously constructed floating wave attenuator that failed during Super Typhoon Mawar. These repairs are critical for unimpeded operations by the USCG, Port Operations, and Navy Security Forces and Emergency Response teams. Work at the marina would involve pile driving to install new and replacement piles that would reinforce the floating docks and the new wave attenuator. Additionally, the existing engineered revetment along Sumay Point would be repaired by removing the deteriorated steel structure and restoring the rock revetment protection. **Figure 1-1** provides an overview of the proposed land-based and in-water project activities.

1.2 Background

Glass Breakwater

The Glass Breakwater in Apra Harbor, Guam, has played a critical role in the island's maritime infrastructure since its construction. Initially planned before World War II (WWII), the breakwater's development was expedited after the war, primarily by the Navy Seabees, and completed in 1946. This structure was named in honor of Navy Captain Henry Glass (later promoted to Admiral), who played a significant role in liberating Guam from the Spanish during the 1898 Spanish-American War. The Navy owns the western 1.89 miles of the breakwater (above and below water), and the Government of Guam owns the eastern 0.86-mile segment (above water). Apra Harbor is a vital maritime hub for Guam, serving both military and commercial purposes. The harbor supports Naval Base Guam (NBG), which includes facilities for Navy ships and submarines, and the Port of Guam, the island's primary commercial port handling cargo, fuel, and passenger vessels.

Figure 1-1. Location Map for Glass Breakwater and Sumay Cove Repairs

Basemap: World Imagery; World_Ocean_Base

The breakwater is essential to shelter and protect Navy, commercial, government, and privately owned vessels that use Apra Harbor. The breakwater also safeguards the shore facilities and infrastructure within the harbor from severe wave action during typhoons and other heavy weather events.

Historically, the breakwater was substantially larger, extending approximately 100 feet farther out on the outer (Philippine Sea) and leeward (Apra Harbor) sides than the current footprint. Over the years, the breakwater has experienced wear from wave action and several weather events that degraded the structure's size and protective capacity, and necessitated the need for repairs. On May 24, 2023, Super Typhoon Mawar passed north of Guam, bringing destructive winds and swells that severely damaged sections of the breakwater. The storm's impact caused significant erosion and displacement of the protective armor rock on the western segment of the breakwater, compromising the breakwater's integrity. The recent damage created an urgent need for repairs to maintain the harbor's functionality and prevent further degradation, which could lead to increased damage, higher future repair costs, and potentially significant environmental impacts. The Glass Breakwater is vital to the Navy's mission because, without it, Apra Harbor would be open to severe wave action that accompanies typhoons and other heavy weather events originating from the Philippine Sea. Wave heights of 8 to 9 meters (25 to 30 feet) have been recorded during previous super typhoons that occur in 7- to 15-year return intervals. Modeled wave heights for a 100-year storm event have indicated potential wave heights upward of 13 meters (44 feet); the current project design would address wave action up to this level. The worsening condition of the breakwater affects the position of the existing USCG ATON. The ATON, located on the southwest end of the breakwater, is the only physical means to guide all incoming vessels into the mouth of the Outer Apra Harbor**.**

Assessments conducted in February 2024 revealed that one-third of the breakwater has experienced a loss of volume of armor stone at or greater than 20 percent and these areas are classified as "failed" according to the U.S. Army Corps of Engineers (USACE) Coastal Engineering Manual (USACE 2002). The remaining two-thirds of the breakwater have experienced a 10 to 15 percent loss of volume of armor stone, considered intermediate damage condition leading to failure. Furthermore, a visual inspection conducted on May 9, 2024, showed an increased rate of degradation from normal wave action. If left unaddressed, this deterioration is likely to result in a breach of the breakwater, posing major risks to military and commercial ships, facilities, operations, and the overall logistical use of Apra Harbor. In the event of even a partial breach, the maintenance road on top of the breakwater crest would become impassable, leading to exponential increases in repair costs and time. Additionally, a partial breach would result in potentially devastating sedimentation and siltation effects that would impede vessel transit in the Outer Apra Harbor and damage or result in mass mortality of corals from crushing and loss or degradation of essential fish habitat. The acceleration of breakwater failure underscores the urgent need for repair. In 2024, a separate emergency EA was prepared to address immediate and critical repairs that would temporarily secure the breakwater and protect against imminent breach (Department of the Navy [DoN] 2024). The Proposed Action in this subsequent EA addresses the plan for completion of long-term repairs to the remaining damaged portions of the breakwater.

Sumay Cove

The Sumay Marina experienced major damage both in and above the water. Damaged infrastructure at the marina potentially presents a substantial impediment to the Navy's critically important Security and Emergency Response Actions, as well as USCG, and Port of Guam operations. The existing wave attenuator failed completely during Super Typhoon Mawar, leaving a situation in which all vessels moored in the marina are vulnerable to experiencing damage from routine waves and potentially significant damage during storms. Plans for in-water repair include removal of existing damaged piles; installation of new and replacement piles to support the floating dock system; and replacement of the

existing damaged floating wave attenuator at the mouth of the marina with a new fixed pile-supported design. As possible, existing piles that are not damaged would be incorporated into the dock design. Additionally, the existing engineered revetment along Sumay Point would be repaired by removing the deteriorated steel structure and restoring the rock slope protection.

1.3 Location

The Navy on Guam supports naval activities to maintain operational readiness—maintaining the ability of units to respond to regional threats and to protect the interests of the U.S. and its allies. The NBG is the Navy's operations center and is located on the southwest coast of Guam around Apra Harbor, including the Orote Peninsula. It serves as the forward deployment base and logistics hub, including the main munitions storage and distribution center for sea, land, and air forces operating in Asia and the Western Pacific.

The NBG covers about 4,500 acres on the west-central coast of Guam. It surrounds Apra Harbor and includes all of Orote Peninsula, as well as a low, largely marshy area along the east side of the harbor. Apra Harbor is located on the western shore of Guam, midway down the island and about 10 kilometers (6 miles) southwest of the capital city of Hagåtña. The Philippine Sea surrounds the outside of the harbor and western Guam.

As shown in **Figure 1-1**, Apra Harbor has two recognized zones: Outer Apra Harbor and Inner Apra Harbor. Water depths along the main channel in Outer Apra Harbor range from approximately 52 meters (170 feet) near the mouth down to 26 m (85 feet) near Inner Apra Harbor; the average depth along the channel is approximately 42 m (134 feet) (National Oceanic and Atmospheric Administration [NOAA] Chart 81054_Public Apra Harbor). From the main channel, depths decrease to shallower waters and shoals. Inner Apra Harbor is 9 to 12 meters (30 to 40 feet) deep, and Sasa Bay ranges as deep as 9 to 12 meters (30 to 40 feet) near the mouth but is generally much shallower, with numerous shallow shoals and mangroves. The majority of submerged land within Outer Apra Harbor is administered by the Navy and is used for military training and recreational activities. It also provides access for civilian vessels and the Government of Guam's Port Authority, which is in the northeastern portion of Outer Apra Harbor. The Port of Guam is a deep-water port within the inner reaches of Apra Harbor that offers facilities and services to ships of all registries, provides a combination of maritime, commercial, transportation, and recreational services, and is the island's primary terminal container port for cargo supply changes for goods including food, fuels, medical supplies, machinery, construction and building materials and equipment, and vehicles (Port Authority of Guam [PAG] 2024). The Port operates the only commercial seaport in the region which is the primary seaport in Micronesia serving as a transshipment point for the entire Western Pacific region (PAG 2021). The Navy authority over Inner Apra Harbor restricts its use to military vessels, which include naval and USCG vessels as well as vessels from allied nations. No recreational uses are permitted in Inner Apra Harbor. Fourteen wharves are located within Inner Apra Harbor to support the Navy and USCG vessels and operations (DoN 2022). Sumay Cove is an enclosed embayment on the southern shore of Outer Apra Bay, extending approximately 850 meters (2,790 feet) to the south and ranging from about 40 meters (131 feet) across to 180 meters (591 feet) at its widest point. The entrance to Sumay Cove is flanked by Sumay Point on the west and Explosive Ordnance Disposal Point on the east.

1.4 Purpose of and Need for the Proposed Action

The purpose of and need for the Proposed Action is to complete necessary long-term repairs and modernization to the Glass Breakwater and Sumay Cove infrastructure with the goal of improving safety,

accessibility, usability, and functionality of the area for the Navy, USCG, Port Operations, Military Sealift Command (MSC), and Morale, Welfare, and Recreation (MWR) users, as well as for all citizens of Guam.

The Proposed Action is needed to prevent the imminent breach of the breakwater, thereby safeguarding the harbor, shoreline, and vital Navy and Port of Guam infrastructure that is essential to sustain critical military missions and civilian activities on Guam. Without the Proposed Action there remains a risk of breaching the Glass Breakwater, which would result in major impacts on Navy mission readiness and operational capabilities. The degraded condition of the breakwater, exacerbated by ongoing normal wave action, storms, and typhoons, heightens the likelihood of breach. Continued exposure to even normal wave action not only increases the risk of breach but also poses a risk of potentially devastating environmental damage to the underwater habitat areas of Endangered Species Act (ESA)-listed threatened hard coral species (*Acropora globiceps*) in Apra Harbor.

The proposed repairs in Sumay Cove are needed to improve the safety, accessibility, usability, and functionality of the area for the USCG, Port Operations, Navy Security Forces, MWR, and critically important emergency response operations that are based there. The Proposed Action seeks to improve safety while minimizing environmental impacts on natural and cultural resources.

1.5 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the action alternative (Alternative 1) and the No Action Alternative. The environmental resource areas analyzed in this EA include air quality, water resources, geological resources, cultural resources, biological resources (including marine and terrestrial resources), health and safety, greenhouse gases (GHGs), noise, socioeconomics, infrastructure, transportation, hazardous materials (HAZMAT) and hazardous waste (HAZWASTE), and visual resources. The project area for each resource analyzed may differ due to how the Proposed Action interacts with or impacts the resource. For instance, the project area for cultural resources may only include the construction footprint of a structure, whereas the health and safety project area would expand outside of the construction area.

1.6 Key Documents and Analyses Incorporated by Reference

Key documents are sources of information incorporated into this EA. Documents are considered to be key because they address similar actions, analyses, or impacts that may apply to this Proposed Action. Precedence in NEPA documents has encouraged incorporating documents by reference. The Navy has determined that the following documents, which are incorporated by reference in part or in whole, describe and address similar CAU placement activities at the Admiral Glass Breakwater and pile driving/dock repair activities within Apra Harbor and Sumay Cove:

<u>Similar Armor Unit Placement for Breakwater Repair</u>

- *Environmental Assessment for Glass Breakwater Emergency Breach Repairs at Naval Base Guam, Apra Harbor, Guam* (hereafter, "2024 Glass Breakwater Emergency EA") (DoN 2024a) addressed emergency breakwater repair activities to fill degraded gaps (voids) with re-located armor and crest stones to temporarily reinforce the breakwater structure. Repair activities evaluated would impact land and in-water resources (including marine resources) within the first two meters out (horizontally) from the breakwater. Analysis determined that these repair activities would result in less than significant impacts on affected environmental resources. Following coordination and informal consultation with the NOAA-National Marine Fisheries Service (NMFS), it was determined that these activities were not likely to adversely affect the endangered Central-West Pacific distinct population segment (DPS) of green turtle (*Chelonia mydas*), the endangered hawksbill turtle

(*Eretmochelys imbricata*), the threatened Indo-West Pacific DPS of scalloped hammerhead shark, or the threatened *A. globiceps* hard coral (DoN 2024b).

Similar Pile-driving and Dock Construction

- The Navy's record of *Categorical Exclusion (CATEX) for Special Project ST052-05 Repair and Modernization of Waterfront Facilities at Sumay Cove, Naval Base Guam* (hereafter, "2010 Sumay Marina Repairs CATEX") (DoN 2010) and associated permit and ESA Section 7 consultation documents described marina repairs, including impact hammer installation of 1,000 linear feet (LF) of sheet piles (approximately 130 sheet piles) and 55 (16-inch diameter) concrete piles. Sites for the concrete piles were pre-drilled, and then each pile was hammered to a depth of 20 feet below the mudline. Additionally, the noise analysis developed for the 2010 repairs at Sumay Marina addressed pile driving, dock repairs, and marina upgrade activities that are comparable to the repairs currently proposed and is therefore incorporated by reference to supplement the noise analysis in this EA. Further, the 2011 *Biological Opinion (BO) for the Sumay Cove Marina Repairs* project determined that the underwater noise and sedimentation anticipated from dock repairs and pile driving activities would not jeopardize the continued existence of green sea turtles or hawksbill sea turtles and would have no effect on designated or proposed critical habitat under NMFS jurisdiction (NOAA-NMFS 2011). Also, although noise from the proposed activities would likely adversely affect protected sea turtles, NMFS determined that the expected effects would not rise to the level of take because the turtle's expected response to the noise stressors was expected to cause no measurable harm or harassment of those animals.
- *Lima, Mike, and November (LMN) Wharf Repair and Modernization at Naval Base Guam, Apra Harbor, Guam* (hereafter, "*2020 LMN Wharf Repair EA*") (DoN 2020a) provided a thorough description and analysis of impacts on marine species, water quality, and benthic sediments in the Apra Harbor marine environment that would result from installation of 2,315 LF of 24-inch King and Z steel sheet piling (between 200 and 300 sheet piles) and 55 (16-inch diameter) concrete piles, dredging and excavation, and wharf repair activities. Similar to the 2011 Sumay Marina Repairs, pile sites would be pre-drilled, and piles would be hammered to a depth of approximately 20 feet below the mudline. The noise analysis developed for the *2020 LMN Wharf Repair EA* also addressed pile driving, dock/marina repair, and restoration actions comparable to the activities proposed in Sumay Cove and is therefore also incorporated by reference to supplement the underwater noise analysis in this EA. Following coordination and informal consultation with NOAA-NMFS, it was determined that the proposed pile driving and repair activities at the LMN wharves were not likely to adversely affect endangered or threatened species or designated or proposed critical habitat under NMFS' jurisdiction (NMFS 2020a).

Best Management Practices (BMPs) to avoid or minimize potential for impacts resulting from elevated underwater noise, sedimentation, entanglement, disturbance from human activity, direct physical contact with construction equipment, vessel strikes, and wastes and discharges identified for these prior-evaluated actions will continue to be followed for the Proposed Action (refer to **Section 2.5** for the comprehensive list of BMPs to be implemented).

The Draft EA was made available online at: **https://pacific.navfac.navy.mil/About-Us/National-Environmental-Policy-Act-NEPA-Information** for review during the public review and comment period to ensure reasonable public accessibility of the information they each provide.

1.7 Relevant Laws and Regulations

The Navy has prepared this EA based upon federal and state laws, statutes, regulations, and policies pertinent to the implementation of the Proposed Action, which are listed in **Table 1-1.**

Table 1-1. Laws and Regulations Relevant to Implementation of the Proposed Action

Laws/Regulations
• National Environmental Policy Act (NEPA) (42 *United States Code* [U.S.C.] Section 4321 *et seq*.) • Navy regulations for implementing NEPA (32 CFR Part 775) • Clean Air Act (CAA) (42 U.S.C. Section 7401 *et seq*.) • Clean Water Act (CWA) (33 U.S.C. Section 1251 *et seq*.) • Rivers and Harbors Act (RHA) (33 U.S.C. Section 401 *et seq*.) • Coastal Zone Management Act (CZMA) (16 U.S.C. Section 1451 *et seq*.) • National Historic Preservation Act (NHPA) (54 U.S.C. Section 3001018 *et seq*.) • Endangered Species Act (ESA) (16 U.S.C. Section 1531 *et seq*.) relevant to marine and terrestrial resources • Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSA) (16 U.S.C. Section 1801 *et seq.*) • Marine Mammal Protection Act (MMPA) (16 U.S.C. Section 1361 *et seq*.) • Migratory Bird Treaty Act (MBTA) (16 U.S.C. 703-712) • Comprehensive Environmental Response and Liability Act (42 U.S.C. Chapter 103) • Emergency Planning and Community Right-to-Know Act (42 U.S.C. Chapter 116) • Resource Conservation and Recovery Act (42 U.S.C. Section 6901 *et seq*.) • Toxic Substances Control Act (15 U.S.C. Chapter 53) • Executive Order (EO) 11988, *Floodplain Management* • EO 12088, *Federal Compliance with Pollution Control Standards* • EO 13089, *Coral Reef Protection* • EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks* • Guam Air Pollution Control Standards and Regulations (Regulation 1302, Chapter 1, Title 22 of Guam Administrative Rules and Regulations) • Guam Administrative Record (GAR) 8, Chapter 13, *Importation of Sand, Quarried, or Mined Products* • Guam EO 91-37, *Amendment to EO Number (No.) 91-16 Relative to the Importation of Sand and Other Quarried Products*

Table Note: For purposes of this Environmental Assessment (EA), the Department of the Navy has voluntarily elected to generally follow those Council of Environmental Quality regulations at 40 Code of Federal Regulations (CFR) Parts 1500 – 1508 that were in place at the outset of this EA, in addition to DoN's procedures/regulations implementing NEPA at 32 CFR Part 775, to meet the agency's obligations under the NEPA, 42 United States Code Sections 4321 et seq.

1.8 Public and Agency Participation and Intergovernmental Coordination

NEPA directs agencies to involve the public in preparing and implementing their NEPA procedures.

The Navy has prepared this EA to inform the public of the Proposed Action and to allow the opportunity for public review and comment. A 15-day Draft EA review and comment period began with a Notice of Availability (NOA) published in the *Pacific Daily News* over three consecutive days (March 25 through 27, 2025) to inform the public of the March 28, 2025 comment period start date. The NOA announced the availability of the Draft EA and the locations where public review copies were available. The Draft EA

was made available on the following website: **https://pacific.navfac.navy.mil/About-Us/National-Environmental-Policy-Act-NEPA-Information** and at the Nieves M. Flores Hagåtña Public Library. No comments were received from the public. Additionally, a public notice was posted from April 24 through May 23, 2025 on the U.S. Army Corps of Engineers – Honolulu District (USACE POH) website (https://www.poh.usace.army.mil/Missions/Regulatory/Public-Notices/) for a 30-day public review and comment on the Navy's application for applicable permitting under the Clean Water Act and/or Rivers and Harbors Act. A copy of the USACE-POH public notice is provided in **Appendix A**.

Table 1-2 lists the Navy's agency coordination and consultation efforts for the Proposed Action. Consultation documents are currently under review with the respective regulatory authorities/agencies. Results of those consultations will be incorporated into the corresponding appendices, as identified in **Table 1-2**.

Table 1-2. Interagency Coordination and Consultation Efforts Required for the Proposed Action

Agency	Applicable Regulation(s)	Description	Related Agency Documentation Provided in:
United States Army Corps of Engineers and Guam Environmental Protection Agency (Guam EPA)	• Clean Water Act (CWA) Section 401 – Water Quality Certification • CWA Section 404 – Dredge and fill in navigable waters • Rivers and Harbors Act (RHA) Section 10 – construction in navigable waters	Correspondences and coordination for appropriate permitting and water quality certifications.[1]	**Appendix A**
NOAA, NMFS	• Endangered Species Act (ESA) – federally protected species and habitats • Marine Mammal Protection Act (MMPA) – federally listed species and habitats • Magnuson-Stevens Fishery Conservation and Management Reauthorization Act (MSA) – Essential Fish Habitat (EFH)	Development of a Biological Assessment per ESA and also addressing MMPA, as applicable. Development of an EFH Assessment addressing federally-protected fish species and habitat	**Appendix C**
Guam State Historic Preservation Office (SHPO)	• National Historic Preservation Act (NHPA) Section 106	Consultation regarding protected cultural, historical, and archeological resources within or near the Proposed action	**Appendix D**
Guam Coastal Management Program (CMP)	• Coastal Zone Management Act (CZMA) as adopted by the Guam CMP	Coordination regarding Navy's coastal consistency determination (CCD) in accordance with the CZMA	**Appendix E**

[1]-All required permits and certifications will be obtained after completion of the EA, prior to work start of construction.

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2 Proposed Action and Alternatives

2.1 Proposed Action

The Navy proposes to perform necessary long-term repairs and modernizations to Glass Breakwater and vital infrastructure in Sumay Cove and at Sumay Marina (**Figure 1-1**).

Repair activities would involve restoring the Glass Breakwater, Sumay Marina floating docks, wave attenuator, and Sumay Point shoreline protection to at least their original state and improving function and resiliency. The Navy estimates that repairs would begin in mid-2025 and would continue on a phased progression through 2030. Upon completion of construction activities, the coastal and marina infrastructure would be managed and maintained consistent with existing practices.

2.2 Screening Factors

NEPA requires consideration of alternatives to a federally proposed action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and to meet the purpose and need require detailed analysis.

Potential action alternatives that met the purpose of and need for the Proposed Action (specified in **Section 1.4**) were evaluated against the following screening factors:

- **Timeliness:** Repairs must begin once approvals and permits are obtained following completion of the NEPA process and within the 5-year funding expiration timeframe.
- **Construction:** Construction must be feasible and within the existing breakwater, docks, and shoreline protection footprints.
- **Longevity:** Repairs must ensure a minimum lifespan of 25 years with ongoing maintenance, as required.
- **Criteria Compliance:** Repairs must meet current criteria specified in relevant manuals (e.g., USACE coastal engineering standards) to provide stability, withstand severe environmental conditions, and provide sufficient wave dissipation to reduce the force of incoming waves before they reach harbor infrastructure and the shoreline.

2.3 Alternatives Carried Forward for Analysis

Based on the alternative screening factors for meeting the purpose of and need for the Proposed Action, one action alternative (Alternative 1) was identified and is analyzed within this EA, along with the No Action Alternative.

2.3.1 No Action Alternative

Under the No Action Alternative, the proposed critical repairs identified for the Proposed Action would not be completed, and the breakwater, at risk of imminent breach, would continue to degrade. Failure to execute critical repairs would continue to expose the breakwater to more serious damage, including partial breach of the breakwater head and breach of the breakwater trunk. If there were even a partial breach, future breakwater repairs would be extremely costly and difficult to execute. The degraded condition of the breakwater, exacerbated by normal wave action, storms, and typhoons, heightens the likelihood of breach. Continued exposure to even normal wave action stressors not only increases the risk of breach but also poses a severe risk of potential environmental damage to submerged habitat areas of the ESA-listed coral species. Strong waves, especially during typhoon conditions, would expose

more of the slope, leading to inevitable breach of the breakwater. During a breach, large segments of the breakwater would break away, and damaging waves would impact Navy ships, submarines, facilities, and infrastructure, as well as Port of Guam operations within Apra Harbor. If the breakwater is not repaired, the position of the existing USCG ATON would be damaged or lost, affecting the safety of all incoming and outgoing vessels through the mouth of the Outer Apra Harbor.

The degraded state of the floating docks and failed wave attenuator in Sumay Marina would continue to present a dangerous situation for USCG, Port Operations, Navy Security Forces and Emergency Response teams, MSC, and MWR vessels, personnel, and other users, likely leading to a required relocation of the docks and/or construction of a new marina. The degraded state of the Sumay Point revetment exposes the upland to erosion and wave overtopping with potential for destabilization of the Sumay Channel.

The No Action Alternative would not meet the purpose of and need for the Proposed Action; however, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA. The No Action Alternative will be used to analyze the consequences of not undertaking the Proposed Action and will serve to establish a comparative baseline for analysis.

2.3.2 Alternative 1

Alternative 1 would ensure repairs are implemented to restore the breakwater's functionality and long-term resilience. This alternative would ensure the breakwater maintains its structural integrity and protects Apra Harbor from severe wave action. This would safeguard both military and commercial maritime operations. Project work would begin in late summer to early fall of 2025 and would be projected to last approximately five years. It is anticipated that the Project would require 70 (to 85 at peak) construction personnel, with the workforce comprised of approximately 20 percent local workers and approximately 80 percent off-island workers; an average of approximately 70 personnel would be supporting phased development activities over the five-year construction timeframe. The following describes the Project activities required for the Glass Breakwater and Sumay Cove repairs.

2.3.2.1 Glass Breakwater Repairs

This approach involves phased placement of CAUs on the western 1.9 kilometers (1.2 miles) of deteriorated and/or failing areas of the breakwater (**Figures 2-1** and **2-2**). This alternative (Alternative 1) places CAUs on the breakwater head section (south/west end), along approximately 30 meters (100 LF) on the leeward (inner, harbor) side, and along the entire ocean (outer, Philippine Sea) side (1.9 kilometers) except for along the Luminao reef. The repair areas would extend from the breakwater crest up to approximately 49 meters [160 feet] seaward from the center of the crest road for the Outer Breakwater and up to 46 meters [150 feet] for the Inner Breakwater Repair activities would potentially affect a maximum of up to 21.9 acres of underwater area (below the Mean Higher High Water [MHHW] line) on the outer (Philippine Sea) side of the breakwater and head section, which includes the entire area from the MHHW waterline to the outer limit of the breakwater toe. Planned repairs would only be likely to disturb up to 11.4 acres on the outer breakwater, and up to 0.2 acres of underwater area below the MHHW line on the leeward (harbor) side of the breakwater. Additionally, this work would require temporary relocation of the existing ATON situated at the breakwater head section. The temporary site for relocation would be within 200 feet of ATON's charted location. Relocation would be coordinated and approved through the USCG, and a notice to mariners would be issued through the USCG, the National Geospatial-Intelligence Agency (NGA), and/or the National Ocean Service (NOS), about the temporary change. The ATON would be placed back on the head section when construction is complete.

Breakwater repair activities would include the following work elements:

1. **Site Preparation**: Vegetation clearing and earthwork to create work and access areas on the breakwater crest to accommodate crane pads, construction equipment, and heavy truck traffic would be required prior to repair activities. Several potential construction laydown areas (including material loading and offloading, concrete casting, and material storage areas) have been identified, as shown in **Figure 2-1**. The primary concrete casting yard would encompass the pre-cast yard, materials stockpile, and CAU storage. Contingent CAU and aggregate storage, and an alternative concrete casting yard would be located at the old Cabras Quarry site or the paved lot located across the street and approximately 700 feet southwest from the quarry entry along Highway 11.

   The Hotel Wharf site along the inner side of the breakwater in the Outer Harbor would be the primary location for loading and unloading barges, personnel transports, supply boats, and push boats to shuttle workers, materials, equipment, and supplies to and from the breakwater work areas. Other wharves located in the Inner Harbor (e.g., F6 Wharf) may also be used on a contingent basis for these purposes and to avoid forecasted typhoon conditions or tropical storms. **Figure 2-2** provides a schematic of the process for stone and CAU transport via barge, lifted by crane, and placement along the breakwater. On the leeward side of the breakwater, a spud/jack-up barge and temporary moorings (piles or anchors) would be used to position vessel for unloading CAUs and for other repair/construction support. The moorings would be supported by piles (up to 16 steel pipe piles) or anchors. Any spuds or mooring piles installed would be placed only into soft sediment and would be removed following completion. Piles that are removed will be disposed of at the local upland landfill.

2. **Temporary Removal of Existing Armor Layer and Toe Foundation:** To provide a stable foundation for placement of the CAUs, existing rock and CAUs along the slope, crest, and toe would be removed within the areas of the breakwater to be rebuilt. Removal would be down to the breakwater core for the slope and crest and approximately 6 meters (20 feet) deep along the lower toe apron section. **Figure 2-3** provides a notional cross-section schematic of the existing breakwater design and shows the limits of work. The removed rock and CAUs would be used to rebuild the breakwater core, and some rock (up to 7,800 cubic yards [CY]) would be hauled off-site to be used for shoreline protection repairs within Apra Harbor, including at Sumay Point. Predominantly, existing armor stone that has settled or fallen from the slope into the water leaving voids along the breakwater would be excavated and used to build a reinforcing base approximately halfway between the base of the slope and the outer limit of the existing toe. The reinforcing base would be excavated to an elevation no deeper than 20 feet below the MHHW height to support the buildup of CAUs and/or CAUs and would serve to prevent settling or seaward movement of the CAUs, which would be placed from the reinforcing base up the slope to the crest. Using this approach, repair and buildout of the breakwater could disturb a maximum area of up to approximately 21.9 acres (which conservatively includes the entire the entire area from the MHHW waterline along the breakwater slope to the outer limit of breakwater toe). However, it is likely that the required work would only disturb approximately 11.4 acres of submerged area (below the MHHW line) inside the footprint of the existing toe on the outer (Philippine Sea) side and 0.2 acres of submerged area (below the MHHW line) within the footprint of the existing toe on the leeward (Apra Harbor) side of the breakwater.

3. **Rebuilding the Core Foundation:** As necessary in each repair area, the breakwater's core would be graded and rebuilt to provide a stable foundation for placement of the CAU armor layer. The imported, quarried aggregate filter material and bedding rock (up to 54,000 CY) that would be used for this work would be transported to Guam via ships or barges and transported to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge.

4. **Casting of Concrete Armor Units:** It is anticipated that the CAUs would be fabricated on the island at a casting yard, co-located with a construction staging area at either Polaris Point or Cabras Quarry (**Figure 1-1**). Concrete would be purchased from an existing local supplier (Hawaiian Rock's Agat plant or Smithbridge's Polaris Point plant). Concrete would be hauled from the supplier's batching plant to the selected casting yard via mixer trucks and placed into armor unit molds.

5. **Placement of Concrete Armor Units:** Approximately 20,100 large CAUs (25 to 50 tons each) would be placed along the toe, slope, and crest of the breakwater. The CAUs would be transported from the casting yard to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge. It is anticipated that 75 percent of the CAUs would be hauled to the breakwater repair site from the concrete casting yard via truck, and the remaining 25 percent would be hauled by barge to the Hotel Wharf site for transloading onto barge via crane. When fully laden, the barge would then transit to and moor against the pre-positioned spud barge leeward of the breakwater near the CAU-placing crane. CAUs would then be offloaded from the barge onto the breakwater by the CAU-placing crane.

Figure 2-1. Overview of the Glass Breakwater Repair Effort

Figure 2-2. Notional Cross-Section of Stone and CAU Transport and Placement for Glass Breakwater Repair

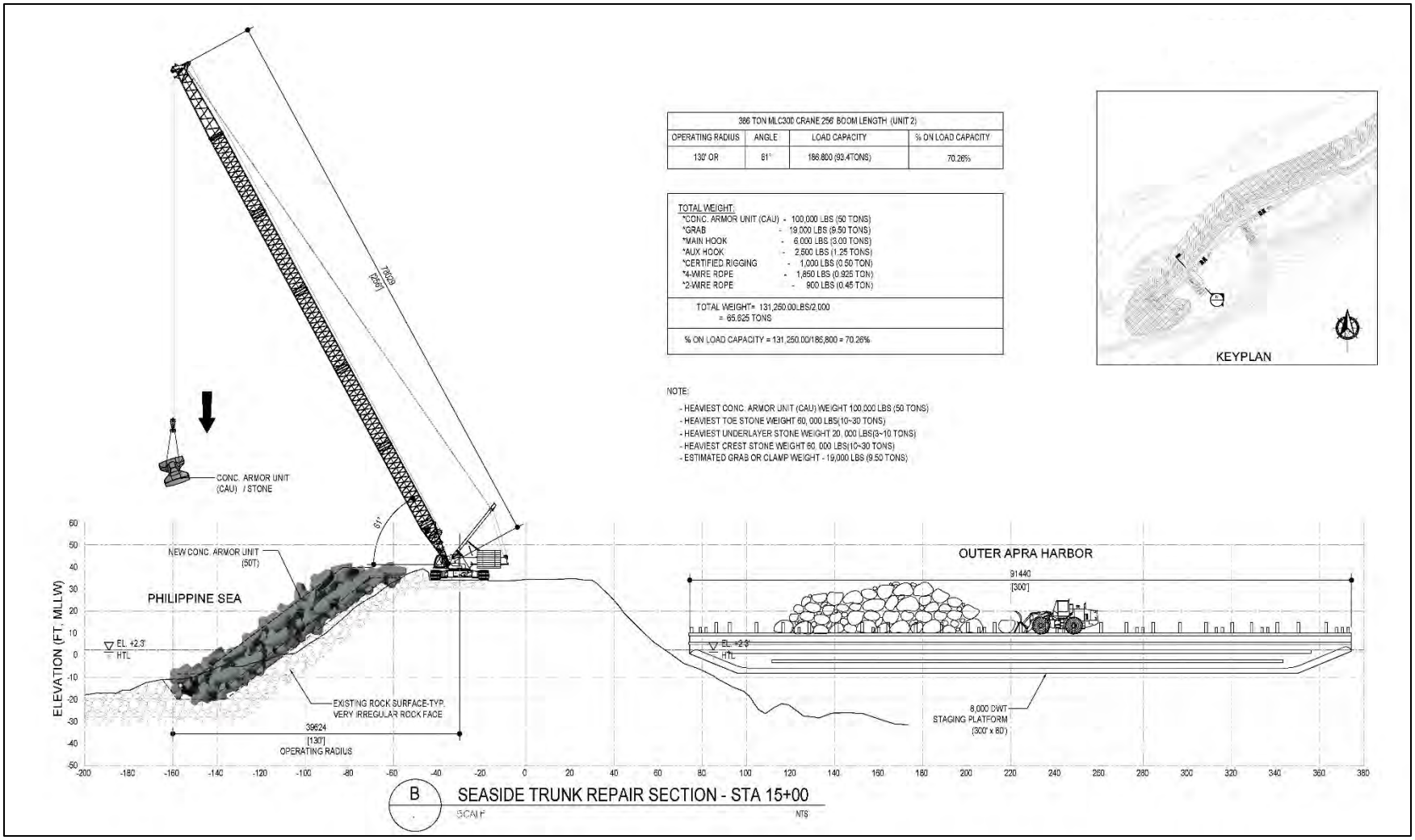

Figure 2-3. Notional Cross-Section – New Reinforcing Base within the Limit of Work (Blue Shaded Area) to Existing Toe of Glass Breakwater

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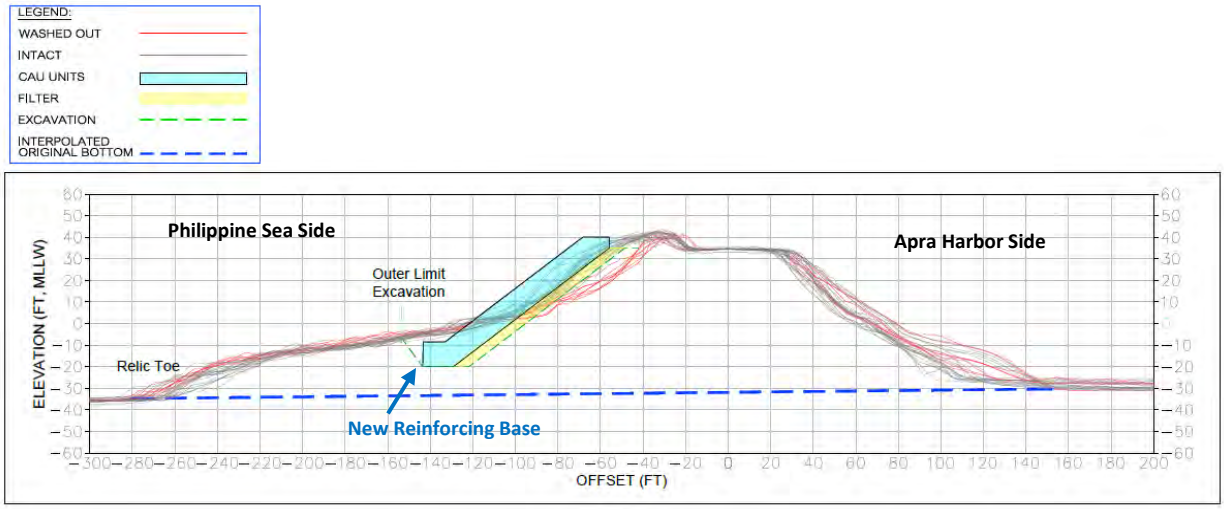


2.3.2.2 Sumay Cove Repairs

Proposed Action activities in Sumay Cove (presented in **Figures 2-4** through **2-6**) would begin in 2027, last approximately two years, and would include the following component actions:

1. **Sumay Marina Floating Dock Repairs.** Repairs would drive up to 12 (20-inch diameter) octagonal concrete piles to provide lateral support and replacement of existing deteriorated piles for the floating docks supporting the USCG, Port Operations, MWR, and Navy Security and Emergency Response forces vessels and up to 12 (16-inch diameter) octagonal piles to replace damaged/deteriorating main dock guide piles. In the marina area, the ocean bottom is at a depth of approximately 5.5 meters (18 feet) and is comprised of silt. Sites where piles would be driven would be pre-drilled, and then each pile would be hammered to a depth of approximately 20 feet below the mud line. Finger and main dock pile installation for the proposed Sumay Dock repairs and wave attenuator would be conducted in a similar manner as described in the *2011 BiOp for Sumay Cove Marina Repairs* and the *2020 LMN Wharf Repair EA* and with the same pile driving requirements as assessed in the *NMFS 2022* consultation response on similar Navy project work elsewhere in the Pacific Island Region (i.e., PIRO-2020-03728). It is anticipated that on average, one pile would be driven per day over a two-month period for all proposed projects in Sumay Cove.

   Following pre-drilling if necessary, the process for impact driving the concrete piles begins by placing a choker cable around a pile and lifting the pile into a vertical position with a crane. The in-water pile is then lowered into position inside the template and set in place at the mudline, vibrated into place, and driven to design elevation using impact hammers. As needed, jetting would be used to assist in pile installation. Impact hammers have guides that hold the hammer in alignment with the pile while a heavy piston moves up and down, striking the top of the pile, driving the pile into the substrate from the downward force of the hammer. Assuming a similar number of strikes as described in the NMFS (2020b and 2022) consultation responses for similar pile driving activities, it is anticipated that driving a concrete pile would require an average of 200 hammer strikes per pile to reach the 20-foot depth below the mudline. This number will

vary depending on factors such as soil condition, tip elevation, size of hammer, and final dimensions of the piles. **Table 2-1** summarizes the total proposed number of concrete piles to be installed for the Proposed Action and estimates the total number of strikes required for impact hammer installation of all project-related piles to be driven in Sumay Cove.

To support construction of the marina docks and wave attenuator, a temporary trestle may be constructed within Sumay Cove. The trestle would require installation of up to 10 (36-inch) steel pipe piles, which would be set in place via vibratory pile driving. Upon completion of construction, the trestle structure would be removed and the trestle piles would be pulled or cut off at the mudline.

2. **Sumay Marina Wave Attenuator.** Up to 32 octagonal concrete piles (20-inch diameter) or tubular steel piles (36-inch diameter) would be driven into pre-drilled sites to a depth of approximately 20 feet below the mud line to support the fixed wave attenuator. The pile installation method would be similar as described above for the Sumay Marina dock piles. Storm waves from the harbor can propagate along the Sumay Channel and impact the outer marina docks. A fixed (pile-supported) wave attenuator (see **Figure 2-5**) is proposed to reduce these waves to increase the survivability of the floating docks and to maintain safe vessel operation within the basin. The face of the attenuator would be constructed of steel or concrete panels that are attached above the water and extend below the water with a gap at the bottom to allow for water flow. The wave attenuator is intended to block wave energy that would adversely affect the Sumay Marina docks while allowing for water flow around and under it to maintain circulation within Sumay Cove. A concrete cap would be constructed on the piles and navigation lights installed on the cap. The adjacent bulkhead contains corals; however, the wave attenuator would not be attached to the bulkhead; it would be its own free-standing structure in the approximate location of the previous attenuator.
3. **Sumay Point Revetment Restoration.** At Sumay Point (shown in **Figure 1-1**), an existing deteriorated steel structure would be demolished and removed (demonstrated in **Figure 2-6**). The underlying slope would be backfilled and compacted, likely requiring the import of soil/bedding material, and then imported rock or rock salvaged from the breakwater (approximately 900 CY) would be placed above and in water to restore the previously constructed rock revetment. The new rock would be placed within the existing revetment footprint and such that it ties into the existing rock in the water and at both ends. The rock would be brought to the Sumay Point site via truck from the breakwater (salvaged existing armor and core layer rock from breakwater repair) or from the Port of Guam (imported from off-island via ship/barge). At a haul capacity of approximately 10 CY per truckload, this work would require 90 truck trips. All construction work would likely occur from the landside.

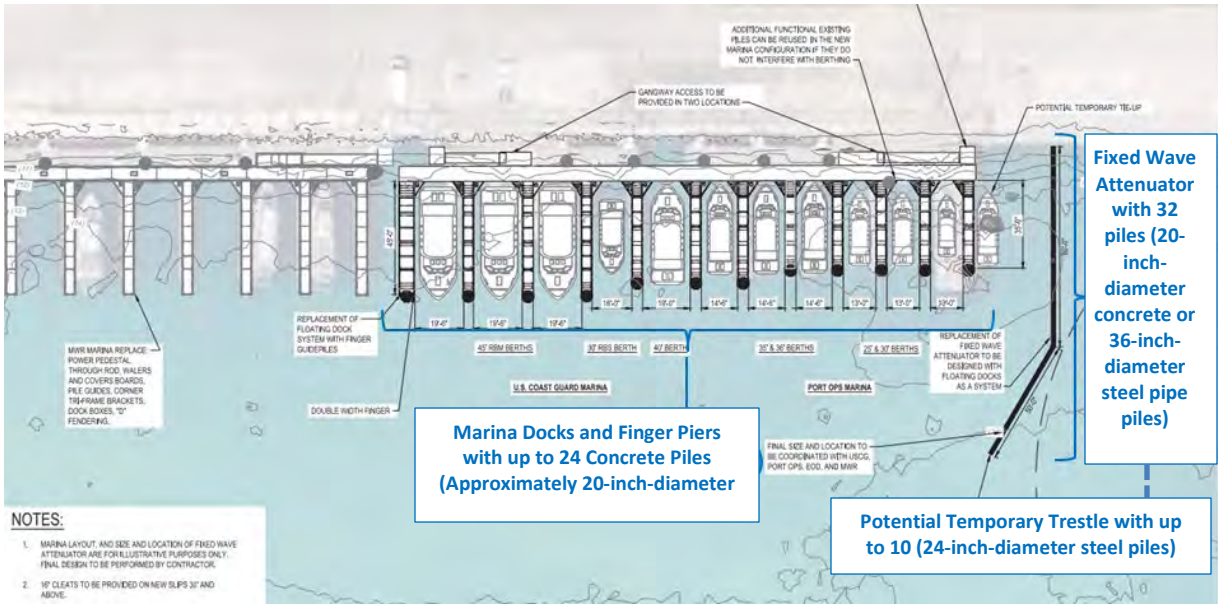
Table 2-1. Summary of Pile Driving Required for the Proposed Action

Location	Structure	Method of Pile Driving	Number of Piles [1]	Pile Type	Pile Size - Diameter (inch) x Length (feet) [2]	Pre-Drill Duration (hours) per Pile	Vibratory Hammer Duration (hours) per Pile [3]	Impact Hammer Load Tests Strike per Pile [3]	Impact Hammer Duration (minutes) per Pile [3]	Average Number of Piles Installed per Day [4]
Glass Breakwater	Mooring Piles [5]	Pre-drill, vibrate to design elevation, impact hammer for proof loading	16	Tubular steel	24-inch x 60 feet	4	8	200 strikes/pile	15	1
Sumay Marina	Wave Attenuator		32	Octagonal concrete Tubular steel	20-inch x 60 feet 36-inch x 60 feet	4	8	200 strikes/pile	15	1
Sumay Marina	Finger Dock Guide Piles		12	Octagonal concrete	20-inch x 60 feet	4	8	200 strikes/pile	15	1
Sumay Marina	Main Dock Guide Piles		12	Octagonal concrete	16-inch x 60 feet	4	8	200 strikes/pile	15	1
Sumay Marina	Temporary Trestle [6]		10	Tubular steel	24-inch x 60 feet	4	8	200 strikes/pile	15	1

Key: hrs = hours; TBD = to be determined

Notes: [1] Anticipated number of piles to be driven per project are from TPC-Nan (2024). [2] Reflects maximum diameter piles. The reported pile driving requirements for activities are assumed to be the same or similar to those used on similar Navy projects elsewhere (e.g., NMFS PIRO-2020-03728, NMFS 2022) and represent a reasonable surrogate for effort required during pile installation and removal at Sumay Point. [3] Indicates the total anticipated duration of impact pile driving activity per specified project if installed using a vibratory or impact hammer. [4] It is anticipated that one pile will be driven per day over a 60-day period. [5] Reflects maximum number and types of piles potentially driven to support vessel mooring at the Admiral Glass Breakwater. [6] Reflects the maximum number and types of piles potentially driven for a temporary trestle if needed to support repair and construction activities at Sumay Marina.

Figure 2-4. Schematic of Repair Activities at Sumay Marina



Source: MDPAC JV: Moffat & Nichol 2024

Figure 2-5. Conceptual Diagram of Wave Attenuator

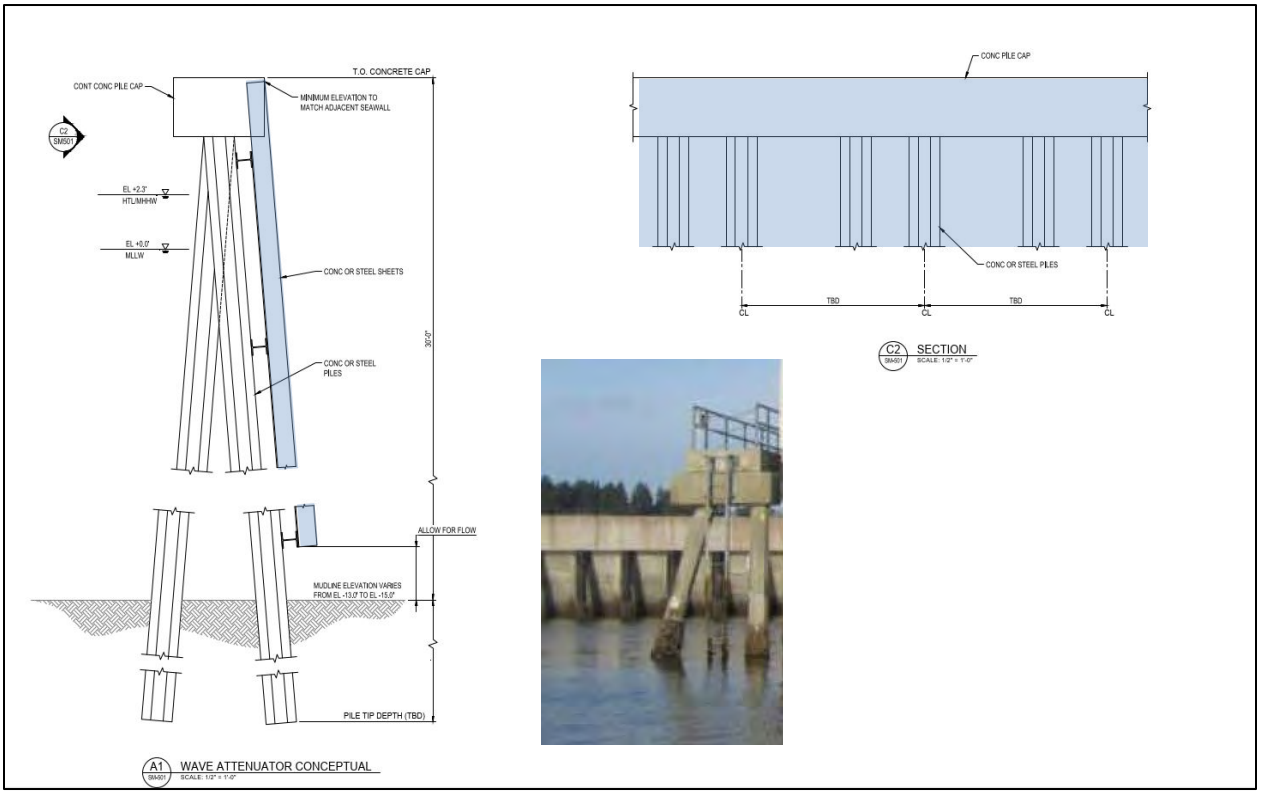
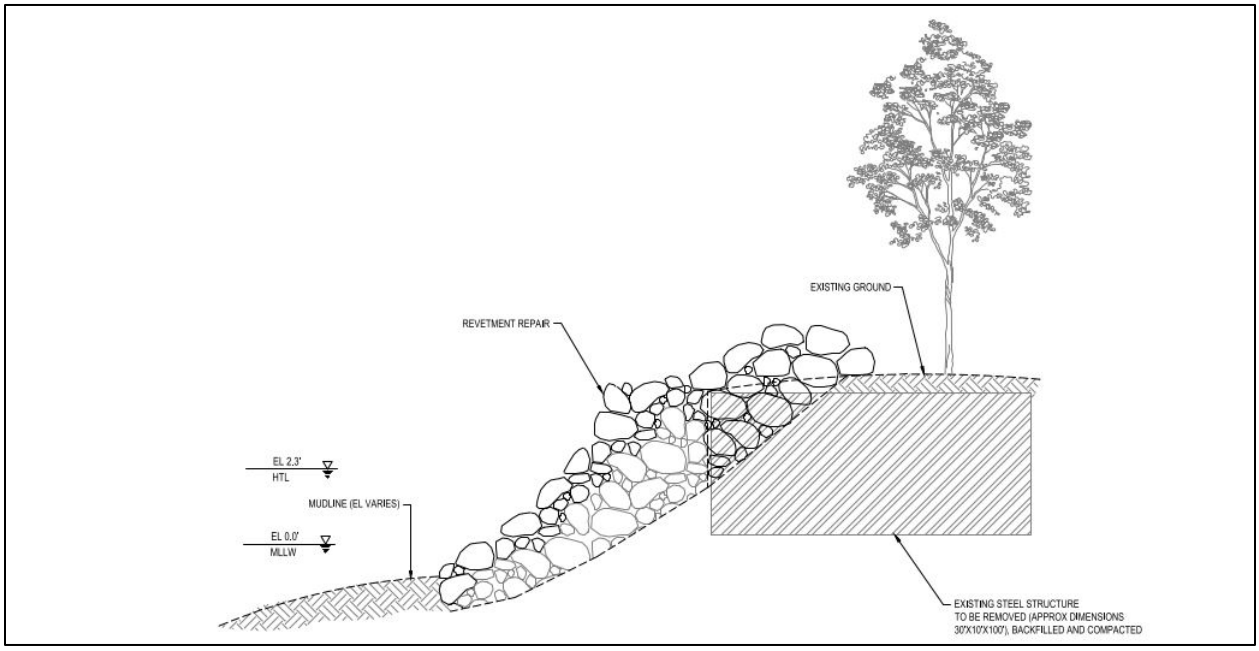


Figure 2-6. Conceptual Cross-Section of Sumay Point Revetment Restoration and Repairs



Source: MDPAC JV: Moffat & Nichol 2024

2.4 Alternatives Considered but not Carried Forward for Detailed Analysis

The following alternatives were considered but not carried forward for detailed analysis in this EA as they did not meet the purpose of and need for the Proposed Action or satisfy the reasonable alternative screening factors presented in **Section 2.2**. Because the typhoon damage was distinct to particular sites and infrastructure that can only exist where they are, alternatives involving different or changed locations were not considered.

2.4.1 Construction of a New Breakwater

This alternative would demolish the current breakwater and construct an entirely new breakwater structure in its place. Construction of a new breakwater would offer adequate harbor protection but would require significantly more time and resources than currently available to address the immediate needs for critical repairs and harbor protection. The lengthy design and construction timelines would not address the immediate need to provide protection to the harbor; therefore, they do not meet the purpose and need. This alternative will not be carried forward for detailed analysis in the EA. There is no other location for a breakwater, as the current location is on top of a relic coral structure. The ocean area just offshore of the reef is several hundred feet deep and impractical for breakwater construction.

2.4.2 Repair using Armor Rocks

This alternative would use rock instead of concrete for the armor units. While this is the conventional style of the existing breakwater, an on-island quarry (Smithbridge Guam) no longer exists, i.e., armor rock would need to be imported to the island and is not readily available from other quarries for the sizes needed for the wave climate. It is not feasible to source and import the amount of armor rock required for completion within the Navy's funding timeline. Further, the placement of armor rocks would have the same environmental impacts as for placement of CAUs, i.e., there would be no environmental benefit to using armor rock in lieu of CAUs.

2.4.3 Steel Sheet Pile Repair

This alternative would include encasing the damaged breakwater areas with steel sheet pile walls on both the harbor side and ocean side. The space between the existing structure and the sheet pile walls would be filled with granular material, anchored with tie rods, and capped with concrete. While this method would stabilize the breakwater, it does not align with the existing conventional breakwater construction style. This alternative does not meet the purpose and need in that it would not conform to the existing conventional breakwater design style; it would be more reflective and with less wave dissipation than the existing conventional breakwater design, and it would remove and not restore coral habitat area. This alternative will not be carried forward for detailed analysis in the EA.

2.4.4 Monolithic Construction Repair

This alternative would include monolithic construction techniques to repair the failed and failing portions of the breakwater. Replacing a conventional (rubble mound or CAUs) breakwater using monolithic construction techniques, such as concrete caisson structure, is generally not feasible due to:

1. **Structural Incompatibility**: Monolithic construction involves creating a single, continuous structure, often using materials like concrete. In contrast, conventional breakwaters are composed of multiple layers of loose stones or rocks or CAUs. The fundamental design principles and behavior under wave action differ significantly between these two types, making integration challenging.

2. **Flexibility and Adaptation**: Conventional (rubble mound and CAUs) breakwaters are designed to be flexible and absorb wave energy through the movement of individual armor units. Monolithic structures, being rigid, do not provide the same level of energy dissipation and have high wave reflection. This could lead to structural failure when subjected to the dynamic forces typically absorbed by a conventional breakwater design.

3. **Construction Techniques**: The construction methods for monolithic breakwaters are substantially different from those used for conventional (rubble mounds and CAUs) breakwaters. Implementing monolithic construction techniques would likely require completely re-engineering the breakwater, leading to increased costs and extended timelines, which do not meet the urgent needs for timely repairs.

This incompatibility with the current structure means it fails to meet the Project's purpose of and need for efficient repairs that maintain the breakwater's original design and functionality. Therefore, it will not be carried forward for detailed analysis in the EA.

2.4.5 Sumay Cove Floating Wave Attenuator

This alternative would rebuild the previously existing floating wave attenuator, instead of the proposed fixed wave attenuator. Similar to the No Action alternative, this would present a potentially dangerous situation for USCG, Port Operations, Navy Security Forces, MSC, and MWR vessels, personnel, and other users during high wave events. Further damage to the floating wave attenuator would likely occur again during high wave events and would not meet the screening criterion of a 25-year longevity. Therefore, this alternative will not be carried forward for detailed analysis in the EA.

2.5 Best Management Practices Included in Proposed Action

This section presents an overview of the BMPs that are incorporated into the Proposed Action in this document. BMPs are existing policies, practices, and measures that the Navy would adopt to reduce the environmental impacts of designated activities, functions, or processes. Although BMPs mitigate

potential impacts by avoiding, minimizing, or reducing/eliminating impacts, BMPs are distinguished from potential mitigation measures because BMPs are (1) existing requirements for the Proposed Action, (2) ongoing, regularly occurring practices, or (3) not unique to this Proposed Action. In other words, the BMPs identified in this document are inherently part of the Proposed Action and are not potential mitigation measures proposed as a function of the NEPA environmental review process for the Proposed Action.

The BMPs include actions required by federal or state law or regulation. The recognition of the general management measures prevents unnecessarily evaluating impacts that are unlikely to occur. **Table 2-2** lists the BMPs and the Regulatory Consultation Avoidance, Minimization, and Mitigation Measures and Recommended Conservation Measures that are applicable to the Proposed Action. BMPs that were specified in the MSA EFH Consultation Response (received from NMFS on May 28, 2025) and the ESA Section 7 BO (PIRO-2025-00832; received from NMFS on July 25, 2025) are listed in the "Best Management Practices" portion of **Table 2-2** in **bold blue font**, and are reiterated in the "Regulatory Consultation Avoidance, Minimization, and Mitigation Measures" portion of the table.

Table 2-2. BMPs and Regulatory Consultation Measures to Avoid and Minimize Effects on Environmental Resources in the Project Area

BEST MANAGEMENT PRACTICES[1]
BMPs to avoid and minimize effects from the Project on ESA-listed sea turtles and sharks
As applicable to mobile Endangered Species Act (ESA)-listed marine species (including non-listed marine mammals, although they are not expected to occur in the Action Area), the following best management practices (BMPs) will be employed to avoid and minimize adverse effects: **A. During in-water activities such as placement and resetting of armor stone and concrete armor units (CAUs) and pile-driving, a dedicated and competent observer who is familiar with local marine species will use binoculars to detect the presence of ESA-listed marine species and notify construction crews to cease work if the ESA-listed species approaches the shutdown zone, as described below.** **1. The Contractor will comply with the following monitoring requirements:** **a) From the breakwater, a competent observer will use binoculars to monitor the Action Area for ESA-listed sea turtles and scalloped hammerhead sharks (*Sphyrna lewini*) during all in-water activities, if deemed necessary. If all work associated with a particular activity takes place above the High Tide Line (HTL), an observer will not be required for that element of the Proposed Action.** **b) Observations will begin each day 30 minutes prior to the start of in-water activities:** **i. If no ESA-listed sea turtles or sharks are seen during the 30-minute pre-clearance survey period, Action activities may commence.** **ii. If an ESA-listed sea turtle or shark is seen during the 30-minute pre-clearance survey period, the observer will notify the Project Manager immediately and monitor the animal. If the animal is within 46 meters (50 yards) of the in-water activity, animal behavior observations will be recorded. Work will not begin until the animal departs the area voluntarily or after 30 minutes have passed since the last animal sighting.** **iii. During in-water activities, the observer will record environmental and action-related information, including but not limited to date, time, weather, action undertaken, status and effectiveness of BMPs, and ESA-listed marine species observed.** **iv. During in-water activities, all in-water work shall stop when an ESA-listed sea turtle or shark approaches or is sighted within 46 meters (50 yards) of the proposed in-water work. Work shall begin/resume after the animal has departed the area voluntarily or after 30 minutes have passed since the last animal sighting.**

v. If and when impact pile driving occurs with 36-inch or smaller steel pipes, a shut-down zone of 120 m (131 yd) will be implemented. All in-water work shall stop when an ESA-listed sea turtle or shark approaches or is sighted within 120 m of the in-water work.

vi. All sightings of ESA-listed marine species shall be recorded.

2. No in-water construction will take place after dark. Off-loading of CAUs from waterside barges to the breakwater will be allowed after dark.

3. **Naval Base Guam will document and report monthly to the National Marine Fisheries Service (NMFS) on all interactions with ESA-listed sea turtles or sharks. NBG will also document any incidents where anchoring, CAU deployment, or other project activities has a direct impact to the benthic community, as reported by the contractors.**

a. The following people will be points of contact for these reports:

i. Mr. Ed Moon, NBG Environmental Director

ii. Maria Santos, NBG Conservation Lead

B. During in-water activities, the following measures will be implemented to reduce the potential for collisions with mobile ESA-listed species:

1. Vessel operators will halt or alter course to remain at least 46 meters (50 yards) away from ESA-listed marine animals.
2. **Vessel operators will reduce vessel speed to 10 knots or less when piloting vessels in the proximity of marine mammals and to 5 knots or less when piloting vessels in areas of known or suspected sea turtle activity. Operators will be particularly vigilant to watch for sea turtles at or near the surface in areas of known or suspected sea turtle activity.**
3. If approached by an ESA-listed marine animal, the vessel operator will put the engine in neutral until the animal is at least 15.2 meters (50 feet) away and then slowly move to 46 meters (50 yards) away from the animal.
4. Vessel operators will not encircle or trap ESA-listed marine animals between multiple vessels or between vessels and the shore or breakwater.
5. Barge and vessels will utilize existing deep water transportation corridors as possible, and while transiting in shallower water, there will be observers on the boats for navigating around corals or sensitive benthic habitat.

C. During in-water activities, the following measures will be employed to reduce potential direct physical impacts on ESA-listed species:

1. No personnel will attempt to disturb, touch, ride, feed, or otherwise intentionally interact with any protected species. Entangled animals will be freed and photographed if possible, and each incident will be reported to NMFS. Entanglement is not expected because the work area will be monitored and BMPs to reduce entanglement from materials in the water (see BMP C.5. and C.6. below), and therefore, no take for entanglements is requested.
2. All personnel will stay more than 46 meters (50 yards) away from sea turtles, in the unlikely event they haul out on land in proximity to construction activities.
3. **Before any equipment or material enters the water, the Contractor will verify that no ESA-listed species are in the area where equipment (e.g., silt curtains [to be used only where practicable], anchor(s), or materials) are expected to contact the seabed.**
4. All objects lowered to the bottom will be lowered or installed 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.
5. In-water tethers and mooring lines for vessels, marker buoys, and silt curtains (to be used only where practicable) will be kept to the minimum lengths necessary and will remain deployed only as long as needed to accomplish the task.
6. 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 from the Action Area if not actively being used.

D. During in-water pile driving activities, the following measures will be applied to protect ESA-listed species:

1. **A soft start procedure would 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.**
2. **If practicable, vibratory hammering and/or the use of a cap shall be used to minimize the impact of noise on marine species. When feasible, measures shall be implemented that attenuate the sound or minimize impacts to aquatic resources during pile installation.**

BMPs to Avoid and Minimize Effects on ESA-listed Corals and EFH

E. All in-water activities, including coral translocation and mitigation work, will cease during the primary Guam coral spawning event for soft (order Alcyonaria) corals. **All in-water activities, including coral translocation and mitigation work, will cease during the primary Guam coral spawning events each year for hard (order Scleractinia) corals.** The total coral spawning period is estimated to be approximately 44 days each year, including 8 days prior to the full moon and 14 days after (Richmond and Hunter 1990):

Estimated Coral Spawning Events for Soft (order Alcyonaria) and Hard (order Scleractinia) Guam Corals

Year	Soft Corals		Hard Corals	
	Date of Full Moon	Estimated Spawning Period	Date of Full Moon	Estimated Spawning Period
2025	May 12	May 4–May 26	July 10	July 2-July 24
2026	May 01	April 23–May 15	July 29	July 21–August 12
2027	May 20	May 12-June 03	July 18	July 10–August 01
2028	May 08	April 30–May 22	July 06	June 28–July 20
2029	May 27	May 19–June 10	July 25	July 17–August 08
2030	May 17	May 09–May 31	July 14	July 06–July 28

F. The development and adherence to an Inclement Weather and Typhoon Contingency Plan must include a large swell plan whereby in-water activities will be conducted during safe weather conditions (i.e., calm seas) and will cease during high surf, winds, or currents. 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 typhoons), equipment will be either removed from the Project site or adequately secured. Guam utilizes the severe weather alert system levels I-IV (provided below). A Condition Level IV is the lowest alert level and indicates a possible threat of destructive winds within 72 hours and a Condition Level 1 is the highest alert that indicates destructive winds are expected 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 Condition Level 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.

1. Guam Typhoon Conditions:
    - i Condition Level I: A typhoon is expected to hit the island within 12 hours.
    - ii Condition Level II: A typhoon is expected to hit the island within 24 hours.
    - iii Condition Level III: A typhoon may possibly hit the island within 48 hours.
    - iv Condition Level IV: Guam is always in Condition IV. A typhoon may develop and hit the island within 72 hours.
2. Spud barges located in the inner harbor will be either relocated to a more sheltered interior area or transit offshore in the event of inclement weather.

G. Equipment (e.g., moorings, anchors, chains) will be placed in soft sediment only, and selection of anchor locations will take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. If practicable, all intertidal work will be conducted at low and/or slack tides.

H. Where applicable, divers will check anchor deployment and shift anchors to another location, if needed, to ensure that they are not a threat to corals or seagrass.

I. All construction-related equipment must be operated and anchored to avoid impacting sensitive marine habitat or contacting coral reef resources during in-water activities or extreme weather conditions:
   1. Anchors, anchor chains, wire ropes, and associated anchor rigging from construction-related vessels must be restricted to designated anchoring areas within the construction footprint (i.e., soft bottom) or within the area that will be permanently impacted.
   2. While in water depths where the draft of the vessel provides less than a 2 m (6 ft) clearance, all vessels should operate at "no wake/idle" speeds at all times and should preferentially follow deep-water routes (e.g., marked channels) whenever possible. If operating in shallow water, all vessels should have a crewmember serve as a dedicated lookout to assist the pilot with avoiding large coral colonies and other benthic organisms that might extend up from the bottom.
   3. Contractors will be required to obtain a permit under 8 GAR Chapter 13 prior to the loading of sand, quarried, or mined products on a vessel bound for Guam. Out of comity, Guam Executive Order (EO) 91-37, Amendment to EO No. 91-16 Relative to the Importation of Sand and Other Quarried Products), all vessels and equipment (including barges and cranes) will be free from fouling organisms before entering Guam's coastal waters.

BMPs to Avoid and Minimize Effects from Water Pollution

J. A Storm Water Pollution Prevention Plan (SWPPP) will be developed by the Construction Contractor to reduce on-site erosion and sedimentation. The SWPPP will include, at a minimum, the following BMPs:

1. Silt socks, filter fabric, or an approved equivalent will be used around out-of-water repair sites along the Glass Breakwater.
2. **An Oil Spill Contingency Plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout the construction of the Project:**
   a) Oil or other hazardous substances will be prevented from seeping into the ground or entering any drainage inlet or local bodies of water.
   b) 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 percent freeboard for precipitation) in the event of an accidental release.
   c) Fueling of Project-related vehicles and equipment will take place at least 46 meters (150 feet) away from the water and within a containment area, preferably over an impervious surface. With respect to equipment that cannot be fueled on land, spill prevention booms will be employed in the water to contain potential spills. All fuel spilled will be cleaned up immediately.
   d) Lubricants and excess oil will be disposed of in accordance with applicable federal, territorial, and local regulations, laws, ordinances, and permits.
   e) Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.
   f) All Project-related materials and equipment placed in the water will be free of pollutants and visually inspected for AIS.
   g) All equipment would be maintained in accordance with the manufacturer's specifications and daily pre-work inspections of heavy equipment for cleanliness and leaks will be conducted. All heavy equipment operations will be postponed or halted until leaks are repaired and equipment is cleaned.
   h) All Project-related debris and other waste will be contained and will not enter or remain in the marine environment.

3. For all in-water activities that require staging materials in the marine environment and/or be supported by divers (e.g. coral translocation), the Navy will ensure that these activities avoid any unnecessary contact with marine organisms, and avoid exposing corals directly or indirectly to taxicopathological agents (which includes sunscreens with harmful chemicals like oxybenzone, avobenzone, and oxycrylene).

BMPs to Avoid and Minimize Effects on In-Water Sedimentation

K. Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices (to be used only where practicable), and curtailment of work during adverse weather and tidal/flow conditions:

1. Full-length silt curtains will be installed immediately adjacent to and around the area of active work within outer Apra Harbor (i.e., the inner wall of Glass Breakwater and Sumay Marina), at all times to isolate and contain the in-water work area and prevent turbid water from flowing outside the project area. Silt curtains will completely enclose the area of active inner Breakwater repair actions to the maximum extent practicable to reduce effects on water quality. Silt curtains will not be used along the outer wall of Glass Breakwater due to rough environmental conditions that do not allow for their safe and effective deployment, and will not be used at Sumay Cove Revetment, because there will be no/minimal disturbance of the bottom at this location.
    a. Silt curtains will be deployed in a manner to avoid contact with corals.
2. The Construction Contractor must continuously monitor to ensure that control measures are in place and functioning properly.
3. If a visible plume is observed outside the silt curtains, construction activity will be suspended and evaluated, and corrective measures will be taken.
4. Activity may resume after a problem is corrected.
5. As practicable, work will be conducted during calm seas with work stoppages during high surf, winds, and currents.
6. Any changes made to these silt curtain plans and/or BMPs by the contractor will be relayed through the Navy to NMFS.

BMPs for Vessel Transits to Guam

L. 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.

M. Operators will be particularly vigilant to watch for marine mammals, pinnipeds, and sea turtles, and remain at least 50 yd (45.7 m) from ESA-listed marine species (120 m when impact pile driving).

N. Vessels will follow established transportation channels whenever practicable.

O. Vessels will be free of AIS in accordance with Guam Executive Order 91-37 and will follow proper Navy ballast water procedures stated in the OPNAV 5090.1. There will be no discharge of oils, fuels, or chemicals to surface waters; fuel hoses, transfer valves, etc. will be checked regularly for fossil fuels.

BMPs for Work on the Inner Breakwater

P. For use of the spud barge at each of its locations, there will be accurately positioned locations using GPS equipment to ensure the spud legs do not contact coral reef habitat, and will be dropped in soft sandy/silty bottom only and devoid of seagrass. Contractors may use depth/bottom sounders, visual assessments, divers, and/or other methods as needed in order to confirm bottom type.

Q. Concurrence with all parties involved in design and environmental regulations will be ensured on locations and details of proposed mooring anchorages that will be utilized for the duration of the project.

R. Periodic distribution of mooring diagrams showing planned vessel locations along with method of anchorage will be approved (updated daily or weekly) by all parties.

S. Mooring and/or anchoring will not occur during adverse weather conditions that may move or disrupt equipment, including typhoons.

T. Work platforms and barges will be oriented to minimize shading to the most reasonable extent practicable. The Navy will attempt to position vessels so that the path of the sun will cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.

BMPs for Work Associated with Seagrass Restoration

U. Divers and any other in-water workers will avoid trampling, ripping, and other harm of areas with healthy seagrass or other corals and benthic organisms.

V. In the event of a nursery to grow seagrass prior to outplanting, proper consideration will be taken with respect to drainage and effluence into coastal waters.

BMPs to Avoid and Minimize Effects of Fugitive Dust

W. No person shall cause or permit visible fugitive dust to become airborne without taking reasonable precautions. Examples of reasonable precautions are:

1. Use of water or suitable chemicals for control of fugitive dust in the demolition of existing buildings or structures, construction and retrofitting operations, the grading of roads, or the clearing of land;
2. Application of asphalt, water, or suitable chemicals on roads, material stockpiles, and other surfaces that may allow the release of fugitive dust;
3. Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. Reasonable containment methods shall be employed during sandblasting, spray painting, or other similar operations;
4. Construction and operation of the concrete casting yard would implement BMPs to manage fugitive dust. BMPs to prevent fugitive dust could include the following:
   a) Emissions from silos, weigh hoppers and mixers would be controlled to the extent practicable, potentially employing fabric filters or baghouses.
   b) Fugitive emissions from materials handling and loading would be controlled with shrouds, suction, wetting, or best management practices (BMPs)
   c) Covering, paving, spraying construction access roads to minimize dust at the casting yard.
5. Covering all moving, open-bodied trucks transporting materials that may release fugitive dust;
6. Maintenance and sealing of roadways and parking lots to prevent the exposure of such surfaces to wind, water, or vehicular travel erosion, as applicable; and
7. Prompt removal of earth or other materials from paved streets that have been transported there by trucking, earth-moving equipment, erosion, or other means.
8. Use of diesel particulate filters and diesel oxidation catalysts in equipment.
9. Limiting heavy-duty diesel vehicle idling times.

BMPs to Avoid and Minimize Effects of Noise

X. Nearly all noise would be limited to normal working hours and would return to ambient levels at the conclusion of the construction, and no pile driving would occur outside of daytime work hours or within 50 feet of any occupied vessels.

Y. The Project would use low-noise emission products, as certified by the USEPA.

Z. For impact hammers used during pile driving, the power of the hammer would be reduced to minimum energy levels necessary, reducing the amount of noise produced in the marine environment.

AA. All construction-related boats would follow the "No Wake" restriction in Sumay Cove.

BMPs to Avoid and Minimize Effects on Moorhen

BB. Mariana moorhen and nest surveys shall be performed by dedicated staff who has been trained in the identification of Mariana moorhen and nest survey procedures. This staff's sole responsibility will be to monitor and survey for wildlife. Mariana moorhen and nest surveys shall be performed no more than 3-days prior to initiating in-water construction activities.

CC. Any documented nests or broods within the project vicinity shall be reported to the USFWS within 48 hours.

DD. A trained monitor shall be present during in-water construction activities at all sites that have Mariana moorhens and/or nests, as identified during pre-construction surveys.

EE. A 100-foot buffer shall be established and maintained around all active nests and/or broods until the chicks have fledged.

FF. Should a Mariana moorhen be observed within the project site, or flies into the site all work within 100 feet of the individual(s) shall stop. Work shall not resume until the Mariana moorhen(s) leave the area on their own accord.

GG. An annual report providing the results of Mariana moorhen nest surveys and monitoring shall be submitted to the USFWS.

REGULATORY CONSULTATION AVOIDANCE, MINIMIZATION, AND MITIGATION REQUIREMENTS

CZMA Consistency Review: Department of Agriculture (DOAG) and Guam EPA Development and Resource Policy Requirements [2]

Development Policy 8. Erosion and Siltation.

DOAG comments:

1. Erosion control measures such as silt curtains, sediment barriers, and temporary berms should be implemented during construction to prevent sediment from entering the water. The project should also avoid working during stormy weather or high-tide events to reduce the risk of sediment displacement.

Guam EPA comments:

1. Comply with the Guam Soil Erosion and Sediment Control Regulations (22 GCA Chapter 10); and apply, to the maximum extent practicable, the erosion and sediment control standards to prevent adverse impacts from construction site runoff (2006 CNMI/Guam Stormwater Management Manual, Volume I).
2. Secure permits and install best management practices prior to the start of the project.
3. Ensure that each laydown area is permitted and that appropriate erosion and sediment control measures and BMPs are in place prior to use. Stormwater runoff must also be managed and pretreated prior to discharge. The concrete casting yard is classified as an industrial activity; therefore, the contractor must provide a stormwater pre-treatment system using the hotspot design criteria and standards (Chapter 2 Volume I, 2006 CNMI/Guam Storm water Management Manual).
4. Stabilize sloped areas to reduce soil erosion.
5. Submit required plans for approval by Guam EPA including Erosion Control Plan, Stormwater Runoff Drainage System Plan, and an Environmental Protection Plan.
6. If the project is covered under the Federal Storm Water Regulations (40 CFR Parts 122 & 123), a notice of intent to discharge storm water to surface and marine waters of Guam must be submitted to USEPA

and a copy furnished to Guam EPA. An NPDES permit which authorizes the discharge must also be secured.

Pursuant to Development Policy 8, Erosion and Siltation, the federal agency shall:

(1) Comply with the Guam Soil Erosion and Sediment Control Regulations, 22 GAR Chapter 10.

(2) Comply with the Stormwater Management Criteria for Guam (2006 CNMI Guam Stormwater Management Manual).

(3) Consult with Guam EPA to secure required permits prior to the commencement of the project.

(4) Implement best management practices (BMPs) to stabilize disturbed slopes, preventing sediment from entering the water and reducing soil erosion and runoff from the construction site.

(5) Manage and pretreat stormwater runoff prior to discharge.

(6) Be advised to consult with the Guam EPA for the following:

a. Erosion Control Plan, Stormwater Runoff Drainage System Plan, and Environmental Protection Plan; and

b. If the project falls under the Federal Storm Water Regulations (40 CFR Parts 122 & 123), a notice of intent to discharge storm water to surface and marine waters of Guam must be submitted to the USEPA, with a copy provided to Guam EPA. Additionally, an NPDES permit authorizing the discharge is required and must be obtained before any discharge occurs; and

c. Provide a stormwater pre-treatment system using the hotspot design criteria and standards (Chapter 2, Volume I, 2006 CNMI Guam Stormwater Management Manual).

Resource Policy 1. Conservation of Natural Resources.

DOAG presents these comments:

1. The repair activities might result in temporary or permanent loss of habitats used by marine species and coastal vegetation. Therefore, an environmental impact assessment should be completed to determine the extent of potential habitat loss or fragmentation, with mitigation measures, such as habitat restoration plans or replanting efforts.
2. A plan to avoid working during sensitive periods for marine life (e.g. spawning or breeding seasons) should also be considered.
3. A hazardous materials management plan should be in place to ensure proper handling, storage, and disposal of materials. Additionally, spill response protocols must be established to quickly address any accidental releases into the environment.

Pursuant to Resource Policy 1, Conservation of Natural Resources, the Federal Agency shall:

(1) Be advised to develop an environmental impact assessment to address marine species, coastal vegetation, habitat loss, and spawning or breeding seasons.

(2) Be advised to implement protocols to prevent spills and manage hazardous materials.

Resource Policy 2. Air Quality.

Guam EPA comments:

1. Criteria pollutant emissions associated with the proposed action must comply with Guam Air Pollution Control Act, 10 GCA Chapter 49.
2. Dust control and maintenance measures must be implemented for the entirety of the project.

Pursuant to Resource Policy 2, Air Quality, the federal agency shall:

(1) Comply with the Air Pollution Control Act, 1 O GCA Chapter 49.

(2) Comply with the Guam Hazardous Waste Management Regulations.

(3) Implement dust control and maintenance measures for the duration of the project.

Resource Policy 3. Water Quality.

Guam EPA comments:

1. The installation of respective stormwater systems must comply with design criteria in the 2006 CNMI/Guam Stormwater Management Manual.
3. To avoid construction activity water quality impacts, all project equipment must be managed such that pollution control measures and BMPs are carefully applied to control hydraulic fluid spills and/or oil leaks from cranes and all other equipment.
2. Spill prevention kit(s) must be readily available on site. Proper housekeeping must also be strictly implemented to prevent the transport of contaminants by stormwater runoff onto the ground.

3. No construction equipment is allowed to be located directly in surface or marine waters.
4. Any debris and waste generated during construction must be disposed of at a Guam EPA permitted site and must adhere to the requirements of the Guam Solid Waste Disposal and Collection Regulations. (22 GAR Chapter 20 and 21)
5. Guam EPA is concerned about the exposure of emerging contaminants during earth moving activities. Thorough soil testing, proper handling and disposal of any contaminated soils must be strictly implemented to avoid contamination of surface and/or marine waters.
6. Discharges that would cause or contribute to violations of any applicable G WQ S. or cause or contribute to significant degradation of the waters of Guam is prohibited.
7. (22 GAR 5). Additionally. water quality criteria stated in Section 51 03(a) shall be strictly complied with.

Pursuant to Resource Policy 3, Water Quality, the federal agency shall:

(1) Comply with the Water Pollution Control Act, 10 Guam Code Annotated (GCA) Chapter 47.
(2) Comply with the Guam Stormwater Management Manual Criteria for stormwater systems.
(3) Be advised to consult with the Guam Seashore Protection Commission on matters that may be applicable to the Guam Seashore Protection Act to ensure compliance.
(4) Comply with the Guam Hazardous Waste Management Regulations.
(5) Comply with the Soil Erosion and Sediment Control Regulations by:
a. Implementing BMPs for erosion and sediment control and stormwater management.
(6) Implement spill prevention measures during site preparation and throughout the construction period to prevent oil and chemical leaks.
(7) Maintain spill kits on-site; and enforce strict housekeeping to prevent contaminants from spreading.
(8) Dispose of all construction debris and waste at a Guam EPA-permitted site in full compliance with 22 GAR Chapters 20 and 21.
(9) Be advised to consult with Guam EPA on:
a. Complying with the Guam Water Quality Standards to prevent water degradation from discharges.
b. Soil testing, proper handling, and disposal of contaminated soils.
(10) Construction equipment is strictly prohibited from being placed in surface or marine waters.

Resource Policy 4. Fragile Areas.

Pursuant to Resource Policy 4, Fragile Areas, the federal agency shall:

(1) Comply with the Endangered Species Act of Guam, 5 GCA Chapter 63 Article 2.
(2) Comply with the Historical Objects and Sites, 21 GCA Chapter 76.
(3) Employ best management practices for the conservation of marine and terrestrial ecosystems.
(4) Be advised to implement habitat and conservation efforts that may include but not limited to endangered species safeguards, monitoring and compliance.

Resource Policy 7. Recreational Areas.

DOAG comments:

1. During the construction period, notice for alternative sites must be provided to the community.

Pursuant to Resource Policy *7,* Recreational Areas, the federal agency shall:

(1) Comply with Guam Beach Areas, 21 GCA Chapter 64
(2) Provide notice to the community about the duration and locations of closed-off areas.

Resource Policy 8. Public Access.

DOAG comments:

1. Safe access must be granted to fishers during the seasonal fish runs. Signage must be posted around the construction site to deter any unauthorized entry.

Pursuant to Resource Policy 8, Public Access, the federal agency shall:

(1) Comply with Public Access to the Ocean Shore, 21 GCA Ch. 65.

Magnuson-Stevens Act Consultation: NMFS EFHA Mitigation Measures and Conservation Recommendations (CR) [1, 2, 3]

EFH Mitigation Actions:

EFH-1: Restore seagrass habitat

EFH-2: Enhance habitat that promotes coral settlement with crustose algae as summarized in the following as specified in the BO (PIRO-2025-00832):

(1) Avoidance Measure: Reducing footprint from new trench to relic toe
(2) Avoidance Measure: Use a shuttle barge to avoid building a temporary trestle in the inner breakwater
(3) Minimization Measure: Translocate coral (target moving approximately 902 colonies)
(4) Minimization Measure: Remove algal growth on coral after translocation (primary focus on area where coral is transplanted)
(5) Minimization Measure: Reattach transplanted coral that becomes dislodged after translocation (all broken coral >8cm that has at least 20% living tissue)
(6) Offset Measure: Seagrass restoration at Dadi Beach (up to 9 acres [36,800 m^2] of seagrass meadow restoration)[4]
(7) Offset Measure: Crustose coralline algae (CCA) spreading at Glass breakwater (approximately 0.002 acres [1 m^2] presumed over the course of 30 years.

EFH Conservation Recommendations:

EFH-CR-1: The Navy should develop conservation specific evaluation criteria (i.e., risks to benthic organisms from spills, increased turbidity, direct physical impacts, corridor interactions, etc.) for all ten of the proposed fabrication and staging locations and only use those locations that pose the smallest risk.

EFH-CR-2: To ensure that aquatic invasive species are not introduced at any stage of the project (e.g., shipping of materials, boating, deployment of CAU's, etc.), the Navy should coordinate with and follow the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP). The JRM INRMP contains comprehensive objectives and actions that define and implement invasive species management, which begins through prevention, then addresses early detection and monitoring, and finally control and eradication.

EFH-CR-3: To minimize the impact of diver operations, the Navy should familiarize divers, dive support, and vessel crew with underwater terrain features including shallow areas where there is a potential for vessel hull, propellers and divers to be in contact with the shallow reef areas such as near the trench walls.

EFH-CR-4: To minimize the risk of additional coral tissue loss, disease, or predation, the Navy should close injuries to any large Porites sp. corals (e.g., damage sustained to *Porites* species during anchoring, staging, or deployment activities) with coral safe epoxy or clay.

EFH-CR-5: The Navy should not start any in-water construction activities until NMFS has approved the final mitigation plans (e.g., coral translocation plan, seagrass restoration plan, and CCA transplantation plan). NMFS should be given the opportunity to advise and/or provide additional CRs specific to the mitigation plans, including but not limited to recommendations related to seagrass and CCA collection, transplantation/translocation methods, monitoring, offset evaluation sufficiency (i.e., survivorship and/or demonstrated ecosystem recovery), and comprehensive impact avoidance measures (i.e., BMPs) that address all phases of the proposed restoration action.

EFH-CR-6: Coral translocation, seagrass and algae transplantation, and marine monitoring all require a high level of expertise and should only be performed by experts (i.e., led by a PhD or team lead with similar experience) using well documented and replicable methods (i.e., following guidance from recent literature and focusing on work previously performed within the Pacific region). Any planned deviation from the minimization or offset approach outlined within the EFHA or changes to the future mitigation planning documents should be socialized with NMFS before work begins.

EFH-CR-7: The Navy should attempt to translocate and document all corals that meet the translocation criteria defined within the EFHA. That is likely to mean that coral colonies beyond the estimated 902 colonies may be identified.

EFH-CR-8: To ensure that the translocation of coral colonies is meeting early survivorship targets, the Navy should work with NMFS to develop appropriate monitoring schedules and protocols and provide a monitoring report to NMFS after each monitoring event. Each report should clearly document the performance between coral morphology types, colony sizes, and translocation location (i.e. if the corals are not all translocated to the same location). If survivorship of translocated corals does not meet the 60% survivorship target (as compared to control sites) at the end of the survey period, the Navy should coordinate with NMFS to discuss the potential need for additional offset.

EFH-CR-9: The Navy needs to decide whether the development of a coral nursery is going to be part of the mitigation package for this action and if/how the development of a nursery will be factored into reaching the offset requirements. Development of a new coral nursery will also require an additional consultation with NMFS and coordination with the U.S. Army Corps of Engineers as it will require the installation of new structures within the navigable waters of the United States. Methods/procedures for tracking the amount of coral that comes into the nursery and the amount of coral that is outplanted from the nursery to the environment will need to be developed and recorded. The goal will be to track and report when the nursery's output exceeds the input from received corals. Corals that are growing in the nursery are not creditable until they are outplanted and survive for a period of time in the natural environment.

EFH-CR-10: To ensure that the proposed offset from the Habitat Equivalency Analysis [3] (HEA; developed by NMFS and the Navy during the EFH Consultation) is effective, the Navy should develop a plan for implementation that would quantify seagrass restoration success at Dadi Beach. These data could then be integrated into a follow-up modelling effort to determine if recovery is matching rates and targets used within the original HEA, and that ecosystem function is being effectively offset. To support this effort, the Navy should consider coordinating this monitoring plan with the actions listed within the 2024 JRM INRMP, Marine Habitat Management section. If the 2024 JRM INMRP is not prescriptive enough to meet the needs of this specific consultation, then the Navy should consider including Dadi Beach seagrass surveys within the next update to the JRM INRMP.

EFH-CR-11: Should the proposed mitigation strategies fall short of conservation targets at any time (i.e., whether during initial execution, after early monitoring, or following a future HEA analysis), the Navy should coordinate with NMFS and develop a contingency plan/project to ensure all lost ecosystem services and functions are accounted for before mitigation is considered final.

ESA Section 7: NMFS Required Mitigation Measures[1]

ESA Mitigation Actions

ESA-BO-1: The Contractor will comply with the following monitoring requirements:

a. From the Breakwater, a competent observer will use binoculars to monitor the action area for ESA-listed sea turtles and scalloped hammerhead sharks during all in-water activities. If all work associated with a particular activity takes place above the High Tide Line (HTL), an observer will not be required for that element of the Proposed Action.
b. Observations will begin each day, 30 minutes prior to the start of in-water activities:
    i. If no ESA-listed sea turtles or sharks are seen during the 30-minute pre-clearance survey period, in-water activities may commence.
    ii. If an ESA-listed sea turtle or shark is seen during the 30-minute pre-clearance survey period, the observer will notify the Project Manager immediately and monitor the animal. If the animal is within 46 m (50 yards [yds.]) of the in-water activity, animal behavior observations shall be recorded. Work will not begin until the animal departs the area voluntarily or after 30 minutes have passed since the last animal sighting.
    iii. During in-water activities, the observer will record environmental and action-related information, including but not limited to date, time, weather, action undertaken, status and effectiveness of BMPs, and ESA-listed marine species observed.
    iv. During in-water activities, all in-water work shall stop when an ESA-listed sea turtle or shark approaches or is sighted within 46 m (50 yds.) of the proposed in-water work. Work shall begin/resume after the animal has departed the area voluntarily or after 30 minutes have passed since the last animal sighting.
    v. If and when impact pile driving occurs with 36" or smaller steel pipes, a shut-down zone of 120 m (131 yds.) will be implemented. All in-water work shall stop when an ESA-listed sea turtle or shark approaches or is sighted within 120 m of the in-water work.
    vi. All sightings of ESA-listed marine species shall be recorded.

ESA-BO-2: NBG will document and report monthly to NMFS on all interactions with ESA-listed sea turtles or sharks. NBG will also document any incidents where anchoring, CAU deployment, or other project activities has a direct impact to the benthic community, as reported by the contractors.

ESA-BO-3: Vessel operators will reduce vessel speed to 10 knots or less when piloting vessels in the proximity of marine mammals and to 5 knots or less when piloting vessels in areas of known or suspected sea turtle activity. Operators will be particularly vigilant to watch for sea turtles at or near the surface in areas of known or suspected sea turtle activity.

ESA-BO-4: Before any equipment or material enters the water, the Contractor will verify that no ESA-listed species are in the area where the equipment (e.g., silt curtain (to be used only where practicable), anchor(s), or materials) are expected to contact the seabed.

ESA-BO-5: During in-water pile driving activities, the following measures will be applied to protect ESA-listed species:

a. A soft start procedure would 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.
b. If practicable, vibratory hammering and/or the use of a cap shall be used to minimize the impact of noise on marine species. When feasible, measures shall be implemented that attenuate the sound or minimize impacts to aquatic resources during pile installation.

ESA-BO-6: All in-water activities, including coral translocation and mitigation work, will cease during the primary Guam coral spawning events each year for hard (order Scleractinia) corals.

ESA-BO-7: A Storm Water Pollution Prevention Plan (SWPPP) will be developed by the Construction Contractor to reduce on-site erosion and sedimentation.

ESA-BO-8: An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout construction of the project.

ESA-BO-9: Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment de-vices (to be used only where practicable), and curtailment of work during adverse weather and tidal/flow conditions

Additional Terms and Conditions Specified in the ESA Section 7 BO (PIRO-2025-00832):

In order to be exempt from the prohibitions of Section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action may lapse.

Reasonable and Prudent Measure 1: The Navy shall ensure the proposed action has a monitoring and reporting program sufficient to confirm the amount and extend of take are not exceeded, and that the terms and conditions in the **Incidental Take Statement (ITS)** are effective in minimizing incidental take. The following terms and conditions implement Reasonable and Prudent Measure 1:

ESA-BO-ITS-1: The Navy shall establish record keeping and reporting standards for these data collections and provide an annual summary to NMFS PRD to track the take and transplantation and propagation efforts of *A. globiceps*.

ESA-BO-ITS-2: The Navy shall work with NMFS to develop appropriate monitoring schedules and protocols for a coral translocation plan prior to implementation of the action. If survivorship of translocated corals from subsequent monitoring reports does not meet the 60% survivorship target (as compared to

	control sites) at the end of the survey period(s), the Navy shall coordinate with NMFS to determine if additional steps can be taken to improve survivorship.
ESA-BO-ITS-3:	The Navy shall provide annual reports to NMFS by the end of December of each year that detail the results of the monitoring efforts for the previous calendar year.
ESA-BO-ITS-4:	The Navy shall also coordinate and report all related metrics to the Joint Region Mariana Integrated Resources Management Plan partners at the annual metrics meetings so long as the project or nursery related activities occur.

Table Notes:

[1] See **Appendix C** for the full MSA EFH and ESA Section 7 consultation documents from NMFS. Text in **bold blue font** reflects the BMPs that were specified in the ESA Section 7 Biological and Conference (BO, PIRO-2025-00832) and associated ITS.

[2] The comments and recommendations provided in the Coastal Zone Management Act Coastal Consistency Determination (CZMA CCD) and the Conservation Recommendations included in the NMFS MSA EFHA Response are advisory in nature and not mandatory. They will be implemented where feasible and applicable. In contrast, the BMPs and AMMs and Terms and Conditions specified in the BO are mandatory and must be implemented to comply with the terms of the BO and fulfill obligations under the Endangered Species Act (ESA).

[3] Mitigation actions for EFH offset reflect Navy and NMFS early coordination to develop a Habitat Equivalency Analysis (HEA) model designed to quantify the interim loss of ecosystem services and function associated with the adverse effects of the Proposed Action, which facilitated development of a quantifiable strategy focusing on EFH area replacement. The HEA output defined the EFH replacement area at 315,460.58 square feet.

[4] Acreage of seagrass replacement habitat includes a 30 percent buffer to account for the percentage of seagrass that may not survive and to still accomplish successful replacement of the 315,460.58-square-feet of EFH as agreed through MSA EFH consultation.

3 Affected Environment and Environmental Consequences

This chapter presents a description of the environmental resources and baseline conditions that could be affected by implementing any of the alternatives and an analysis of the potential direct and indirect effects of each alternative.

3.1 Introduction

All potentially relevant environmental resource areas were initially considered for analysis in this EA. In compliance with the NEPA and DoN guidelines, the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

"Significantly," as used in NEPA, requires considerations of both context and intensity. Context means that the significance of an action must be analyzed under several perspectives, such as society as a whole, the affected region, the affected interests, and the locality. Significance varies with the setting of a proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant. Intensity refers to the severity or extent of the potential environmental impact, which can be thought of in terms of the potential amount of the likely change. In general, the more sensitive the context, the less intense a potential impact needs to be in order to be considered significant. Likewise, the less sensitive the context, the more intense a potential impact would be expected to be significant. Additionally, regarding duration of impacts, "short-term" is generally defined as only occurring during the construction period and "long-term" is following construction over an extended period of time, e.g. years.

Sections 3.2 through **3.11** provide the affected environment discussions and impacts analyses for the following resources: air quality (including consideration of GHGs), biological resources, cultural resources, geological resources, HAZMAT and HAZWASTE, infrastructure and transportation, noise, health and safety, socioeconomics, and water resources (including consideration of coastal zone resources). **Section 3.12** summarizes the potential impacts on environmental resources. Refer to **Table 2-2** for the series of sustained compliance actions that are currently in place for NBG that would continue to be implemented under the Proposed Action in accordance with applicable regulations or DoN guidance in addition to the BMPs discussed in **Sections 3.2** through **3.11**. **Section 4.2** discusses the irreversible and irretrievable resource commitments anticipated with the implementation of the Proposed Action.

3.1.1 Resource Areas Eliminated from Further Analysis

The determination of issues to be analyzed in detail in this EA and those not carried forward for detailed analysis is part of the scoping process. No impacts or negligible impacts would be expected on the following resource areas from implementation of the Proposed Action or alternatives, and as such, they were found to not be significant and are not being carried forward for detailed analysis:

Airspace: The Proposed Action would not involve impacts to military or civilian airspace or facilities. The proposed Project location is not proximal to military or civilian airfield, or airspace. At approximately 10 miles to the northeast, A.B. Won Pat International Airport is the nearest airport to the project area. The proposed Guam Glass Breakwater Repairs would not extend into any of the airport's approach or departure surfaces. Orote Airfield is located on Orote Peninsula, over two miles to the west of the project area. It consists of improved expeditionary runways and taxiways used in field training exercises

by helicopters and some fixed-wing aircraft (DoN 2010). There is a helipad in the southeast corner of Polaris Point. Project construction equipment and operations would not impede air operations at Orote Airfield or Polaris Point. Glass Breakwater Emergency Breach Repairs operations would take place within the existing footprint of the Glass Breakwater and have no potential to affect the airspace or operations of helicopter or fixed-wing aircraft operations at Orote Peninsula or Polaris Point. Therefore, no additional analysis is required with respect to airspace impacts.

Land Use: Land use would remain the same as under existing conditions. Terrestrial components of the Project involve temporary staging areas and a CAU concrete casting yard within one of the established laydown areas already zoned for industrial uses. Therefore, land use requires no additional analysis in this EA.

3.1.2 Reasonably Foreseeable Actions

This EA analyzes the cumulative environmental impacts from the Proposed Action combined with potential impacts from reasonably foreseeable actions.

Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time. Past actions are those actions, and their associated impacts, that have shaped the current environmental conditions of the project area. Therefore, the impacts of past actions are now part of the existing environment and are included in the affected environment described in **Sections 3.2** through **3.11.** This EA considers present and reasonably foreseeable actions at NBG that could have a causal relationship to the Proposed Action and may result in cumulative impacts. These present and reasonably foreseeable actions are listed in **Table 3-1**. The cumulative effects on the environment that would result from the incremental impacts of the Proposed Action, when combined with the potential impacts of the present and reasonably foreseeable actions, are discussed qualitatively in the respective impacts section of each resource area in **Sections 3.2** through **3.11**.

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA, the study area delimits the geographic extent of the cumulative impacts analysis. In general, the study area will include those areas previously identified in respective resource areas evaluated in **Section 3**. The time frame for cumulative impacts centers on the timing of the Proposed Action.

Another factor influencing the scope of cumulative impacts analysis involves identifying other actions to consider. Beyond determining that the geographic scope and time frame for the actions interrelate to the Proposed Action, the analysis employs the measure of “reasonably foreseeable” to include or exclude other actions. For the purposes of this analysis, public documents prepared by federal, state, and local government agencies form the primary sources of information on reasonably foreseeable actions. Documents used to identify other actions include notices of intent for EISs and EAs, management plans, land use plans, and other planning-related studies.

Table 3-1. Cumulative Action Evaluation Cumulative Impact Analysis

Action	Level of NEPA Analysis Completed	Description
Past Actions		
Alpha and Bravo Wharf Improvements	EA/ FONSI	Extension of Bravo Wharf in Inner Apra Harbor and construction dredging to meet requirements of new class of submarines. Also included utility upgrades at Alpha and Bravo Wharves.
Apra Harbor Wharf Improvements	FEIS/ROD	Reconstruction of and structural upgrades to the wharf complex that was badly damaged from a 1989 earthquake. Provision and replacement of

Action	Level of NEPA Analysis Completed	Description
(Uniform & Tango, MILCON P-204)		shoreside utilities and infrastructure to accommodate Amphibious Readiness Group and Joint High Speed Vessels transient ships at Tango Wharf.
Inner Apra Harbor Maintenance Dredging	EA/FONSI	Dredging of sediment from the sea floor fronting Alpha, Bravo, Delta, Echo, Victor, X-Ray, Romeo, Sierra, Tango, and Uniform Wharves in Inner Apra Harbor to restore the original navigational depths at each wharf.
Kilo Wharf Extension	FEIS/ROD	Extension of Kilo Wharf in Outer Apra Harbor to accommodate new multi-purpose support ships (i.e., the T-AKE).
Ocean Dredged Material Disposal Site Offshore of Guam	FEIS/ROD	Permanent ocean site in the Philippine Sea for disposing of dredged material originating from Guam, including naval facilities at Apra Harbor. Disposal limited to 1,000,000 cubic yards per calendar year.
Polaris Point Beach Restoration	Record of CATEX	Repair eroded areas of the Polaris Point coastline south of the project area that were damaged by Typhoon Paka by filling the eroded areas with rock and sand in order to make the area safe for recreation.
Polaris Point Seawall Repair	CATEX	Backfill and installation of riprap to repair eroded seawall along the north shoreline of Polaris Point near Building 4446.
X-Ray Wharf Improvements – North Berth (MILCON P-518)	EA/FONSI	Construct a new earth-filled, sheet pile wharf contiguous to the existing X-Ray Wharf bulkhead, improve utilities, and dredge portions of Inner Apra Harbor and the harbor fronting X-Ray Wharf to accommodate T-AKE ships.
MILCON P-661 Navy-Commercial Tie-In Hardening	EA/FONSI	Replace the existing Navy/commercial petroleum, oil, and lubricant pipeline tie-in with a new, hardened tie-in facility within the pipeline easement causeway in the vicinity of Apra Harbor, Guam (Project implementation likely post-2022).
Underwater Electromagnetic Measurement System (RM18-1828)	EA/FONSI	Installation of passive sensor array in the navigational channel entering Inner Apra Harbor.
X-Ray Wharf Improvements – South Berth (MILCON P-519)	EA/FONSI	Second component of new earth-filled, sheet pile wharf contiguous to existing X-Ray Wharf bulkhead, including utility improvements and dredging of Inner Apra Harbor fronting X-Ray Wharf to accommodate T-AKE ships.
Present and Reasonably Foreseeable Future Actions		
Mariana Islands Training and Testing (Regional)	NEPA EIS/Overseas EIS	Continue training and testing activities within the Study Area at sea and on Farallon de Medinilla. These activities include the use of active sonar and explosives while employing mitigation measures.
Polaris Point Rock Revetment	CATEX	Supply and install stone armoring for revetment construction to prevent further coastal erosion. All work is planned above the MHHW.
Sumay Marina Entrance - Explosive Ordnance Disposal Point	CATEX	Supply and install stone or concrete armoring behind existing concrete revetment that is undermined on the backside. Work is planned above MHHW.
Lima, Mike, November Wharf Repair and Modernization	EA/FONSI	Re-face wharf and repair the wharf deck, fixtures, and electrical utilities.
MILCON P-676 Polaris Point Pier	EA/FONSI	Construction of waterfront ship repair and berthing facilities to support U.S. Navy Virginia-Class submarines. Project will also provide complete hotel services, including berthing space, mooring, power, and utilities.
Fuel Infrastructure Improvements	CATEX	Critical fuel infrastructure upgrades are being constructed at NBG and along the port area of Apra Harbor to address damage from Super

Action	Level of NEPA Analysis Completed	Description
		Typhoon Mawar and improve Guam's fuel supply chain resilience. Construction for a new fuel pipeline will be conducted off-base along Marine Corps Drive, between Polaris Point and the NBG Main Gate. The phased construction is for the new Navy fuel line from Tenjo Vista to X-Ray The NBG Main Gate will remain open during construction, and NBG will continue to monitor traffic patterns and data. During the construction period, inner lanes of both south and northbound will be closed in sections. Outer southbound and northbound lanes will remain open. There will be one lane open for traffic to flow both inbound and outbound off-base.
Oscar, Papa, Quebec, and Romeo Wharves Maintenance Dredging	EA/FONSI	Maintenance dredging Oscar, Papa, Quebec, and Romeo wharves in Inner Apra Harbor, NBG. Dredging would be performed to restore the depth of the Oscar, Papa, Quebec, and Romeo wharves to -35 feet Mean Lower Low Water.
PAG Modernization Program	EA/FONSI	New equipment, systems, and buildings; terminal modernization; new yard capacity (Outer Apra Harbor); structural refurbishment of existing docks; dredging to increase berth depths (Wharves F4–F6 in Outer Apra Harbor); land reclamation for construction of new berth (F7); 900 feet of additional berthing space; dredging of Outer Apra Harbor. Projects are within PAG-controlled areas of Cabras Island.
Repair Finger Pier	EA/FONSI	Comprehensive rehabilitation, repair, and modernization of the Finger Pier northwest of Lima Wharf, including structural repair and provision of water, electricity, and fueling utilities.
Repair Oscar, Papa, and Quebec Wharves	EA/FONSI	Restore wharves to fully functional condition as ship repair and berthing wharves meeting Department of Defense and Navy requirements.
P-835 (formerly P1103U) Lima Wharf and Inner Apra Harbor Dredge EA	EA/FONSI	Construction dredging at Lima Wharf to the required depth of -43 feet water depth and Inner Apra Harbor channel of -40 feet water depth.
Guam and CNMI Military Relocation	FEIS/ROD	Establish operational USMC presence in Guam consisting of approximately 5,000 USMC personnel and 1,300 dependents. Upgrade existing Inner Apra Harbor general-purpose wharves and utilities; create an embarkation area and amphibious vehicle/small boat laydown area (Inner Apra Harbor).

Key: CATEX = Categorical Exclusion; CNMI = Commonwealth of the Northern Mariana Islands; EA = Environmental Assessment; EIS = Environmental Impact Statement; FEIS = Final Environmental Impact Statement; FONSI = Finding of No Significant Impact; MHHW = Mean Higher High Water; NBG = Naval Base Guam; NEPA = National Environmental Policy Act; PAG = Port Authority of Guam; ROD = Record of Decision; TBD = To Be Determined; USMC = United States Marine Corps.

Where feasible, the cumulative impacts were assessed using quantifiable data; however, for many of the resources included for analysis, quantifiable data is not available, and a qualitative analysis was undertaken. In addition, where an analysis of potential environmental effects for future actions has not been completed, assumptions were made regarding cumulative impacts related to this EA where possible. The analytical methodology presented for each resource analysis in **Sections 3.2** through **3.11** was also used to determine cumulative impacts.

The analyses show that, when considered with relevant past, present, and reasonably foreseeable projects, the incremental effects of Alternative 1 would not contribute to cumulative impacts on pertinent resource areas. Because it would not contribute any incremental effects, the No Action Alternative would not result in cumulative impacts on the relevant resource areas during construction.

3.2 Air Quality and Greenhouse Gases

3.2.1 Definition of the Resource

This section evaluates potential impacts to air quality that could result from implementation of the Proposed Action. Air quality in a given location is defined by the concentration of various pollutants in the atmosphere. A region's air quality is influenced by many factors, including the type and number of pollutants emitted into the atmosphere, the size and topography of the air basin, and the local meteorological conditions.

Most air pollutants originate from human-made sources, including mobile sources (e.g., diesel-fueled vehicles) and stationary sources (e.g., concrete casting yard, refineries, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Air pollutants are also released from natural sources such as volcanic eruptions and forest fires. Some pollutants are formed through atmospheric chemical reactions from other pollutant emissions (called precursors) that are influenced by weather, ultraviolet light, and other atmospheric processes.

Greenhouse gases (GHGs) are gases that trap heat in the atmosphere. These emissions are generated by both natural processes and human activities. The accumulation of GHGs in the atmosphere helps regulate the earth's temperature. GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), tropospheric ozone, and several fluorinated and chlorinated gaseous compounds (89 *Federal Register* [FR] 31802). Each GHG has an estimated global warming potential (GWP), which is a measure used to compare the relative impact of GHGs on global warming, expressed as a factor of how much heat a GHG traps in the atmosphere over a specific time period, typically 100 years, compared to CO_2. All GHGs are multiplied by their GWP, and the results are added to calculate the total equivalent emissions of CO_2 (CO_2e). GWPs are published in 40 CFR 98 (revised April 2024). CO_2 has a GWP of 1. The GWPs of CH_4 and N_2O are 28 and 265, respectively. CO_2, and to a lesser extent, CH_4 and N_2O, are products of combustion and are generated from stationary combustion sources as well as vehicles, aircraft, and vessels. High GWP gases include GHGs that are used in refrigeration/cooling systems, such as chlorofluorocarbons and hydrofluorocarbons.

3.2.2 Regulatory Setting

3.2.2.1 Criteria Pollutants and National Ambient Air Quality Standards

The principal pollutants defining air quality, called "criteria pollutants," include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone, particulate matter (measured as suspended particulate matter less than or equal to 10 microns in diameter [PM_{10}] and fine particulate matter less than or equal to 2.5 microns in diameter [$PM_{2.5}$]), and lead (Pb). CO, SO_2, Pb, NO_2, and some particulates are emitted directly into the atmosphere from emissions sources. Ozone, NO_2, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes. Volatile organic compound and nitrogen oxide emissions are precursors of ozone and are typically used to represent ozone generation. Since the phase-out of leaded fuels in the 1970s and 1980s, Pb emissions have been negligible from the types of emission sources under this Proposed Action. As such, Pb is not included in this air quality analysis.

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS) (40 CFR part 50) for criteria pollutants. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have long-term and short-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to

protect against chronic health effects. Ambient air is defined as that portion of the atmosphere, external to buildings, to which the general public is exposed. Each Ambient Air Quality Standard (AAQS) has its own criteria, known as the "form" of the standard, related to if and how many times it may be exceeded before the AAQS is considered violated. The concentration that follows the form of the standard and that is used to compare with an AAQS is a design value. Pollutant concentrations at or near ground level are of particular interest because this is where most environmental impacts from air pollution occur.

Areas that are and have historically been in compliance with the NAAQS are designated as attainment areas. Areas that violate a federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment.

The CAA requires states to develop a general plan to attain and maintain the NAAQS in all areas of the country and a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These plans, known as a State Implementation Plan (SIP), are developed by state and local air quality management agencies and submitted to USEPA for approval.

3.2.2.2 Guam Air Pollution Control Standards and Regulations

Guam adopted AAQS are defined in 22 Guam Administrative Rules and Regulations (GARR) § 1302. Guam AAQS have been established for SO_2, particulate matter (measured as PM_{10}), CO, ozone, NO_2, and Pb. The Guam AAQS are given in terms of primary standards, which define levels of air quality necessary "with an adequate margin of safety, to protect the public health," and secondary standards, which define levels of air quality necessary "to protect the public welfare from any known or anticipated adverse effects of a pollutant." A comparison of federal and Guam air quality standards is provided in **Table 3-2**.

Table 3-2. NAAQS and Guam AAQS

Criteria Pollutant	Primary/ Secondary	Averaging Period	NAAQS		Guam AAQS	
			Level	Form	Level	Form
CO	Primary	8-hour	9 ppm	Not to be exceeded more than once per year	9 ppm	Maximum average not to be exceeded more than once per year
	Primary	1-hour	35 ppm		35 ppm	
SO_2 [1]	Primary	1-hour (2010)	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	–	–
	Secondary	Annual	10 ppb (2024)	Annual mean, averaged over 3 years	0.5 ppm (2010)	Maximum average not to be exceeded more than once per year
	Primary	Annual (1971)	–	–	0.03 ppm	Annual mean
	Primary	24-hour (1971)	–	–	0.14 ppm	Maximum average not to be exceeded more than once per year
NO_2	Primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	–	–
	Primary and secondary	Annual	53 ppb	Annual mean	53 ppb	Annual mean
Ozone	Primary and secondary	8-hour	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years	–	–
	Primary and secondary	1-hour	–	–	0.12 ppm	Maximum average not to be exceeded more than once per year
$PM_{2.5}$	Primary	Annual	9 µg/m^3	Annual mean, averaged over 3 years	–	–
	Secondary	Annual	15 µg/m^3		–	–
	Primary and secondary	24-hour	35 µg/m^3	98th percentile, averaged over 3 years	–	–
PM_{10}	Primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years	150 µg/m^3	Maximum average not to be exceeded more than once per year
	Primary and secondary	Annual	–	–	50 µg/m^3	Annual mean
Pb [2]	Primary and secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded	1.5 µg/m^3	Maximum mean averaged over a calendar quarter

Sources: 40 CFR 50, 22 GARR § 1302 (November 2023)

Key: ppb = parts per billion, ppm = parts per million, µg/m^3 = micrograms per cubic meter

Notes: [1] The EPA first established primary SO_2 standards in 1971 at 140 ppb over a 24-hour averaging period and at 30 ppb over an annual averaging period (36 *Federal Register* 8186). In 1996, USEPA retained the 1971 standards without revision (61 *Federal Register* 25566). In 2010, the USEPA revised the primary NAAQS for SO_2 and revoked the two 1996 primary standards (0.03 ppm annual standard and 0.14 ppm 24-hour standard, as identified in 40 CFR § 50.4) because they would not provide additional public health protection given the revised 1-hour standard at 75 ppb.

[2] In areas designated nonattainment for the Pb standards prior to the promulgation of the current (2008) standards, and for which implementation plans to attain or maintain the current (2008) standards have not been submitted and approved, the previous standard (1.5 µg/m^3 as a calendar quarter average) also remains in effect.

3.2.2.3 Hazardous Air Pollutants

The USEPA has identified 188 hazardous air pollutants (HAPs), also referred to as toxic air pollutants or air toxics, that are known or suspected to cause cancer or other serious health and environmental effects. AAQS have not been established for HAPs because USEPA's strategy is to use reductions of HAP emissions from stationary industrial, mobile, and indoor sources to provide nationwide health protections. National emission standards exist for controlling HAPs from specific types of stationary sources, which are regulated under Section 112(b) of the 1990 CAA Amendments. The *National Emission Standards for Hazardous Air Pollutants* regulate HAP emissions from stationary sources (40 CFR Part 61 and Part 63). The primary control methodologies for these pollutants for mobile sources involve reducing their content in fuel and altering the engine operating characteristics to reduce the volume of pollutant generated during combustion. To assess risk from exposure to toxics, the USEPA has tabulated long-term (chronic) and short-term (acute) dose-response assessments that could be used for risk assessments of HAPs (USEPA 2024a).

3.2.2.4 General Conformity

The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity determination are called *de minimis* levels. *De minimis* levels (in tons per year [tpy]) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question.

A conformity applicability analysis is the first step of a conformity evaluation and assesses if a federal action must be supported by a conformity determination. This is typically performed by quantifying applicable direct and indirect emissions that are projected from the implementation of the federal action. Indirect emissions are those emissions caused by the federal action and originating in the region of interest, but which can occur at a later time or in a different location from the action itself and are reasonably foreseeable. The federal agency can control and will maintain control over the indirect action due to a continuing program responsibility of the federal agency. Reasonably foreseeable emissions are projected future direct and indirect emissions that are identified at the time the conformity evaluation is performed. The location of such emissions is known, and the emissions are quantifiable, as described and documented by the federal agency based on its own information and after reviewing any information presented to the federal agency. If the results of the applicability analysis indicate that the total emissions would not exceed the *de minimis* emissions thresholds, then a conformity determination is not required, and the conformity evaluation process would be complete.

3.2.2.5 Permitting

The CAA establishes several permitting programs that are implemented by USEPA and Guam Environmental Protection Agency to regulate emissions from various sources to protect public health and the environment. Key permits include the Title V Operating Permit for major sources of air pollution; the minor source and the Prevention of Significant Deterioration (PSD) permit programs, both focused on protecting air quality in areas that meet or exceed air quality standards by limiting new pollution in these areas; and the Nonattainment Area New Source Review permit, which applies to areas that do not meet the NAAQS, requiring stricter controls on new or modified facilities to reduce emissions.

The new source review permitting process is specific to new stationary sources and modifications at existing stationary sources and is required by the regulatory agencies to obtain an air pollution permit

before commencing construction. This permitting process for stationary sources is required whether the source or modification is planned for nonattainment areas or attainment and unclassifiable areas.

3.2.2.6 GHGs

Currently, there are no regulatory thresholds of significance for GHG emissions. The USEPA implements the GHG Reporting Program, requiring certain facilities to report GHG emissions from stationary sources if such emissions exceed 25,000 metric tons of CO_2e per year (40 CFR 98). Major source permitting requirements for GHGs are triggered when a facility exceeds the major threshold of 100,000 metric tpy for stationary source CO_2e emissions. For a facility that is already a major source of criteria pollutants under USEPA's PSD program, major modification permitting requirements, including incorporating best available and economically feasible emissions controls for GHGs, would be triggered by a net change of 75,000 tpy for stationary source CO_2e emissions. However, a major modification for any one criteria pollutant would also need to occur for the GHG threshold to be applicable.

For NEPA analyses purposes, reasonably foreseeable direct and indirect GHG emissions of proposed actions and reasonable alternatives (as well as the no action alternative) should be quantified when practicable. Under the Navy's *Climate Action 2030* plan, the Navy attempts to reduce the Navy's carbon footprint and enhance the Navy's resiliency. Key goals, include ensuring the Navy's infrastructure, operations, and military readiness are resilient to rising sea levels and extreme weather events (DoN 2022b).

3.2.3 Affected Environment

The air quality region of influence (ROI) includes Apra Harbor and surrounding areas, including the Glass Breakwater, Sumay Cove, associated staging areas and concrete casting yard, and nearby waters (within 3 nautical miles of shore). Apra Harbor is within the Guam Air Quality Control Region (AQCR 246), which encompasses all of Guam (40 CFR § 81.353).

Ambient air quality around Apra Harbor is influenced by stationary sources, including the Piti and Cabras power generation units, approximately 2.5 miles east of the Glass Breakwater repair area, and fueling operations at the Mobil Oil fuel terminal within the Port of Guam, approximately 1.5 miles east of the Glass Breakwater repair area. There are no stationary sources of air emissions within the Glass Breakwater or Sumay Cove/Sumay Point repair areas. Mobile sources of air emissions within the ROI include internal combustion engines in vehicles traveling on Routes 1 and 11 and within NBG and vessels traveling within Apra Harbor and Sumay Cove.

Guam is designated as unclassifiable/attainment for all criteria pollutants with the exception of SO_2 (40 CFR § 81.353). Two areas in Guam are designated as nonattainment for the 1971 SO_2 NAAQS. These areas include the Piti area and the Tanguisson area, which are the portions of Guam within 3.5 kilometers (approximately 2.2 miles) of the Piti Power Plant and the Tanguisson Power Plant, respectively (USEPA 2024b). In December 2017, the USEPA designated the portion of Guam within 6.074 kilometers (approximately 3.8 miles) of the Piti Power Plant as nonattainment for the 2010 SO_2 NAAQS. The project areas are not within the Tanguisson 1971 SO_2 nonattainment area; however, some of the project areas are within the Piti 1971 SO_2 nonattainment area, and all of the project areas are within the Piti-Cabras 2010 SO_2 nonattainment area. The General Conformity *de minimis* threshold for emissions of SO_2 within the nonattainment areas is 100 tpy (40 CFR § 93.153[b][1]).

The effective date of nonattainment designation for the Piti-Cabras area was April 9, 2018. The statutory attainment date was established as April 9, 2023. Since designation, Guam has not submitted a SIP revision. Attainment status determinations generally rely on the most recent three years of monitoring data. However, there are currently no air monitoring stations on Guam, and ambient air quality data has

not been collected since 1991. The SO_2 nonattainment designation is based on modeling results for the years 2010–2013. The modeling analysis showed that the Piti-Cabras SO_2 design value for 2011–2013 was approximately 223 ppb, nearly three times the 2010 1-hour primary SO_2 NAAQS of 75 ppb. Additional modeling results submitted by Guam EPA indicated SO_2 emissions within the Piti-Cabras nonattainment area totaled 9,197 tons in 2020 (**Table 3-3**), which was 33 percent lower than the average annual SO_2 emissions of 13,797 tons modeled for 2011–2013. On December 19, 2024, USEPA issued the *Finding of Failure to Attain by the Attainment Date for the 2010 1-Hour Primary Sulfur Dioxide National Ambient Air Quality Standard; Guam; Piti-Cabras Nonattainment Area* (89 FR 103819) based on incomplete modeling and emissions data and information concerning control strategy implementation (USEPA 2024c).

Guam Power Authority's (GPA) Piti-Cabras Power Plant facilities in the Piti Point area consists of the Cabras units 3 and 4 and Piti Unit 7 operated by GPA, Cabras units 1 and 2 operated by Taiwan Electrical and Mechanical Engineering Services, and Piti units 8 and 9 operated by Marianas Energy Company (USEPA 2017, Guam CCU 2020, Guam CCU 2024). The Cabras units 1–4 consist of two steam turbines and two slow-speed diesel generators. Piti Unit 7 is a 40-megawatt (MW) diesel-fired combustion turbine. Piti units 8 and 9 consist of two slow-speed diesel generators, each rated at 44-MW (DoN 2024a). Guam EPA-reported SO_2 emissions within the Piti-Cabras area for 2020 are summarized in **Table 3-3**.

Table 3-3. 2020 Actual Emissions for the Piti-Cabras SO2 Nonattainment Area

Facility Name	2020 Actual Emissions (tpy)
Cabras	6,816
Piti	2,297
TEMES [1]	0.11
Marine vessels	84
Total	**9,197**

Source: USEPA 2024c
Key: SO_2 = sulfur dioxide; tpy = tons per year; TEMES = Taiwan Electrical and Mechanical Engineering Services
Note: [1] Piti Unit 7 was operated by TEMES for a 20-year term that started in December 1997. Guam Power Authority has operated and maintained Piti Unit 7 since December 2017 (Guam CCU 2024).

On June 20, 2023, the Guam Legislature adopted *Substitute Bill No. 101-37 (COR) - An Act to Repeal and Reenact § 1310 of Article 1, Chapter 1, Title 22 GARR, Relative to Adopting Updated Emission Standards for Sulfur Oxides from Fuel Combustion to Ensure the Island of Guam Meets the National Ambient Air Quality Standards for Sulfur Dioxide Transmitted by the Guam Environmental Protection Agency*. Rule 1310, which took effect on July 12, 2023, sets fuel sulfur content limits of 0.2 percent for Cabras units 1 and 2 and 0.0015 percent for all other sources, except ocean-going vessels (22 GARR § 1310). The rule was designed as a control strategy to attain the 2010 1-hour SO_2 NAAQS.

Sensitive air receptors within the ROI include Family Beach, which is a recreational beach approximately 2,500 feet (0.5 mile) east of the Glass Breakwater; Gab Gab Beach and San Luis Beach, which are recreational beaches on Navy property 2,100 to 3,600 feet (0.4 to 0.7 mile) west of the Sumay Cove repair area; Sumay Marina adjacent to the Sumay Cove repair area; recreational users of Sumay Point; on-base housing, and the nearby recreational ball fields. **Figure 3-1** shows the location of sensitive air receptors in relation to project areas, and **Table 3-4** provides the distance between these receptors and the respective project areas.

Figure 3-1. Project Areas and Sensitive Air Receptor Locations

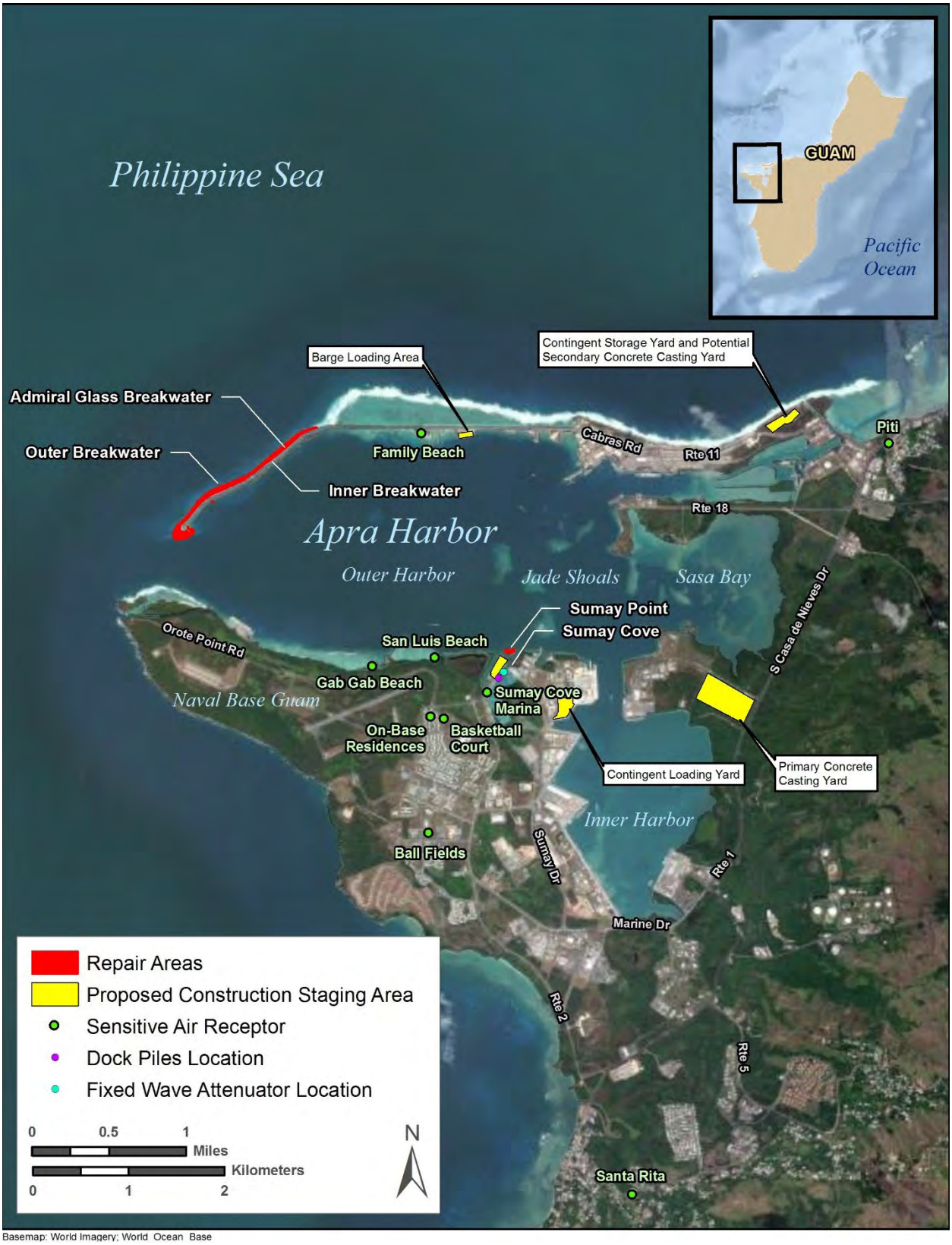


Table 3-4. Distances and Headings from the Project Areas to Sensitive Air Receptors

	Sensitive Air Receptor Location Relative to Project Area					
Project Area	**Residential Areas**	**Recreational Centers/ Ball Fields**	**Family Beach**	**Gab Gab Beach**	**San Luis Beach**	**Sumay Marina**
Glass Breakwater	**Off-base Residences:** Piti 3.5 miles E and Santa Rita 5.6 miles SSE **On-base Residences:** 1.9 miles SE across the harbor	Off-base: NA On-base: 2 to 2.5 miles SE across the harbor	0.5 miles E	1.5 miles S	1.5 miles SSE	1.8 miles SE
Primary Concrete Casting Yard (Polaris Point)	**Off-base Residences:** Piti 1.7 miles NE and Santa Rita 3.2 miles S **On-base Residences:** 1.4 miles SSW	Off-base: NA On-base: 1.7 miles SW	3.5 miles NW	2.2 miles W	1.9 miles W	1.5 miles W
Secondary Concrete Casting Yard (Old Cabras Quarry Site)	**Off-base Residences:** Piti 0.6 miles E and Santa Rita 5.1 miles S **On-base Residences:** 2.91 miles SW across the harbor	Off-base: NA On-base Basketball Court and Ball field: 3 and 3.5 miles SW, respectively, across the harbor	2.4 miles W	3 miles SW	2.9 miles SW across the harbor	2.6 miles SW across the harbor
Sumay Cove Repairs	**Off-base Residences:** Piti 2.7 miles NE and Santa Rita 3.6 miles SSE **On-base Residences:** 0.4 miles SW	Off-base: NA On-base basketball court and baseball field, respectively: 0.4 miles and 1.0 miles SW	1.5 miles NNW	0.7 miles W	0.4 miles W	0.0-0.1 miles S

Key: E = east; N = north; S = south; W = west

The USEPA's 2020 Air Toxics Screening Assessment provides emissions, ambient concentrations, and exposure estimates for 181 HAPs plus diesel particulate matter. For HAP/air toxics with health data based on long-term exposure, the assessment estimates cancer risks, the potential for noncancer health effects, or both, including noncancer health effects for diesel particulate matter. The Air Toxics Screening Assessment is not currently available for Guam (USEPA 2024f).

Climate

Guam experiences a tropical marine climate, which is influenced by its tropical location, prevailing trade winds blowing from east to west, tropical storms, and ocean currents. The trade winds contribute to a wet season that lasts from July to November and a dry season that lasts from December to June. Guam's location within the Pacific typhoon belt results in tropical storms, particularly during the wet season, that bring heavy rains and strong winds. The warm waters of the Pacific Ocean and Philippine Sea moderate temperatures and contribute to high levels of humidity. Between 1991 and 2020, Guam has had an average temperature of 83.4 degrees Fahrenheit (°F) in the hottest month of June, with average high temperatures that have exceeded 80°F, and an average temperature of 80.5°F in the coldest month of February, with average low temperatures that fell to 75°F. Over the entire period, the average

temperature was 82°F. The average annual precipitation was 16.24 inches. The wettest month of the year was January with an average precipitation of 98.12 inches (NOAA 2021).

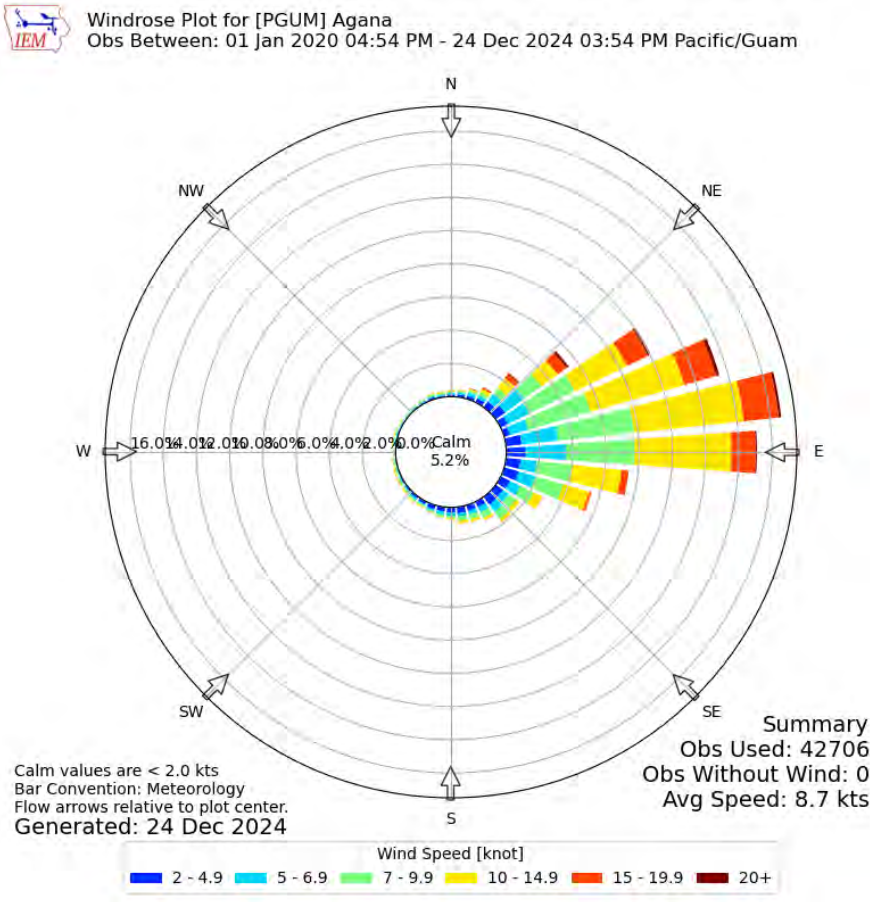
Meteorological conditions affect the dispersion and transport of air pollutants and the resulting air quality.

Figure 3-2 depicts the wind rose for data collected from 2020 to 2024 at the Agana weather station at Antonio B. Won Pat International Airport. The wind rose represents the directions around a compass, and the length of the petal or spoke indicates wind direction and frequency toward the center point. Individual segments of the spoke represent the frequency of winds for defined wind speed categories, with the slowest winds closest to and the fastest winds furthest from the center of the diagram. The windier part of the year lasts for six months, from November to May, with average wind speeds of more than 13.8 miles per hour. The calmer season has an average hourly wind speed of 10.9 miles per hour (Iowa Environmental Mesonet 2024).

Guam is experiencing rising sea levels, increased frequency and intensity of tropical storms and typhoons, higher temperatures, coral bleaching, and human health effects. These changes can impact ocean and coastal habitats, such as coral reefs, can reduce their effectiveness to protect coastal communities from storm surges, putting infrastructure and communities at greater risk. Warmer temperatures cause more evaporation, and warmer air can hold more moisture, leading to heavier rainfall, which can result in more intense tropical storms. Changes to precipitation patterns could affect water resources, while coastal erosion threatens infrastructure and natural habitats. Increased frequency and intensity of rainfall and storms can lead to increased flooding and rate of erosion, which in turn can lead to damaged roadways and infrastructure. In contrast, dry summers, mixed with increased heat and low humidity, can contribute to the cause and spread of wildfires (USEPA 2016, Frazier et al. 2023).

Historically, Guam's maximum temperatures have not been greater than 95°F; however, the island is expected to experience temperatures greater than 95°F up to 24 days per year by the end of the century (CMRA 2024). High temperatures can cause adverse health effects such as heat stroke and dehydration and can affect cardiovascular and nervous systems, especially in vulnerable populations (i.e., children, elderly, sick, and low-income populations). Warmer air also can increase the formation of ground-level ozone, which has a variety of health effects, including aggravation of lung diseases and increased risk of death from heart or lung disease (USEPA 2016, Frazier et al. 2023).

Figure 3-2. Wind Rose for Guam



Greenhouse Gases

On Guam, the primary GHGs emitted are CO_2, CH_4, and N_2O from the combustion of fuel (Guam CCRC 2024). Estimated GHG emissions by Guam sector are shown in **Table 3-5**. Annual GHG emissions from primary Guam sectors are estimated at 2,612,758 tons of CO_2e per year (Guam CCRC 2024). Because GHG emissions from the Piti-Cabras Power Plant facilities exceed the USEPA GHG Reporting program's reporting threshold of 25,000 metric tpy, the facilities are required to report their annual GHG emissions to USEPA. In 2023, the Piti-Cabras Power Plant facilities produced a combined total of 956,037 metric tons of CO_2e with 43 percent from Piti units 8 and 9, 41 percent from the Cabras units, and 16 percent from Piti Unit 7 (USEPA 2023a). There are no other large-emitting facilities required to report their GHG emissions within the ROI. Global GHG emissions in 2023 reached approximately 53.82 billion metric tons of CO_2e (Ritchie et al. 2024). As shown in **Table 3-6**, the U.S. emitted over 6,300 million metric tons of CO_2e in the most recently reported years (USEPA 2024d). GHG emissions are assessed on a global scale.

Table 3-5. Estimated Annual GHG Emissions for Guam

Emissions Source Category	CO_2e (metric tpy)	Percent of total
Stationary Combustion (from GPA Electricity Generation)	1,184,497	45%
Mobile Combustion (from road vehicles)	1,364,018	52%
Solid Waste (Landfill)	45,404	2%
Wastewater Treatment	18,839	1%
Total	**2,612,758**	**100%**

Source: Guam CCRC 2024

Key: CO_2e = equivalent emissions of carbon dioxide; GPA = Guam Power Authority; tpy = tons per year

Table 3-6. U.S. GHG Emissions Trends (million metric tons CO2e)

Economic Sector	2018	2019	2020	2021	2022
Transportation	1,871.6	1,874.6	1,625.3	1,805.5	1,801.5
Electric Power Industry	1,799.2	1,650.8	1,482.2	1,584.4	1,577.5
Industry	1,541.9	1,531.8	1,435.9	1,455.8	1,452.5
Agriculture	683.5	661.0	640.0	645.9	634.0
Commercial	453.5	462.6	436.9	443.7	463.7
Residential	376.8	384.2	384.2	369.6	391.3
U.S. Territories [1]	26.3	25.1	25.1	23.9	22.7
Gross Total [2]	**6,752.7**	**6,590.1**	**6,001.8**	**6,328.8**	**6,343.2**

Source: USEPA 2024d

Note: [1] Emissions from U.S. Territories are based on the fuel consumption in American Samoa, Guam, Puerto Rico, the U.S. Virgin Islands, Wake Island, and other outlying U.S. Pacific Islands.

[2] Totals may not sum due to independent rounding.

3.2.4 Environmental Consequences

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives and the dispersion and transport of those emissions. Air quality effects are changes to the environment resulting from the Proposed Action that are reasonably foreseeable and have a reasonably close causal relationship to the action. These effects may include but are not limited to:

- Risks to populations resulting from the exposure to HAPs
- Changes in ambient concentrations for criteria pollutants and their effects on compliance with the NAAQS and Guam AAQS

Emissions from the Proposed Action would primarily be from fuel-burning equipment, vehicles and vessels (carrying equipment, rock, aggregate materials), and ground disturbance during construction. Pollutants emitted 3-12 nautical miles and beyond 12 nautical miles from shore would be from intermittent transit of shipping vessels. The expected dispersion and transport of pollutant plumes of these intermittent emissions in the broad ocean area are not expected to interfere with the attainment of ambient air quality standards or contribute to human health risks from HAPs exposure and were not analyzed further in detail. Other emissions sources include concrete casting yard operations and demolition activities. To assess air quality impacts from emissions released from the Proposed Action a qualitative analysis was performed. This analysis considered expected locations of pollutant plumes and receptors to determine if they overlap to assess exposure potential. Activity duration and how changes in pollutant concentrations would affect design values were also considered. For example, the 1-hour SO_2 NAAQS is based on a 3-year average, but if an activity does not occur for the entire duration of the 3-year period, the period of no activity would lower the 3-year average. Therefore, the duration and intensity of pollutant exposure were considered in evaluating air quality impacts from the Proposed Action.

The Proposed Action is anticipated to release GHGs into the atmosphere. These emissions are quantified for the Proposed Action and compared to the No Action Alternative.

Sources of Emissions. The following activities under the Proposed Action would generate criteria pollutant, HAP, and GHG emissions. Emissions would primarily be produced from the combustion of fuel.

- Emissions from government and construction vehicles
- Emissions from vessels delivering materials and supporting construction activities

- Construction equipment, including heavy equipment, generators, concrete casting yard, etc.
- Vehicular emissions from worker commutes

3.2.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur, and there would be no change to baseline air quality as long as the breakwater remains in its current condition. However, if the proposed breakwater repairs do not occur, the breakwater will continue to erode and degrade with increased wave action and storms. In the event of breakwater breach, port operations would be halted resulting in temporary reduction in vessel and equipment emissions at the port and would also likely result in an increase in emissions outside the port due to increased vessel maneuvering and increased use of air cargo. These emissions will vary depending on the extent of failure, sea conditions, the duration of repair efforts, the percentage of sea cargo shifted to air freight, and the particular vessels/planes used, and are not quantifiable at this time. However the per ton GHG emissions of freight shifted to air cargo would be expected to be 25-50 times higher than for sea cargo. Further, wave action and storms have intensified in recent years (increased storm intensities and sea level rise); therefore, continued degradation in the existing conditions with no supportive action to prevent worsening of infrastructure vulnerabilities from ongoing meteorological trends and continued global emissions of GHGs could present ongoing potential for significant effects on the Glass Breakwater and subsequently Apra Harbor infrastructure and facilities.

3.2.4.2 Alternative 1

Alternative 1 would not introduce any new permanent stationary sources of air emissions. Short-term, temporarily emitted air emissions (e.g., fugitive dust, combustion of fossil fuels) would be generated during the activity period, which is estimated to be approximately 5 years, 7 days per week, 12 hours per day. Based on the anticipated construction phasing and activities for Alternative 1, emissions were estimated for each year of construction and provided in **Table 3-7**. Detailed emissions modeling results are included in **Appendix B**.

Table 3-7. Estimated Annual Criteria Pollutant and HAP Emissions from Alternative 1

Year	NO_X (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	VOC tpy)	HAPs
2025							
Glass Breakwater							
Nonroad Equipment	9.698	5.573	0.010	0.667	0.374	0.510	0.030
Onroad Mobile	0.641	1.551	0.001	0.085	0.045	0.097	0.034
Vessel Mobile	40.615	6.318	0.086	1.052	1.019	2.125	0.229
Concrete Casting Yard							
Nonroad Equipment	6.669	3.960	0.007	0.504	0.281	0.351	0.046
Onroad Mobile	1.818	1.218	0.001	0.206	0.131	0.224	0.054
Sumay Cove Repairs							
Nonroad Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Onroad Mobile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vessel Mobile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	0.000	0.000	0.000	0.341	0.085	0.000	0.000
2025 Total	**59.440**	**18.620**	**0.106**	**2.856**	**1.935**	**3.307**	**0.392**

Year	NO_X (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	VOC tpy)	HAPs
2026							
Glass Breakwater							
Nonroad Equipment	33.552	19.390	0.036	2.075	1.266	1.766	0.101
Onroad Mobile	1.433	2.364	0.002	0.188	0.102	0.179	0.051
Vessel Mobile	80.092	12.310	0.089	2.102	2.039	4.196	0.452
Concrete Casting Yard							
Nonroad Equipment	10.639	6.169	0.011	1.196	0.496	0.560	0.068
Onroad Mobile	3.269	2.107	0.003	0.379	0.232	0.377	0.079
Sumay Cove Repairs							
Nonroad Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Onroad Mobile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vessel Mobile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	0.000	0.000	0.000	0.702	0.176	0.000	0.000
2026 Total	**128.985**	**42.340**	**0.140**	**6.642**	**4.310**	**7.078**	**0.751**
2027							
Glass Breakwater							
Nonroad Equipment	33.648	19.444	0.036	2.078	1.269	1.771	0.091
Onroad Mobile	1.295	2.225	0.002	0.177	0.093	0.161	0.047
Vessel Mobile	80.092	12.310	0.089	2.102	2.039	4.196	0.452
Concrete Casting Yard							
Nonroad Equipment	10.639	6.169	0.011	1.189	0.495	0.560	0.060
Onroad Mobile	2.964	1.996	0.003	0.354	0.212	0.346	0.073
Sumay Cove Repairs							
Nonroad Equipment	1.505	0.890	0.002	0.056	0.056	0.079	0.007
Onroad Mobile	0.008	0.148	0.000	0.003	0.001	0.002	0.002
Vessel Mobile	0.216	0.112	0.001	0.018	0.018	0.036	0.004
Resuspended Road Dust	0.000	0.000	0.000	0.710	0.177	0.000	0
2027 Total	**130.367**	**43.293**	**0.143**	**6.687**	**4.359**	**7.152**	**0.735**
2028							
Glass Breakwater							
Nonroad Equipment	33.648	19.444	0.036	1.804	1.228	1.771	0.081
Onroad Mobile	1.230	2.100	0.002	0.148	0.065	0.153	0.045
Vessel Mobile	80.092	12.310	0.089	2.102	2.039	4.196	0.452
Concrete Casting Yard							
Nonroad Equipment	10.639	6.169	0.011	0.947	0.459	0.560	0.052
Onroad Mobile	2.820	1.905	0.003	0.285	0.145	0.331	0.070
Sumay Cove Repairs							
Nonroad Equipment	1.505	0.890	0.002	0.056	0.056	0.079	0.006
Onroad Mobile	0.007	0.138	0.000	0.003	0.001	0.002	0.002

Year	NO_X (tpy)	CO (tpy)	SO_2 (tpy)	PM_{10} (tpy)	$PM_{2.5}$ (tpy)	VOC tpy)	HAPs
Vessel Mobile	0.216	0.112	0.001	0.018	0.018	0.036	0.004
Resuspended Road Dust	0.000	0.000	0.000	0.710	0.177	0.000	
2028 Total	**130.157**	**43.068**	**0.143**	**6.073**	**4.187**	**7.129**	**0.711**
2029							
Glass Breakwater							
Nonroad Equipment	7.971	4.609	0.009	0.267	0.267	0.420	0.017
Onroad Mobile	0.386	0.953	0.001	0.056	0.024	0.056	0.021
Vessel Mobile	7.830	1.092	0.009	0.205	0.199	0.410	0.044
Concrete Casting Yard							
Nonroad Equipment	8.342	4.835	0.009	0.292	0.292	0.439	0.034
Onroad Mobile	1.854	1.384	0.002	0.209	0.103	0.237	0.053
Sumay Cove Repairs							
Nonroad Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Onroad Mobile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vessel Mobile	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	0.000	0.000	0.000	0.450	0.113	0.000	0.000
2029 Total	**26.383**	**12.873**	**0.029**	**1.480**	**0.998**	**1.562**	**0.169**
2030 and Beyond							
2030 and Later Years	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

Note: Emissions modeling results are included in **Appendix B**
Key: CO = carbon monoxide, HAPs = hazardous air pollutants, NOx = nitric oxide, $PM_{2.5}$ = particulate matter to 2.5 micrometers, PM_{10} = particulate matter to 10 micrometers, SO_2 = sulfur dioxide, VOC = volatile organic compound, tpy = tons per year

BMPs would be implemented to minimize fugitive dust during construction. BMPs could include watering of active work areas, using wind screens, keeping adjacent paved roads clean, covering of open-bodied trucks, limiting the area that is disturbed at any given time, and/or mulching or chemically stabilizing inactive areas that have been worked. Additional emission reduction measures include limiting heavy-duty diesel vehicle idling times, use of diesel particulate filters and diesel oxidation catalysts in equipment, and application of chemical dust suppressants.

Emissions from the tailpipes of on-road and nonroad mobile sources as well as fugitive dust lack plume rise. Thus, air emissions are expected to initially disperse in the immediate vicinity of activities and then be transported downwind of release. Observations at the Guam International Airport indicate wind directions are mostly from the east, which would transport emissions away from public areas and sensitive receptors most of the time. This includes Family Beach, which is east and north of the Glass Breakwater and Sumay Cove, respectively. The Sumay Marina is south of the Sumay Cove repair area, and winds from the east would likely disperse emissions away from the marina area; however, vessels transiting through Sumay Cove and recreational users of Sumay Point may be affected by air emissions. When winds are from the west, sensitive air receptors may experience some increase in emissions; however, winds from the west would be infrequent and the quantities of emissions coming from emissions sources to the east (e.g., concrete casting yard) would be low, commensurate with the activity level (see **Table 3-7**). Emissions would dilute and disperse over the distances from the emission source

or project site to the receptor. Therefore, air emissions would not likely have an appreciable effect on sensitive air receptors.

For Alternative 1, HAPs would be generated by the combustion of fuels in on-road vehicles and non-road equipment, including generators. HAP emissions were estimated for the most abundant HAPs emitted from combusted fuels. Annual HAP emissions are shown in **Table 3-7**, and it is expected that HAP emissions would be produced in small quantities.

Anticipated air quality impacts from Alternative 1 are not expected to interfere with the attainment of NAAQS or Guam AAQS or appreciably increase human health risks from HAP exposure in areas where sensitive receptors and/or public presence is expected. Therefore, impacts to air quality from emissions of criteria pollutants and HAPs under Alternative 1 would be less than significant.

General Conformity

The Navy completed an applicability analysis to comply with USEPA General Conformity requirements. The Proposed Action is subject to the General Conformity rule because of its location within the Piti-Cabras SO_2 nonattainment area. As shown in **Table 3-7**, annual emissions of SO_2 from Alternative 1 would not exceed the applicable SO_2 *de minimis* threshold of 100 tpy. Therefore, a conformity determination is not required. The Record of Non-Applicability is provided in **Appendix B** and documents the completion of the General Conformity applicability analysis.

Permitting

Temporary stationary sources of emissions to support Glass Breakwater and Sumay Cove repairs include emergency generator sets. Permitting scenarios would vary based on the types and sizes of the stationary sources, the timing of the construction activities, and the types of emissions controls selected. Stationary sources of air emissions would fully comply with Guam EPA's permit requirements.

GHGs

The GHG emissions generated from the Proposed Action alternatives contribute to the global atmosphere, regardless of the specific location within the ROI or specific timeframe that they are produced. Alternative 1 would generate GHGs during the 5-year construction period. Estimated GHG emissions from Alternative 1 are shown in **Table 3-8**.

Table 3-8. Estimated Annual GHG Emissions from Alternative 1

Year	CO_2 (tpy)	CH_4 (tpy)	N_2O (tpy)	CO_2e (tpy) [1, 2]
2025	7,336.505	0.037	0.450	7,456.909
2026	16,085.271	0.141	1.036	16,363.847
2027	16,343.034	0.140	1.060	16,627.870
2028	16,343.606	0.136	1.062	16,628.861
2029	3,621.148	0.033	0.285	3,697.625
2030 and later years	0.000	0.000	0.000	0.000
Total	**59,729.564**	**0.487**	**3.894**	**60,775.112**

Table Notes: [1] Detailed emissions modeling results are included in **Appendix B**. [2] To calculate the total CO_2e, all GHGs are multiplied by their global warming potential and the results are added together. Global warming potentials are published in 40 CFR 98 (revised April 2024). The global warming potentials used to calculate CO_2e are as follows: CO_2 = 1; CH_4 = 28; N_2O = 265.
Key: CO_2e = equivalent emissions of carbon dioxide; tpy = tons per year

Total GHG emissions from Alternative 1 are estimated to be approximately 60,775 tons of CO_2e (55,134 metric tons of CO_2e) over the course of the construction period. This total is equivalent to the following GHG emissions per USEPA's GHG Equivalencies Calculator (USEPA 2024e):

- 12,860 gasoline-powered passenger vehicles driven for one year
- 140,402,015 miles driven by an average gasoline-powered passenger vehicle
- 6,203,893 gallons of gasoline consumed
- 5,415,914 gallons of diesel consumed
- 7,404 homes' energy use for one year
- 0.144 natural gas-fired power plants in one year
- 127,647 barrels of oil consumed
- 4,457,406,006 smartphones charged

The GHG emissions from Alternative 1 were compared to estimated annual emissions for Guam (**Table 3-9**). GHG impacts result from the incremental addition of GHGH emissions from millions of individual sources. The quantitative analysis of CO_2e emissions is for illustrating the differences between Alternative 1 and the No Action Alternative emissions. Alternative 1 is estimated to result in a total of approximately 55,134 metric tons of CO_2e greater than the No Action Alternative (i.e., no construction); the highest annual emissions from Alternative 1 construction are estimated to be 15,085 metric tons of CO_2e (2028) representing a 0.58 percent increase when compared with estimated annual GHG emissions in Guam. To provide real-world context of the GHG impacts at the island-wide and national scales, **Table 3-9** presents the predicted total net GHG emissions that would result from Alternative 1 as compared with the Guam and U.S. projected emissions for the same time period.

Table 3-9. Comparison of Estimated Total Greenhouse Gas Emissions for Alternative 1

Reference Scale [1,2]	CO_2e (metric tons)
Alternative 1	55,134.254
Guam	13,063,790
U.S.	31,716,000,000
Alternative 1 Percent of Guam Total	**0.42%**
Alternative 1 Percent of U.S. Total	**0.00017%**

Sources: Guam CCRC 2024, USEPA 2024b
Key: CO_2e = equivalent emissions of carbon dioxide
Notes: [1] For the purposes of this table, the time period considered for the Proposed Action includes the 5-year construction period (2025 through 2029).
[2] Annual GHG emissions for each reference area were considered to be consistent across all years considered (i.e., U.S. reported GHG emissions for 2022 were used for years 2025 through 2029).

GHG emissions would be temporarily generated from Alternative 1 and would cease following completion of construction. Therefore, Alternative 1 would result in a minor increase in GHG emissions, and no detectable changes to ongoing environmental trends would occur from the emission levels associated with these activities. Therefore, GHG impacts from Alternative 1 would be less than significant.

3.2.4.3 Cumulative Impacts

Air emissions from construction activities for past actions are considered to have ceased, and operational emissions from those actions are considered as part of the existing environment; therefore, cumulative impacts from past actions, combined with the Proposed Action, would not occur. If implemented concurrently, emissions from the Proposed Action and all of the identified present and reasonably foreseeable future actions may interact to result in short-term, adverse, cumulative impacts on air quality in the vicinity of Apra Harbor. Polaris Point Rock Revetment, NBG wharf repair projects, fuel pipeline construction, PAG Modernization, and dredging activities may interact with the Proposed

Action's air quality impacts if construction of the Proposed Action occurs concurrently with any of the projects. Emissions from present and reasonably foreseeable future actions, when combined with emissions from the Proposed Action, would be greater than what was analyzed for the Proposed Action alone, resulting in short-term, minor, adverse, cumulative impacts. Occurrences of additive air emissions would be temporary in nature and cease upon completion of the Proposed Action. It is anticipated that cumulative air quality impacts from present and reasonably foreseeable future actions within the ROI would be less than significant because, as described in **Section 3.2.4.2**, transport of air emissions to public areas would be infrequent, and when they occur, air pollutant concentrations are expected to be low. BMPs and emissions reduction measures, as identified in **Section 3.2.4.2**, would be implemented to minimize air emissions from the Proposed Action and the present and reasonably foreseeable future actions and reduce the potential for cumulative impacts on air quality.

3.3 Biological Resources

3.3.1 Description of the Resource

Biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal. Protected biological resources include species listed as threatened, endangered, or proposed under the ESA and species that are protected by other laws or programs (**Table 3-10**).

3.3.2 Regulatory Setting

Protected species include species listed as threatened or endangered under the ESA, species afforded federal protections under the MMPA or the MSA, and the MBTA.

Table 3-10. Biological Resources Relevant Laws and Regulations

Law/Regulation	Definition
Endangered Species Act	The ESA (16 U.S.C. § 1531 *et seq.*) establishes a federal program to protect and recover imperiled species and the ecosystems upon which they depend. The ESA requires federal agencies, in consultation with USFWS or NMFS, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitats of such species. Under the ESA, "jeopardy" occurs when an action is reasonably expected, directly or indirectly, to diminish the number, reproduction, or distribution of a species so that the likelihood of survival and recovery in the wild is appreciably reduced. An "endangered species" is defined by the ESA as any species in danger of extinction throughout all or a significant portion of its range. A "threatened species" is defined by the ESA as any species likely to become an endangered species in the foreseeable future. The ESA also prohibits any action that causes a "take" of any listed species. "Take" is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." Federal species of concern are not protected by law; however, these species could become listed and, therefore, are given consideration when addressing impacts from a proposed action. Listed plants are not protected from take, although it is illegal to collect or maliciously harm them on federal land. Under the ESA, critical habitat is designated if USFWS or NMFS determines that the habitat is essential to the conservation of a federally threatened or endangered species. In consultation for those species with critical habitat,

Law/Regulation	Definition
	federal agencies must ensure that their activities do not adversely modify critical habitat to the point that it will no longer aid in the species' recovery.
Marine Mammal Protection Act	All marine mammals are protected under the MMPA of 1972 (16 U.S.C. 1361–1407). The MMPA prohibits the "taking" of marine mammals and enacts a moratorium on the import, export, and sale of any marine mammal, along with any marine mammal part or product, within the U.S. The MMPA defines "take" as "the act of hunting, killing, capture, and/or harassment of any marine mammal; or the attempt at such." The MMPA defines harassment as "any act of pursuit, torment, or annoyance which has the potential to either: (a) injure a marine mammal in the wild, or (b) disturb a marine mammal by causing disruption of behavioral patterns, which includes, but is not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."
Magnuson-Stevens Fishery Conservation and Management Act	The MSA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a federal fisheries management plan. Pursuant to the MSA, federal agencies must consult with NMFS on all actions or proposed actions authorized, funded, or undertaken by the agency that may adversely affect EFH (per MSA Section 305[b][2]). EFH is defined as those waters and substrate necessary to fish (or other species) for spawning, breeding, feeding, or growth to maturity (50 CFR 600.10). Under the MSA, the U.S. has exclusive fishery management authority over all fishery resources found within its EEZ. The EEZ extends from the seaward boundary of each coastal state, including any Commonwealth, territory, or possession of the U.S., to a distance of 200 nautical miles from the baseline from which the breadth of the territorial sea of the U.S. is measured (50 CFR 600.10). In the Pacific Islands, EFH has been designated for federally managed species referred to as MUS that are cooperatively managed by NMFS and the WPRFMC. MUS in the Pacific Islands are fully described in the Council's Fishery Ecosystem Plans (FEPs) and include bottomfish, crustaceans, precious coral, and pelagic fish species caught in quantities sufficient to warrant management or monitoring by NMFS and the Council. The Proposed Action is located within the boundaries of the following FEPs: (1) FEP for the Mariana Archipelago and (2) FEP for Pacific Pelagic Fisheries of the Western Pacific Region. The Mariana Archipelago FEP boundary includes all waters and associated marine resources within the EEZ surrounding the CNMI and the Territory of Guam. Although there is overlap between the Mariana Archipelago FEP boundary and the Pacific Pelagic FEP boundary, the Mariana Archipelago FEP specifically manages demersal resources and habitats associated with the federal waters of the Mariana Archipelago. The Pacific Pelagic FEP boundary encompasses all areas of pelagic fishing operations in the EEZ or in the high seas for any domestic vessels that (1) fish for, possess, or transship Pacific Pelagic MUS within the EEZ waters of the Western Pacific Region or (2) land Pacific Pelagic MUS within the states, territories, commonwealths, or unincorporated U.S. island possessions of the Western Pacific Region.
Migratory Bird Treaty Act	The MBTA was enacted to protect migratory birds and their parts (i.e., eggs, nests, and feathers). Migratory birds are protected under the MBTA of 1918 (16 U.S.C. Parts 703–712) as amended, and EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. An MOU was executed in September 2014, and extended in May 2022 until both parties deem a revised MOU is required between the Department of Defense and USFWS to promote the conservation of migratory birds. Section 315 of the Authorization Act for Fiscal Year 2003 (Public Law 107–314, 116 Statute 2458) exempts military readiness activities carried out in accordance with 50 CFR Part 21.15 from the prohibition against the incidental taking of migratory birds. Military readiness activities, as defined in the Authorization Act and implementing regulations at 50 CFR Part 21.3,

Law/Regulation	Definition
	include all training and operations of the Armed Forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. The EO 13186 requires federal agencies to avoid or minimize impacts on migratory birds listed in 50 CFR Part 10.13, List of Migratory Birds. If the design and implementation of a federal action cannot avoid measurable adverse impacts on migratory birds, EO 13186 requires the responsible agency to consult with the USFWS.

Sources: DoN 2022a, NMFS 2023a
Key: CFR = Code of Federal Regulations; EO = Executive Order; EEZ = Exclusive Economic Zone; EFH = essential fish habitat; ESA = Endangered Species Act; FEP = Fishery Ecosystem Plans; MBTA = Migratory Bird Treaty Act; MMPA = Marine Mammal Protection Act; MOU = Memorandum of Understanding; MSA = Magnuson-Stevens Fishery Conservation and Management Act; MUS = Management Unit Species; NMFS = National Marine Fisheries Service; U.S. = United States; U.S.C = United States Code; USFWS = United States Fish and Wildlife Service; WPRFMC = Western Pacific Regional Fishery Management Council

3.3.3 Affected Environment

The following discussions provide a description of the existing conditions for Apra Harbor biological resources.

3.3.3.1 Marine Vegetation and Non-Coral Benthic Invertebrates

Marine vegetation includes plants occurring in marine or estuarine waters. These may include mangroves, algae, and various seagrasses. Estuaries, seagrass beds, and mangrove forests occur in Apra Harbor but are not within the project area. Typical benthic invertebrates include sea anemones, sponges, corals, sea stars, sea urchins, worms, bivalves, and crabs.

Section 4.5 of the 2022 *Joint Region Marianas* (*JRM) Integrated Natural Resources Management Plan* (INRMP) and the 2024 *Marine Biological Surveys for Apra Harbor Waterfront Repairs* report provide descriptions and figure overviews of Apra Harbor, including the Outer Apra Harbor, Glass Breakwater, and Sumay Cove (DoN 2022a, AECOS, Inc. 2024).

There have been 17 macroalgae species documented at Apra Harbor; common species include *Halimeda opuntia*, *Dictyota grossedentata*, and *Amphiroa tribulus*. There have been 18 non-coral invertebrate species documented at Apra Harbor; common species include *Linckia multifora* and *Stichopus chloronotus*. Additionally, the yellow sea squirt (*Ascidia dijmphniana*), has been documented occasionally at the Inner Breakwater. A complete inventory list of the marine vegetation and non-coral benthic invertebrate and vertebrate species documented during surveys of the Outer and Inner Breakwaters and at Sumay Point is available in the *2024 Marine Biological Surveys for Apra Harbor Waterfront Repairs* Report (AECOS, Inc. 2024).

3.3.3.2 Marine Wildlife

Coral

There have been three soft coral species documented at Apra Harbor; the most common species include *Sinularia* species and *Asterospicularia randalli* (cauliflower soft coral). There have been 58 hard coral species documented at Apra Harbor; common species include *Acropora hyacinthus*, *Leptastrea purpurea*, and *Pocillopora ankeli*. A complete inventory list of coral species documented during surveys of the Outer and Inner Breakwaters and at Sumay Cove is available in the 2024 *Marine Biological Surveys for Apra Harbor Waterfront Repairs* report (AECOS, Inc. 2024).

Fish

Marine biological surveys conducted specifically for the Proposed Action assessed fish abundance in multiple locations within the project area. There were 16 fish species within 6 families documented at the Outer Breakwater; a total of 37 individual fishes were observed at the tip of the Outer Breakwater, the majority of which were from the genus *Acanthurus*. A total of 686 individual fishes were observed along the Inner Breakwater. A total of 65 individual fish, comprised of 9 fish species from 6 families, were documented at Sumay Cove. A complete inventory list of fish species documented during surveys of the Outer and Inner Breakwaters and at Sumay Point is available in the 2024 *Marine Biological Surveys for Apra Harbor Waterfront Repairs* report (AECOS, Inc. 2024).

3.3.3.3 Protected Species

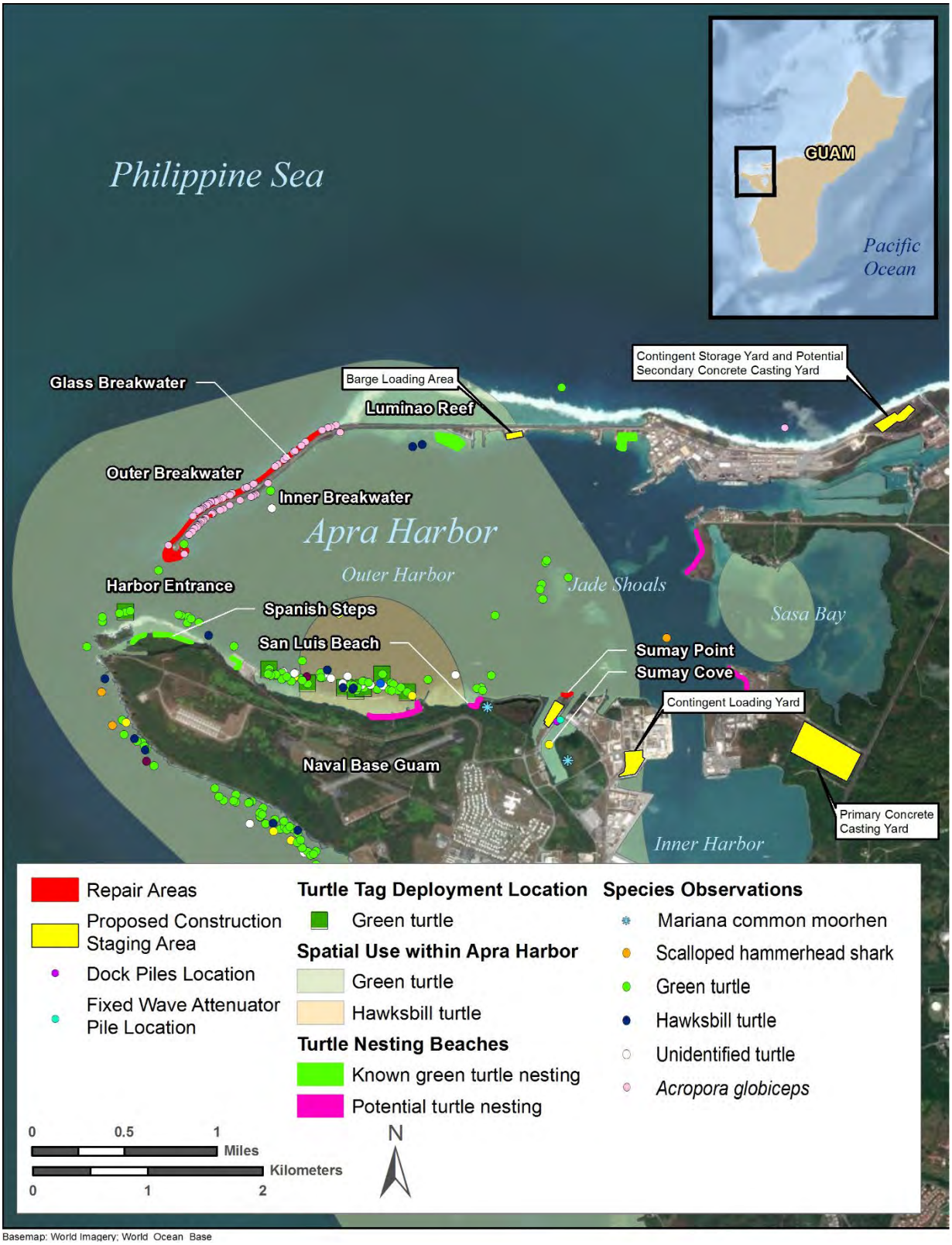
There are 65 protected species (marine mammals, sea turtles, fish, invertebrates, and birds) with the potential to occur in or around the project area, 33 species have been documented within or around Apra Harbor, including eight species protected under ESA. Additionally, there were 4 MMPA-protected species and 7 MBTA-protected species identified within or around Apra Harbor (**Figure 3-3; Table 3-11**). Protected species information was obtained from the Mariana Islands Training and Testing (MITT) Supplemental EISs/Overseas EISs, the Navy Marine Resources Assessment for the Marianas Operating Area, the BiOp on Navy MITT Activities, the Underwater Electromagnetic Measuring System biological assessment, the JRM INRMP, the NMFS ESA Critical Habitat Mapper, and recent biological surveys and reports conducted in Apra Harbor (DoN 2005, DoN 2020a, Gaos et al. 2020a, Gaos et al. 2020b, NMFS 2020c, NAVFAC and AECOS, Inc. 2021, DoN 2022a, Budd et al. 2023, NMFS 2023b, AECOS, Inc. 2024, NOAA Fisheries 2024).

The July 25, 2024 Federal Register (89 Federal Register 60498) determined that *Tridacna squamosa* did not meet the definition of a threatened or endangered species under Section 7. The Federal Register did propose listing*, T. maxima* and *T. squamosa*, both of which have been documented within Apra Harbor, as threatened species under the authority of Section 4(e) of the ESA. This was based on similarity of appearance to listed giant clams that are not present within Apra Harbor and means these species cannot be imported or exported.

Marine Mammals

While marine mammals are frequently observed in the waters surrounding Apra Harbor, they are rarely observed within the harbor. There was a partially decomposed pygmy sperm whale (*Kogia breviceps*) discovered at Naval Supply Depot Beach at NBG in 1989 and a group of six or more humpback whales (*Megaptera novaeangliae*) were photographed at the Apra Harbor entrance in January 1996. Additionally, in 2016, filtered satellite tag locations from short-finned pilot whales (*Globicephala melas*) and a pantropical spotted dolphin (*Stenella attenuata*) were located inside Apra Harbor (Eldridge 2003, NOAA Fisheries 2024). Spinner dolphins (*Stenella longirostris*) have occasionally been spotted in the harbor as well, these occurrences were incidental observations (DoN 2022a). There is no proposed or designated critical habitat for marine mammals within Apra Harbor.

Figure 3-3. Protected Species Documented in and around Apra Harbor



Basemap: World Imagery; World Ocean Base

Table 3-11. Protected Species with the Potential to Occur within the Project Area

Scientific Name	Common/Local Name (DPS)	Protection Status	Habitat	Documented in Apra Harbor
Mammals				
Pteropus mariannus mariannus	Mariana fruit bat/fanihi	T	Limestone native and coconut forests.	No
Marine Mammals				
Mesoplodon densirostris	Blainville's beaked whale/salungai	MMPA	Upper continental slope near 200–2,000 meters (656–6,560 feet).	No
Balaenoptera musculus	blue whale/salungai	E/MMPA	Oceanic.	No
Balaenoptera edeni	Bryde's whale/salungai	MMPA	Offshore, sometimes near a shore/shelf break.	No
Tursiops truncatus	common bottlenose dolphin/tuninos	MMPA	Coastal waters to 2,000 meters (6,560 feet).	No
Balaenoptera acutorostrata	common minke whale/salungai	MMPA	Prefers temperate/boreal waters, uncommon in the tropics.	No
Ziphius cavirostris	Cuvier's beaked whale/salungai	MMPA	Deep waters, generally >1,000 meters (3,281 feet) depth.	No
Dugong dugon	dugong	MMPA	Shallow, tropical waters throughout the Indo-Pacific region; feed primarily in seagrass beds.	No
Kogia sima	dwarf sperm whale/salungai	MMPA	Generally, near the 200-meter (656 feet) isobath.	No
Pseudorca crassidens	false killer whale/salungai	MMPA	Deep waters, generally >1,000 meters (3,281 feet) depth.	No
Balaenoptera physalus	fin whale/salungai	E/MMPA	Generally, near the 200-meter (656 feet) isobath.	No
Megaptera novaeangliae	humpback whale/salungai (Western North Pacific DPS)	E/MMPA	Temperate to subtropical/tropical coastal waters.	1996 Outside Harbor Entrance
Orcinus orca	killer whale/salungai	MMPA	Prefers temperate/polar waters.	No
Peponocephala electra	melon-headed whale/salungai	MMPA	Offshore, prefers deeper waters.	No
Stenella attenuata	pantropical spotted dolphin/tuninos	MMPA	Coastal waters to 1,000 meters (3,281 feet).	Yes
Feresa attenuata	pygmy killer whale/salungai	MMPA	Offshore, prefers deeper waters.	No

Scientific Name	Common/Local Name (DPS)	Protection Status	Habitat	Documented in Apra Harbor
Kogia breviceps	pygmy sperm whale/salungai	MMPA	Oceanic.	1989 Carcass
Grampus griseus	Risso's dolphin/tuninos	MMPA	Deep waters, generally >1,000 meters (3,281 feet) depth.	No
Steno bredanensis	rough-toothed dolphin/tuninos	MMPA	Offshore, prefers deeper waters.	No
Balaenoptera borealis	sei whale/salungai	E/MMPA	Offshore, prefers deeper waters.	No
Globicephala melas	short-finned pilot whale/salungai	MMPA	Tropical to temperate oceanic waters, approaching coastal seas.	Yes
Physeter macrocephalus	sperm whale/salungai	E/MMPA	Deep waters, generally >1,000 meters (3,281 feet) depth.	No
Stenella longirostris	spinner dolphin/tuninos	MMPA	Coastal waters to 1,000 meters (3,281 feet).	Yes
Stenella coeruleoalba	striped dolphin/tuninos	MMPA	Pelagic. Deep water and outer edge of continental slope.	No
Sea Turtles				
Chelonia mydas	green turtle (Central West Pacific DPS)/haggan	E	Nearshore waters, nesting beaches, and offshore waters.	Yes
Eretmochelys imbricata	hawksbill turtle/haggan karai	E	Nearshore waters, potential nesting beaches, and offshore waters.	Yes
Dermochelys coriacea	leatherback turtle/haggan	E	Offshore waters.	No
Caretta caretta	loggerhead turtle/haggan	E	Offshore waters.	No
Lepidochelys olivacea	olive ridley turtle/haggan	T	Offshore waters.	No
Fish				
Sphyrna lewini	scalloped hammerhead shark (Indo-West Pacific DPS)/haluun kiluus	T	Coastal seas from intertidal to depths of 500 meters (1,640 feet); nearshore nursery habitat includes bays and estuaries.	Yes
Carcharhinus longimanus	oceanic whitetip shark/haluu	T	Open ocean, usually well offshore.	No
Manta birostris	giant manta ray/afula	T	Coastlines, oceanic island groups, and offshore pinnacles and seamounts.	No
Invertebrates				
Acropora globiceps	hard coral/acho tasi	T	Intertidal zone, upper reef slopes, and reef flats.	Yes

Scientific Name	Common/Local Name (DPS)	Protection Status	Habitat	Documented in Apra Harbor
Acropora retusa	hard coral/acho tasi	T	Shallow reef slope and back-reef areas.	Yes
Seriatopora aculeata	hard coral/acho tasi	T	Shallow reef slopes.	No
Pavona diffluens	hard coral/acho tasi	T	Most reef environments.	No
Paniluris spp.	spiny lobster/mahonggang	MSA	Surf zone, reef front, may feed in reef flats.	No
Birds				
Sula leucogaster	brown booby/lu'ao	MBTA	Nest on the ground and cliff walls; forage along reef flats.	Yes
Anous stolidus	brown noddy/fahang dankolo	MBTA	Roosts on steep cliffs, rocky offshore islets, and channel markers in Outer Apra Harbor.	Yes
Todiramphus cinnamominus	Guam Micronesian kingfisher/sihek	E	No longer occupies Guam.	No
Aerodramus bartschi	Mariana swiftlet/ yåyaguak	E/MBTA	Mahlac Cave, Fachi Cave, and Maemong Cave	No
Gallirallus owstoni	Guam rail/ko'ko'	E	All habitats except wetlands.	No
Gallinula chloropus guami	Mariana common moorhen/pulattat	E/MBTA	Inhabits tropical freshwater lakes, marshes swamps, wetlands, and wet rice paddies.	Yes
Pluvialis fulva	Pacific golden plover/dulili	MBTA	Mudflats, and shores.	Yes
Egretta sacra	Pacific reef heron/chuchuko'	MBTA	Reef flats and occupying coastal strands and islets.	Yes
Arenaria interpres	ruddy turnstone/dulili	MBTA	Beaches, mudflats, jetties, and rocky shores.	Yes
Numenius phaeopus	whimbrel/kalalang	MBTA	Shores, mudflats, and marshes.	Yes
Phaethon lepturus	white-tailed tropicbird/utak	MBTA	Forages between reef flats and the open deep sea, nests in crevices on cliff walls.	No
Pampusana xanthonura	white-throated ground dove/paluman aoaka	MBTA	Limestone native forest.	No
Gygis alba	white tern/chunge	MBTA	In trees, rocky ledges, and on man-made structures.	Yes
Ixobrychus sinensis)	yellow bittern/kakkak	MBTA	Fresh water marshes and swamps; nests in small, constructed platforms of reed beds or trees and shrubs.	Yes

Source(s): AECOS, Inc. 2024, Budd et al. 2023, DoN 2005, DoN 2020a, DoN 2022a, Gaos et al. 2020a, Gaos et al. 2020b, NAVFAC and AECOS, Inc. 2021, NMFS 2020c, NMFS 2023b, NOAA Fisheries 2024

Key: DPS = Distinct Population Segment; E = endangered; MBTA = Migratory Bird Treaty Act; MMPA = Marine Mammal Protection Act; MSA = Magnuson-Stevens Fishery Conservation and Management Act; T = threatened.

Fish

The ESA- and MSA-protected scalloped hammerhead shark (*Sphyrna lewini*) is a warm-water shark species distributed widely throughout the tropics, Guam scalloped hammerhead sharks are included in the Indo-West Pacific DPS, although there have been few confirmed sightings of this species, mostly on the southern aspect of Orote Point. An 18-month-long environmental DNA study confirmed scalloped hammerhead shark environmental DNA within Inner Apra Harbor and Orote Point (Budd et al. 2023). While it is possible Apra Harbor may contain nursery habitat, the high level of human activity and the lack of quality habitat within Apra Harbor may limit their presence in the area (DoN 2022a). There is no proposed or designated critical habitat for the scalloped hammerhead shark within Apra Harbor.

Sea Turtles

Five sea turtle species have been documented in the Pacific Islands Region. Species include the loggerhead (*Caretta caretta*), olive ridley (*Lepidochelys olivacea*), leatherback (*Dermochelys coriacea*), hawksbill, and green turtles. Only the green and hawksbill turtles have been documented around Apra Harbor and are often associated with coral reef habitat (**Figure 3-3**) (Becker et al. 2019).

Based on vessel-based surveys and Guam aerial survey analysis of nearshore waters near San Luis Beach, Gab Gab Beach, Spanish Steps, Dadi Beach, and Tipalao Beach, these areas appear to have high sea turtle density, with the green turtle most commonly observed. Green turtles use the nearshore waters and patch reef communities of Inner and Outer Apra Harbor to rest and forage and have been documented nesting on Spanish Steps, Dadi Beach, and Kilo Wharf. There are no known or suspected green turtle nesting areas on or near the project areas (Gaos et al. 2020a, DoN 2022a).

Hawksbill turtles have been documented infrequently around Apra Harbor, including one in Sumay Cove. No hawksbill turtles were observed in the 2019 and 2020 biological surveys of the project area and there are no known or suspected hawksbill turtle nesting areas on or near the project areas (NAVFAC and AECOS, Inc. 2021, DoN 2022a).

In 2023, the United States Fish and Wildlife Service (USFWS) and NMFS proposed green sea turtle critical habitat within Apra Harbor. USFWS proposed one acre of additional shore-based green turtle critical habitat, and NMFS proposed critical habitat within the harbor that would extend from the mean high-water line to a depth of 20 meters (66 feet). The USFWS proposed green turtle critical habitat is not within the Glass Breakwater or Sumay Cove project areas; however, the NMFS proposal encompasses portions of green turtle critical habitat within the project area. The proposed green turtle critical habitat is not located where construction activities would be conducted.

Hard Corals

A. globiceps is a reef-building, branching hard coral species found in the Indo-Pacific listed as threatened under the ESA by NMFS in 2014 (79 FR 53852). On Guam, *A. globiceps* is widely distributed on reef flats and upper reef slopes around the island and seems to favor conditions where reasonably intense wave motion is possible. In Apra Harbor, coral-supporting shallow reef flats are present in Sasa Bay, San Luis, Gab Gab, and Spanish Steps (DoN 2022a).

In September 2016, a small colony of *A. globiceps* was documented outside Apra Harbor at Dadi Beach (DoN 2022a). Marine surveys conducted in 2024 documented 20 colonies of *A. globiceps* within the Proposed Action area along the northern and southern aspects of the Glass Breakwater. Based on the area surveyed, the extrapolated estimate of *A. globiceps* colonies is approximately 120 (**Figure 3-3**) (DoN 2024b)). It is estimated that approximately one third, or 37 (up to 47 maximum) *A. globiceps* colonies, would be large enough to translocate. Apra Harbor was excluded from the critical habitat designation

proposed by NOAA in 2020 (88 FR 83644); therefore, no critical habitat for *A. globiceps* is designated or proposed within the project area.

The ESA-listed threatened *A. retusa* has also been reported on both the Outer and Inner Breakwaters (DoN 2022a). This species is considered uncommon and rare and was not documented during 2024 surveys within the project areas (DoN 2005). Apra Harbor was excluded from the critical habitat designation proposed by NOAA in 2020 (88 FR 83644); therefore, no critical habitat for *A. retusa* is designated or proposed within the project area.

Birds

Nine MBTA-protected birds, one of which is also ESA-listed as endangered, *Gallinula chloropus guami* (Mariana common moorhen), have been observed on or around Apra Harbor (**Figure 3-3**). The Mariana common moorhens prefer freshwater habitat, but can occasionally be found in limited brackish or mangrove habitats as well. Historically few individuals (e.g., one to two) have been documented in the wetlands around the project area, most recently in 2014 (DON 2022a). The majority of the MBTA-protected bird species are found on mud and reef flats; the coastal islets, reef flats, wetlands, grassy fields, and other open areas on NBG Main Base provide seasonal foraging habitat for migratory bird species. No MBTA-protected birds, or the Mariana common moorhen, have been documented at the project areas.

3.3.3.4 Essential Fish Habitat

All water column and benthic nearshore resources and submerged lands under the management responsibility of JRM are designated as EFH under the MSA. EFH on Guam may include streams, estuaries, and offshore subtidal habitats that may be important for marine and anadromous fish species. Seagrass is also designated as an EFH pursuant to the MSA (DoN 2022a). **Table 3-12** lists the EFH within the project area.

Table 3-12. Essential Fish Habitat within the Project Area

MUS	Species Complexes	Description of EFH in Action Area	HAPC in Action Area?
Pelagic	Temperate species Tropical species Sharks Squid	Eggs and larvae: the water column down to a depth of 200 meters (3,281 feet) from the shoreline to the outer limit of the EEZ. Juveniles and adults: the water column down to a depth of 1,000 meters (3,281 feet) from the shoreline to the outer limit of the EEZ.	No HAPCs located within Apra Harbor or the project area.
Bottomfish	Shallow-water species (0–50 fathoms) Deep-water species (50–200 fathoms)	Eggs and larvae: the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 400 meters (1,312 feet). Juveniles and adults: the water column and all bottom habitat extending from the shoreline to a depth of 400 meters (1,312 feet), encompassing steep drop-offs and high-relief habitats that bottomfish use throughout the Western Pacific Region.	No HAPCs located within Apra Harbor or the project area.

Source(s): WPRFMC 2009a, WPRFMC 2009b
Key: EEZ – Exclusive Economic Zone; EFH – Essential Fish Habitat; HAPCs – Habitat Areas of Particular Concern; MUS – Management Unit Species

EFH has been designated within the project area for various Management Unit Species (MUS) and life stages, including eggs, larvae, juveniles, and adult bottomfish and Pacific pelagic species, and all life stages of coral reef fauna and flora that comprise Mariana Islands coral reef ecosystems (NMFS 2024a). In addition to EFH, the Western Pacific Regional Fishery Management Council (WPRFMC) or Council has designated Habitat Areas of Particular Concern (HAPC) within EFH for all MUS. HAPCs are specific areas that are considered essential to the life cycle of MUS based on one or more of the following criteria:

(1) the ecological function provided by the habitat is important;

(2) the habitat is sensitive to human-induced environmental degradation;

(3) development activities are, or will be, stressing to the habitat type; or

(4) the habitat type is rare. The Council designated all slopes and escarpments between 40 and 280 meters as HAPC for bottomfish based on the known distribution and habitat requirements of adults (WPRFMC 2009a).

3.3.4 Environmental Consequences

The ROI for the analysis of impacts on biological resources includes the air, land, and marine areas in the vicinity of the Glass Breakwater and Sumay Cove.

3.3.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. Under the No Action Alternative, adverse impacts on biological resources would include continued erosion of rock and stone along the slopes of the breakwater, under normal wave action, leading to damage, destruction, and take of native and protected species, as well as associated EFH. In these conditions, impacts would range from moderate to significant over time. A breach of the breakwater would result in substantial loss of corals, coral habitat, and EFH in the harbor, significantly and adversely affecting those resources.

3.3.4.2 Alternative 1

General Biological Resources: Marine species present in the project areas are expected to be habituated to noise disturbances because of the urbanized environment and vessel traffic; however, there could be short-term, minor, adverse impacts to all marine species from construction-associated noises, suspended sediments in the water, and a reduction in water quality during rock armor placement, pile driving, and vessel use associated with construction activities. There would be short-term, negligible, adverse impacts on marine species from potentially leaked pollutants and sediment plumes associated with construction activities. Adverse impacts of pollutants would be minimized by the implementation of BMPs, and sediment plumes are expected to dissipate quickly due to high wave and current energy. At Sumay Marina docks and wave attenuator work, sediment plumes would be contained by the silt curtain and would not extend over large areas.

There would be short-term, negligible, adverse impacts from vegetation clearing and earthwork around the project areas that would be necessary to create work and access areas for construction activities, the concrete casting yard, and vehicles. No protected species have been documented on or around these areas, and they would be considered low-quality habitat for native or protected species. Additionally, these areas have been developed and disturbed through the years. The Contractor would be required to develop and adhere to a Hazard Analysis and Critical Control Point (HACCP) Plan to ensure no terrestrial or marine invasive species were transported to or from the laydown and concrete casting yard work areas.

Because Guam was an active location for WWII battles, munitions and explosives of concern (MEC) are always a consideration and have been discovered within and around Apra Harbor. It is possible that MEC could be discovered during construction surveys to find cleared sandy bottom areas for installation of mooring piles. If found, the removal or disposal of MEC could contribute to short-term, adverse impacts to marine species or EFH depending on the discovery location. The level and scale of impacts would be dependent on the type, location, and removal method of MEC. In the unlikely event that a UXO may be detonated in the marine environment, nearby marine resources are exposed to physical impacts from shrapnel and effects of a pressure wave. The size and type of munition, depth of detonation, and oceanic conditions determine the radius and effect of a blast.

Marine Vegetation and Non-Coral Benthic Invertebrates. There would be short- and long-term, moderate, adverse impacts on marine vegetation and non-coral benthic invertebrates from temporary disturbance and permanent removal of up to 11.6 underwater acres at the Glass Breakwater (including up to 11.4 acres on the Philippine Sea side and 0.2 acres on the leeward side) and repair activities at Sumay Cove as a result of in water construction activities. Impacts would be contained within the existing footprints; however, sessile species would be unable to voluntarily relocate and would thus be permanently removed.

Marine Wildlife and Protected Species. Short- and long-term, minor to moderate, adverse impacts on native corals and clams that are not ESA-listed would be similar to what was described for marine vegetation and non-coral benthic invertebrates. To the degree practicable, impacts would be minimized by avoiding in-water work during spawning periods.

There would be short-term, minor, adverse impacts to native fish, ESA-listed endangered sea turtles, and threatened scalloped hammerhead sharks during in- and out-of-water construction activities. Impacts would be minor because it is assumed that individuals will move to adjacent suitable habitat to avoid physical disturbance and construction-associated noise. There could be short-term, negligible, adverse impacts from potential vessel strikes or entanglement with construction-associated trash or debris. Navigation for crane and material barges will be based on safety, traffic at the time of transit, weather conditions, and established navigation channels. However, barges and vessels will utilize existing established deep water transportation corridors as possible. When transiting in shallower water, there will be observers on the boats for navigating to avoid areas of coral. The number of vessel/barge trips would be a maximum of 3 per day but more likely 1-2 per day. While all vessels will use established vessel transit routes and project debris and trash will be controlled so as not to enter harbor waters, it is possible individual species could be struck or entangled. The Sumay Cove turbidity curtain, if necessary, would also be expected to be a barrier to individuals approaching project area and potentially becoming entangled. Since species that could be potentially impacted are motile species, it is expected individuals would avoid being struck and entangled. Additionally, with the exception of the green turtle, there are very few documented occurrences of any of these species within the harbor (**Section 3.3.3**). The limited size of the project area along outer shorelines of Glass Breakwater and in Sumay Cove, combined with dedicated marine observers and the 46-meter (50 yard) shutdown zone, further reduces potential impacts. It is expected species would return to the area shortly following completion of construction activities in 2030.

There are no known sea turtle nesting beaches in close proximity to the project area (**Figure 3-3**), and the portion of Glass Breakwater to be repaired is unlikely to support sea turtle nesting activity due to its rocky shoreline and limited amount of sandy coastal habitat. Some sections of Sumay Cove may support sea turtle nesting; however, the Sumay Cove project area consists primarily of armored shoreline, which is not suitable sea turtle nesting habitat.

Of the extrapolated estimate of 120 *A. globiceps* colonies, approximately 37 (up to 47) are expected to be large enough to be successfully translocated resulting in a maximum loss of up to 83 *A. globiceps* colonies. Therefore, there could be a permanent loss of up to 83 colonies of the ESA-listed threatened hard coral, *A. globiceps*, which has been documented on the north and the south aspects of the Glass Breakwater (**Figure 3-3**). In addition to the conservation measures, and to the degree practicable, adverse impacts to *A. globiceps* would be further minimized by avoiding in-water work during coral spawning periods to avoid sensitive spawning times and maximize reproductive success. The Navy submitted a biological assessment to NMFS with a request for formal consultation per Section 7 of the ESA on February 7, 2025. A biological and conference opinion (BO; PIRO-2025-00832) was received from NMFS on July 28, 2025 which included an incidental take statement for up to 150 *A. globiceps* colonies and concluded that Proposed Action would not appreciably reduce the likelihood of the survival and recovery of wild *A. globiceps*; therefore, implementation of the Proposed Action is not likely to jeopardize the continued existence of *A. globiceps*. **Table 2-2** lists the required measures from the BO that would be implemented to avoid, minimize, or mitigate effects on protected species and habitats. A full copy of the BO is provided in **Appendix C**.

***Birds*.** The project areas are not suitable nesting habitat for any of the protected birds documented around Apra Harbor. It is possible individual birds, including the Mariana common moorhen, could be flying above or foraging near the project areas and could be disturbed by construction-associated noises. Therefore, there could be short-term, negligible, adverse impacts to MBTA-protected species, and the ESA-listed Mariana common moorhen. MBTA-protected birds would be expected to continue on their flight trajectory to suitable habitat, and any protected birds that might use Apra Harbor to forage would be expected to conduct that activity in another suitable part of the ROI. While the Mariana common moorhen has been documented around Sumay Cove in freshwater wetland habitats, this species has not been documented frequently around the project area. The most recent occurrence occurred in 2014 when one adult Mariana common moorhen was documented in the northern pond of the Sumay wetlands (DoN 2022a). No surveys have been conducted on noise impacts to the Mariana common moorhen; however other studies have noted that birds and other wildlife have been documented to become habituated to aircraft overflights and other noises after continuous or frequent exposure (e.g., Knight & Gutzwiller 1995, Shannon et al. 2016, USAG-HI 2001). Additionally, this area of the installation has consistent human and vehicular traffic. Therefore, it is expected any individuals in the vicinity of the project area are habituated to human noise and would not be bothered by ambient construction noise or activities. See **Section 2.5** for BMPs to avoid or minimize effects on moorhen that may be near the project area.

***EFH*.** Short-term, minor, adverse impacts on EFH are anticipated from actions occurring directly within or around the EFH from construction and repair activities. Around the Glass Breakwater there are estimated 37 *A. globiceps* colonies of appropriate size for translocation, and up to 47 colonies could be moved to account for small or conspicuous colonies. In addition, 844 colonies of other coral species are candidates for translocation from the breakwater, and 11 coral species colonies are candidates for translocation from the Sumay revetment area, totaling up to 902 colonies that could be translocated. The Proposed Action will temporarily reduce water quality in the immediate Project footprint from increased turbidity and suspended sediments during in-water work; however, minimal or no disturbance of the bottom is expected at the Sumay Point revetment. Additionally, the Proposed Action will contribute to degradation of the in-water soundscape, resulting in potential loss of sessile organisms, including corals and benthic invertebrates, and comprise some life stages of bottomfish MUS and pelagic MUS for the duration of pile installation and removal. Considering the location of the EFH combined with the existing and ongoing harbor traffic, these impacts would be considered minor. The Navy

submitted an EFH assessment to NMFS with a request for EFH consultation per the MSA on March 28, 2025. On April 30, 2025 the NMFS concurred with the Navy's March 28, 2025 EFH effects determination and recommended eleven additional conservations measures (listed in **Table 2-2**) to be implemented to avoid, minimize, offset for, or otherwise mitigate adverse effects on EFH. On May 28, 2025, the Navy agreed to implement the NMFS recommended conservation measures which concluded the EFH consultation as documented in the NMFS July 25, 2025 BO (PIRO-2025-00832) (see **Appendix C**).

The NMFS BO also noted two EHF mitigation actions to be implemented to offset unavoidably lost functions and services provided by coral and other biota through two mitigation actions as part of this proposed action.

1) Restoration of seagrass habitat (up to 9 acres [396,112 ft^2] to buffer for the percentage of grasses that may not survive and still successfully offset the majority of the estimated total 7.14 acres [315,461 ft^2] of lost EFH through out-of-kind and off-site mitigation by restoring and improving seagrass habitat at Dadi Beach) and

2) Enhancement of habitat that promotes coral settlement with crustose coralline algae. **Table 2-2** lists the summary of activities required for these EFH mitigations to restore and replace EFH area and function.

***Critical Habitat*.** If green turtle critical habitat is designated, there would be short-term, negligible, adverse, and long-term, moderate, beneficial impacts to NMFS proposed green turtle critical habitat. Short-term adverse impacts would be anticipated from construction-related noise and physical disturbance, and long-term beneficial impacts would be anticipated from increased protections from the Apra Harbor repairs.

BMPs discussed in **Section 2.5** will be implemented to minimize the general adverse impacts discussed throughout this section.

Once repairs are complete, the Glass Breakwater would have no associated operations and/or maintenance activities. Sumay Cove would have short- and long-term, negligible, adverse impacts from the resumption of normal boating operations and any associated maintenance of floating docks and floating wave attenuator. Long-term operational and short-term maintenance activities could introduce noise and pollutants. These impacts are considered negligible because it is assumed that species that return to the cove are habituated to human activities, and any leaked chemical pollutants would be minimized by the implementation of BMPs and standard operating procedures (SOPs).

Overall, the Proposed Action would result in significant adverse impacts resulting from take of up to 150 colonies of ESA-listed species (*A. globiceps*). The Navy has coordinated with NMFS to identify appropriate mitigation and conservation measures to avoid or minimize adverse impacts (see **Table 2-2** for the list of measures and **Appendix C** for consultation documentation). The Proposed Action is not expected to appreciably diminish EFH or general habitat value long term. Marine species would be expected to re-colonize or repopulate the project areas and would experience long-term, beneficial impacts from the additional protections the Proposed Action would provide.

3.3.4.3 Cumulative Impacts

Cumulative impacts from past, present, and reasonably foreseeable actions on biological resources could be associated with the implementation of the Proposed Action. The repairs at the Glass Breakwater, Sumay Marina Floating Dock, Sumay Cove Wave Attenuator, and Sumay Point Revetment Restoration could impact vegetation, decrease available habitat, and create short-term noise and sediment plumes that could impact vegetation and marine wildlife. There would not be cumulative

impacts with other projects within Apra Harbor because the identified effects for individual projects are generally localized, would minimally overlap, and would occur where few native wildlife and no protected species have been documented. While there are anticipated adverse impacts to protected coral species from the Proposed Action along the Glass Breakwater, measures (see **Table 2-2**) that would minimize these effects would be implemented and the anticipated impacts would not be compounded by other proposed projects within Apra Harbor.

3.4 Cultural Resources

3.4.1 Description of the Resource

Cultural resources include the physical evidence associated with human activities. This includes precontact and historic archaeological sites, buildings, structures, objects, and elements or areas of the natural landscape. Cultural resources include *historic properties,* defined in the NHPA as any precontact or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP). The term *historic properties* also include traditional cultural properties (TCPs). TCPs are eligible for inclusion in the NRHP for association with cultural practices or beliefs of a living community. Such practices or beliefs are important in maintaining the continuing cultural identity of the community. TCPs may include archaeological sites, buildings, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and/or minerals that Native Americans or other groups consider essential for the preservation of their identity or way of life.

3.4.2 Regulatory Setting

The Navy has prepared this EA based upon federal and state laws, statutes, regulations, and policies pertinent to the implementation of the Proposed Action, as detailed in **Section 1.7**. Federal laws and regulations governing cultural resources include the NHPA of 1966, Archeological and Historic Preservation Act of 1974, American Indian Religious Freedom Act of 1978, Archaeological Resources Protection Act of 1979, and Native American Graves Protection and Repatriation Act of 1990. Federal agencies' responsibility for preserving historic properties is defined primarily by Sections 106 and 110 of the NHPA. Section 106 requires agencies to consider the effects of their actions on *historic properties,* and Section 110 mandates proactive identification and management of cultural resources.

3.4.3 Affected Environment

The ROI for cultural resources is referred to as the area of potential effects (APE). The APE is the geographic area or areas within which an undertaking may disturb archaeological resources and/or directly or indirectly cause alterations in the character or use of historic properties. In this context, an undertaking is defined as a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including, among other things, processes requiring a federal permit, license, or approval. The term undertaking is synonymous with the Proposed Action and includes any identified sites where laydown, demolition, and construction activities would occur (see **Figure 1-1**).

The proposed Glass Breakwater repairs would occur in the outer Apra Harbor and the proposed Sumay Marina repairs would occur within Apra Harbor's Sumay Cove. The APE is defined as the project limits encompassed by the Proposed Action. The APE includes 46.16 acres (186,803.1 square meters) and consists of an area within and immediately adjacent to the Glass Breakwater within Apra Harbor, the Sumay Cove area encompassing Sumay Marina and Sumay Point, and the various construction laydown, casting yards, and loading areas shown in **Figure 1-1**.

The Navy has conducted nine archaeological, architectural, and cultural resources surveys within the APE (**Table 3-13**). Only one of the surveys included subsurface testing. None of these surveys identified any historic properties in the APE.

Table 3-13. Cultural Resources Surveys Within Area of Potential Effects

Author	Date	Type of Investigation	Location
Carrell	1991	Underwater Survey	Apra Harbor
Lauter-Reinman	1997	Management Survey of WWII Resources	NBG
Yoklavich and Reinman	1997	Surface Survey and Architectural Survey	Naval Hospital and Ship Repair Facility
Hunter-Anderson, Dixon, and Mangieri	2001	Surface and Subsurface Survey	Polaris Point
Mason and Weitze	2009	Architectural Inventory Survey	NBG
Aaron	2011	Cold War Context and Historic Properties Overview	NBG
Dixon, Walker, and Carson	2011	Surface Survey	Cabras Island
Carrell, Krivor, Burns Pruitt, and Wright	2020	Underwater Survey	Apra Harbor
Meehl	2025	Cultural Resources Surface Survey	Clipper Cove

Key: WWII – World War II; NBG – Navy Base Guam

3.4.3.1 Archaeological Resources

There is one known archaeological site located within the APE (**Table 3-14**). Additionally, submerged historic-period sites, and a village are known in the vicinity of the APE.

Table 3-14. Archaeological Sites Located Within Area of Potential Effects

GHPI Site No.	Site Name	Recorded By	Site Type	NRHP Status
66-03-1723	GL024	Hunter-Anderson, Dixon, and Mangieri 2001.	Post-WWII Fuel Storage Facility	Not Eligible

Key: GHPI – Guam Historic Properties Inventory

The Glass Breakwater is a structure consisting entirely of fill material, with no archaeological sensitivity (Aaron 2011; Lauter-Reinman 1997; Mason and Weitze 2009). Four submerged archaeological sites are known near the APE for the breakwater: *Yosemite 2* (Guam Historic Properties Inventory [GHPI] Site No. 66-03-2206), American Tanker (GHPI Site No. 66-03-1078), Unnamed Wreck (GHPI Site No. 66-03-2191) and Val Bomber (GHPI Site No. 66-03-1087) (Carrell 1991; Carrell et al. 2020). In discussions and correspondence between the Navy and the Guam SHPO between December 2023 and February 2024, the APE for the emergency repairs to the Glass Breakwater was determined to not include adjacent

submerged archaeological sites in Apra Harbor. Documentation of the consultation between the Navy and Guam SHPO is provided in **Appendix D**.

At Sumay Cove, all work will be performed on the Sumay Peninsula, which is recent fill (Meehl 2025). The western shore of Sumay Cove was once the location of a small but active village, and the submerged remains of two WWII-era Japanese seaplanes are located west of Clipper's Landing. The boundaries of Sumay Village are approximately 25 meters (82 feet) from the existing shoreline. Most historic features were found around 150 meters (492 feet) from the present shore. Several archaeological excavations have been completed in this area from 1997 to 2007. The former village site currently occupies a portion of the Navy Main Cantonment, which would be unaffected by the Proposed Action (NAVFAC PAC 2010a). Similarly, the submerged aircraft wrecks are located outside of the APE. Based on previous studies, no historic properties are known to be located within the filled land between Clipper Landing and Sumay Cove and there are unlikely to be undiscovered historical/cultural resources within this portion of the APE (Meehl 2025).

The primary concrete casting yard west of Route 1 on Polaris Point overlaps the recorded location of GHPI Site No. 66-03-1723 (GL024), a post-WWII fuel storage facility consisting of pavements, roads, berms, and concrete foundations. The site was evaluated as *not eligible* for listing in the NRHP (Hunter-Anderson et al. 2001). Backhoe trenches excavated at the site indicate that soils consist of post-WWII fill and that the pre-war shoreline was located east of Route 1. One NRHP-eligible archaeological GHPI Site No. 66-03-1722 (GL010b), is located outside of the APE approximately 300 meters (983 feet) from the proposed casting yard, across the access road to Polaris Point. The resource, which was shovel tested in 2000, consists of a limestone rockshelter complex with prehistoric cultural materials and a subsurface component that includes at least one burial (Hunter-Anderson et al. 2001).

No archaeological resources are known at or near the barge loading area, which is located on the manmade Glass Breakwater (Aaron 2011; Lauter-Reinman 1997; Mason and Weitze 2009); the contingent loading yard, located on post-WWII fill land (Yoklavich and Reinman 1997); or the secondary concrete casting yard located at the former site of the Cabras quarry, which was used as a borrow pit for construction of the breakwater (Dixon et al. 2011).

3.4.3.2 Architectural Resources

The Glass Breakwater was constructed between 1941 and 1946 and the only architectural resource located in the APE, is *eligible* for inclusion in the NRHP (Aaron 2011; Lauter-Reinman 1997; Mason and Weitze 2009). The Glass Breakwater has been previously disturbed within the APE from construction of the service road along the crest and from damage related to multiple storms and typhoons. Extensive natural wave battering and erosion have also damaged the structure over time. The Proposed Action will utilize like-kind materials for the breakwater repair. Armor stones/CAUs will match existing erosion measures along the breakwater and will have minimal effects on the architectural integrity of the breakwater or surrounding visual landscape. Repairs of the Glass Breakwater are essential to maintain and ensure structural integrity. Failure to provide these repairs would lead to further damage to the historic property.

The Pontoon Pier K Site is within the APE for the Sumay Point shoreline protection. The pier is significantly deteriorated, has been altered by later seawall repair projects, and is *not eligible* for inclusion in the NRHP (Meehl 2025).

3.4.3.3 Traditional Cultural Properties

A TCP study for Guam was conducted in 2009, which included interviews, existing information on archaeological sites, ethnographic associations, and Chamorro myths (Griffin et al. 2010, cited in SEARCH 2015). The study is considered preliminary in scope and additional research and consultation would be required to further define and evaluate the potential TCPs identified therein. According to the 2015 ICRMP, the remains of Sumay Village (GHPI Site No. 66-03-1038) was the only site located at NBG identified as a potential TCP in Griffin et al. (2010). Sumay Village is a documented seventeenth-century community located on the north coast of the Orote Peninsula, outside the APE.

3.4.4 Environmental Consequences

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Direct impacts may be the result of physically altering, damaging, or destroying all or part of a resource; altering characteristics of the surrounding environment that contribute to the importance of the resource; introducing visual, atmospheric, or audible elements that are out of character for the period the resource represents (thereby altering the setting); or neglecting the resource to the extent that it deteriorates or is destroyed. Indirect effects to historic properties are those caused by the undertaking that are later in time or farther removed in distance but are still reasonably foreseeable.

3.4.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. Natural wave battering and erosion would continue to occur and damage the structure over time. Forthcoming storms and typhoons would accelerate damage to the structure. Failure to provide these repairs will lead to further damage and eventual destruction of the breakwater, which is an NRHP-eligible historic property. Therefore, potentially significant adverse impacts to cultural resources could occur with the implementation of the No Action Alternative.

3.4.4.2 Alternative 1

No adverse effects on cultural, historical, or archeological resources would be anticipated during construction for the Proposed Action under Alternative 1.

Although one archaeological site is located within the APE at the primary concrete casting yard, the site is not eligible for inclusion in the NRHP. The construction footprints at the other construction laydown areas, Glass Breakwater, or Sumay Cove do not overlap any archeological sites located near the APE. The Pontoon Pier K Site, an architectural resource within the APE for the Sumay Point shoreline protection, is *not eligible* for inclusion in the NRHP.

The NRHP-eligible Glass Breakwater itself would have integrity restored with no appreciable changes to the visual or structural historic integrity. In consideration of the information on underwater archaeology and the built environment, DoN determined that there would be *no adverse effect* on historic properties located within the Navy-owned portions of the proposed project area. The Navy carried out consultation with the Guam SHPO regarding the potential for impacts on resources at or near Project locations on Guam-owned land. On March 13, 2025, the Navy submitted a letter to the SHPO as an addendum to the previous Section 106 Consultation for Emergency Repairs to Glass Breakwater requesting concurrence with the Navy's finding of "No Adverse Effect". The Guam SHPO concurred with the Navy's finding on March 21, 2025. Documentation of the consultation is provided in **Appendix D**.

In the unlikely event that historic properties are inadvertently discovered within the Project's APE during activities associated with the subject undertaking, then the SOPs contained within the *Final Integrated*

Cultural Resources Management Plan NBG, JRM would be followed, as well as provisions of 36 CFR 800.13, *Post-Review Discoveries*.

No long-term adverse impacts on cultural resources are anticipated from the presence of the breakwater or ongoing activities within Apra Harbor or Sumay Cove. Further, long-term, beneficial impacts on cultural resources would be anticipated from a restored and stabilized breakwater that would continue to protect harbor infrastructure and island development from damaging wave action and inland flooding from Apra Harbor during seasonal and extreme storm events.

3.4.4.3 Cumulative Impacts

Cumulative cultural resource impacts from past, present, and future actions within the ROI would be less than significant. No historic properties or archeological sites would be impacted by the proposed action. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects would not result in significant impacts within the ROI.

3.5 Geological Resources

3.5.1 Description of the Resource

The following discussion of geological resources includes marine substrates that may be impacted by pile driving activities and in-water work. Geological resources consist of the Earth's surface and subsurface materials. Within a given physiographic province, these resources typically are described in terms of geology, topography, and physiography; soils; and geologic hazards, where applicable.

Geology is the study of the Earth's composition, which provides information on the structure and configuration of surface and subsurface features. Topography and physiography pertain to the general shape and arrangement of the land surface, including its height and the position of its natural and human-made features. The geology of an area may include bedrock materials, mineral deposits, and fossil remains. Bedrock is relatively hard, consolidated rock beneath surface materials, such as soil or gravel, and can be made of most types of rock (e.g., granite, limestone, sandstone). Some bedrock structures may not be suitable to support infrastructure due to instability, such as heavily fractured bedrock or karst topography. Soils are the unconsolidated earthen materials overlying bedrock or other parent material. Soils are typically described in terms of their complex type and physical characteristics. Differences among soil types, in terms of their structure, elasticity, strength, shrink-swell potential, and erosion potential, affect their abilities to support certain applications or uses. In appropriate cases, soil properties must be examined for their compatibility with particular construction activities or types of land use. Geologic hazards are natural geologic events that can endanger human lives and threaten property. Examples of geologic and related natural hazards include erosion, earthquakes, typhoons, tsunamis, landslides, ground subsidence, and sinkholes.

3.5.2 Regulatory Setting

The following are federal and local regulations that would govern the proposed Project activities pertaining to geological resources.

In-water Construction Activities. Section 10 of the Rivers and Harbors Act (RHA) (33 CFR 320) requires Section 10 approval from the USACE prior to initiating in-water construction activities in navigable waters. Regulated in-water activities include any action that affects the course, location, and capacity of navigable waters, including construction, excavation, or deposition of materials that take place in, on, above, or underneath navigable waters. Section 10 permits are required along with permits under Section 404 of

the CWA (33 CFR 323). A Section 10 permit may be required for repair of the Sumay Point revetment area, restoration of the finger piers, and construction of the new attenuator. The applicable permit would include permit conditions and measures to limit the Project-related impacts on geological resources.

Dredge or Fill Activities. Section 404 of the CWA authorizes the Secretary of the Army, acting through the Chief of Engineers, to issue permits for the discharge of dredge or fill material into wetlands and other Waters of the United States (WOTUS). The Section 404 permitting process protects WOTUS, including wetlands, by authorizing only necessary and unavoidable impacts, including filling, soil movement, and placement of certain pilings in wetlands. Discharges of dredged or fill material (would include rock and CAU placement) are regulated for all waters (and wetlands) regardless of size.

The repairs of the Glass Breakwater and Sumay Cove infrastructure may be eligible for a Department of the Army Individual Permit. Glass Breakwater, Sumay Cove, and Sumay Point project actions would be within previously authorized footprints of these structures. An Individual Permit may require a public interest review and a public notice period, which would be carried out by USACE. Individual permits are generally issued for projects with potentially greater than minimal impacts and therefore requiring a more comprehensive review process. A pre-construction notification must also be submitted to the USACE Honolulu District Engineer prior to commencing the activity.

Guam Soil Erosion and Sedimentation Control Plans. The Guam EPA (22 Guam Administrative Rule [GAR] 10103, 10106, 10107, and Water Pollution Control Act [10 Guam Code Annotated Chapter 47]) and Guam Department of Public Works (GDPW) require that development or construction activities that involve clearing, grading, filling, excavating, and other earth-moving operations must follow an approved erosion control plan. Regulations promulgated under 22 GAR Chapter 66 as amended) apply to “clearing or earth-moving operation including those performed by private and governmental sectors, including the government of Guam and federal agencies on Guam. The Guam EPA Administrator must review every application for a permit for earth-moving operations to determine applicability or exemption...”.

Fill Importation Permit. 8 GAR Chapter 13, Importation of Sand, Quarried, or Mined Products, requires that an import permit be obtained prior to the loading of the sand, quarried, or mined products on a vessel to ensure compliance with required certificates and documents. The proposed Project would involve the importation of fill materials (soil, aggregate, and stone) for the breakwater restoration and Sumay Cove shoreline restoration. Bedrock would be imported to the island via ship/barge and transported to the breakwater repair areas via truck along the breakwater crest road. As a BMP for vessel transits to Guam, the Navy will require contractors to comply with 8 GAR Chapter 13 and EO 92-37, which require an import permit to be obtained prior to the loading of sand, quarried, or mined products on a vessel.

3.5.3 Affected Environment

The following discussion describes the geological resources within the breakwater restoration site (landside and marine substrate) and Sumay Cove area (marine resources and upland soils).

The Glass Breakwater is a long, narrow, manmade revetment structure consisting entirely of fill material (Siegrist et al. 2007) that separates the Outer Apra Harbor from the Philippine Sea. The man-made breakwater borders Apra Harbor to the north and consists of reclaimed sandy/rocky coastal substrate. The Glass Breakwater is characterized by large boulders arranged on steep slopes with only a few small sand deposits (**Figure 3-4**). The physical environment on the Philippine Sea side of the breakwater is a highly dynamic area with considerable energy caused by currents and waves. The marine substrate in this location is very hard and primarily consists of large limestone boulders and reef-forming materials.

In addition, due to strong wave action and water currents, ongoing exposure to tropical storms and major typhoon events, such as Super Typhoon Mawar in 2023, a substantial volume of armoring rock has been dislodged, leading to the failure of multiple sections of the breakwater where the stones have fallen into the Philippine Sea. Soils, aggregates, and larger stones continue to erode into the nearby water areas. While the inner portion of the breakwater is less dynamic than the outer area, the marine substrate in this area is also comprised of rocky substrates and reef-forming materials.

Sediments in the marine environment of Apra Harbor consist mainly of coral, mud, and sand. The most common soil type in the Apra watershed is known as As Ylig, a clay-rich, poorly drained soil commonly found along the volcanic slopes and in drainage-ways of southern Guam. These soils are composed of highly eroded, volcanic rock and alluvium derived from saprolitic tuff and tuff breccia (DoN 2020a). In 2019, site-specific field investigations analyzed geotechnical data from several boring samples collected in nearby Inner Apra Harbor (Earth Mechanics 2019).

Figure 3-4. Photo of large boulders and concrete blocks falling down the steep incline at the head of the Glass Breakwater armored shoreline.

Sumay Cove was artificially created, and there are no high-value soils. The harbor bottom sediments within the Sumay Cove project area consist mainly of silt. The soil within the Project footprint is considered coastal fill (Siegrist et al. 2007) and classified as Urban Land-Ustorthents complex, nearly level. This soil map unit is 60 percent Urban Land, 30 percent Ustorthents, and 10 percent of other minor components. Urban lands consist of areas that are filled with crushed rock or other material resistant to weathering. Urban lands are impermeable to water, and runoff is very rapid. Ustorthents have a slope of 0 to 5 percent and have a low shrink-swell potential. The permeability of Ustorthents is moderately rapid, and runoff is slow. Both soil components consist of quarried fill material commonly resting directly on limestone (United States Department of Agriculture 1988). The most common soil type in the Apra watershed is known as As Ylig, a clay-rich, poorly drained soil commonly found along the volcanic slopes and in drainage-ways of southern Guam. These soils are composed of highly eroded volcanic rock and alluvium derived from saprolitic tuff and tuff breccia (DoN 2020a).

Most of Sumay Cove's floor and channel are composed of sand (Burr et al. 2010; Naval Facilities Engineering Systems Command [NAVFAC] Marianas 2011). Ninety to one hundred percent of the bottom of Sumay Channel is considered to be uncolonized sand (NAVFAC Marianas 2011). According to NAVFAC Marianas (2011), the port area close to Sumay Point is made up of 50–90 percent uncolonized sand and aggregate reef with 50–90 percent coral. Sumay Cove’s very shallow nearshore waters have a lot of silt

and mud and uneven bottoms. Due to a lack of storm water controls (detention/retention facilities), sediments currently move as part of overland sheetflow into the coves. These sediments consist primarily of the fine limestone fill that was used to create Sumay Peninsula. In the water, these sediments are light and are easily resuspended, increasing overall turbidity and reducing visibility in the cove.

3.5.4 Environmental Consequences

The ROI for the analysis of impacts on geological resources includes Outer Apra Harbor land and marine substrate in the vicinity of the Glass Breakwater and Sumay Cove. Protection of unique geological features, minimization of soil erosion, and the siting of facilities in relation to potential geologic hazards are considered when evaluating potential impacts of an installation development project on geological resources. Generally, adverse impacts can be avoided or minimized if proper construction techniques, erosion-control measures, and structural engineering design are incorporated into Project development.

Impacts on geological resources from the Proposed Action would be considered significant if they would substantially alter the lithology (i.e., the character of a rock formation), stratigraphy (i.e., the layering of sedimentary rocks), and geological structures that control groundwater quality, distribution of aquifers and confining beds, and groundwater availability, or would substantially change the soil composition, structure, or function within the environment.

3.5.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur, and there would be no change to baseline geological resources. There would be continued long-term adverse effects on adjacent substrates from the steady deterioration of the Glass Breakwater and marina infrastructure in Sumay Cove. If the breakwater is breached, severe wave action and siltation/erosion of the Outer Apra Harbor would continue to occur. Under the No Action Alternative, failure of the breakwater would continue to spread, broadening the ongoing minor to moderate adverse impacts of sedimentation and erosion during regular wave action and water currents on the Philippine Sea side and head of the breakwater. These would continue to be exacerbated by major tropical storms and typhoons. In the event of breakwater breach, impacts on geological resources in and around Apra Harbor would be severe.

3.5.4.2 Alternative 1

Overall, impacts from the implementation of Alternative 1 would result in minor to moderate temporary sedimentation impacts during the deconstruction and rebuilding of the Glass Breakwater and during piledriving and shoreline restoration activities at Sumay Cove. Long-term, moderate beneficial impacts from restored harbor protection and shoreline stabilization would support minimized erosion and sedimentation into nearby waters of Apra Harbor. The following provides a brief discussion on anticipated impacts at the Glass Breakwater and Sumay Cove.

Glass Breakwater

Initial earthwork for site preparation would provide work areas on the breakwater access road to accommodate crane pads and heavy truck traffic on the roadways. Paving and site improvements for the multiple potential construction laydown areas include temporary roadway gravel of the crest access road. It is anticipated that the CAUs would be fabricated on the island at a concrete casting yard co-located with a construction laydown area. The concrete material would be purchased from a local supplier and transported to the casting yard via truck. Landside activities conducted for Alternative 1 would be within the existing breakwater footprint and crest roadway as well as other nearby industrial

areas. Deconstruction of the existing breakwater may lead to minor erosion and sedimentation of the nearby water areas. This would be minimized through the implementation of the installation's Storm Water Pollution Prevention Plan (SWPPP) and a Project-specific Erosion and Sediment Control Plan for the overall Project. Upon completion of construction activities along the breakwater, it would be anticipated that erosion from the crest would be minimized and the area would be restored and improved from the existing condition. If piles are driven to support vessel mooring, the total area of soft bottom converted to hard substrate would be relatively small at up to approximately 4 square yards (yd^2; the total area of up to 16 [up to 20-inch diameter] piles).

The in-water Alternative 1 construction activities would temporarily affect the marine substrates directly surrounding the Glass Breakwater Project site. On the ocean side of the breakwater, where significant "armor" rocks have been displaced or been washed away into the ocean, repair activities would involve strengthening the breakwater toe, relocating armor stone, placing geotextile fabric, adding aggregate, and placing CAUs to strengthen the breakwater. This would involve work above and below the MHHW line. Applicable construction BMPs listed in **Section 2.5** designed to avoid or minimize water pollution and sedimentation would be employed and be expected to minimize the impacts on geological resources.

Sumay Cove

The Sumay Marina dock and wave attenuator pilings would change the substrate in the location the piles are driven from the existing silty sediments to a hard substrate. The maximum total area of harbor bottom converted to hard substrate would be relatively small at up to approximately 31 yd^2 (the total area of up to 56 [up to 20-inch diameter concrete or 36-inch steel pipe] piles). An additional 8 yd^2 could be affected by the driving of 10 (up to 36-inch steel pipe) piles to construct a temporary trestle to support construction. These would be removed following construction. There would also be short-term impacts on the harbor bottom from the anchoring and/or spudding of the pile driving barge. These impacts would be minimal and only last for the duration of the pile driving activity. The area of Sumay Cove that would be converted to hard bottom following the pile driving activity would be relatively small (less than 10 yd^2). Any construction-related impacts to geological resources from the pile driving activities (associated with the pile driving barge) would be minimal and limited to the construction window. Pile driving activities would follow previously permitted protocols.

In addition to pile driving in Sumay Cove, the existing engineered revetment along Sumay Point would be repaired by removing a deteriorated steel structure and restoring the rock revetment protection. The purpose of the revetment repair is to restore an existing, deteriorating shoreline structure with new fill and rock. The proposed revetment repairs and associated infrastructure would be designed and constructed in accordance with Unified Facilities Criteria (UFC) and seismic standards. All construction work would likely occur from the landside. Temporary staging of construction equipment would occur on paved surfaces in the vicinity of the Proposed Action location. Following construction, beneficial impacts to soils would occur from the upgrades to the stormwater management system and pile replacement. Currently, soils located behind the deteriorating steel sheet pile bulkhead have been leaching out into Sumay Cove. Repairing the revetment would reduce the rate of soil erosion. Additional sediment trapping and filters would also be installed as needed. The revetment repair at Sumay Point would be done in previously disturbed and constructed man-made shoreline areas and would not result in long-term, adverse impacts on geological resources.

3.5.4.3 Cumulative Impacts

None of the past or present actions overlap the geological resources ROI for the Proposed Action. Glass Breakwater repairs would remain within the existing historical footprint of the breakwater, and Sumay Cove repairs would include pile driving into soft sediments in the areas where the floating dock and wave attenuator were already constructed. Sumay Point revetment repairs would likewise be in the location of the existing deficient revetment. Therefore, implementation of the Proposed Action combined with past, present, and reasonably foreseeable future projects would not result in significant impacts on geological resources, including marine sediments, within the ROI.

3.6 Hazardous Materials and Waste

This section discusses HAZMAT, HAZWASTE, toxic substances, and contaminated sites. When discussed in this document, HAZMAT includes petroleum, oils, and lubricants (POL); cleaning agents; adhesives; and other products necessary to perform proposed construction activities.

3.6.1 Description of the Resource

HAZMAT is defined by 49 CFR Section 171.8 as "hazardous substances, HAZWASTE, marine pollutants, elevated temperature materials, materials designated as hazardous in the HAZMAT Table, and materials that meet the defining criteria for hazard classes and divisions in 49 CFR part 173."

HAZWASTE is defined by the Resource Conservation and Recovery Act (RCRA), as amended by the Hazardous and Solid Waste Amendments, as: "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (B) pose substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed."

Special hazards are those substances that might pose a risk to human health and are addressed separately from other hazardous substances. Special hazards include asbestos-containing material, polychlorinated biphenyls, and lead-based paint.

3.6.2 Regulatory Setting

Transportation of HAZMAT is regulated by the U.S. Department of Transportation regulations.

Certain types of HAZWASTE are subject to special management provisions intended to ease the management burden and facilitate the recycling of such materials. These are called universal wastes, and their associated regulatory requirements are specified in 40 CFR Part 273. Four types of waste are currently covered under the universal waste regulations: HAZWASTE batteries, HAZWASTE pesticides that are either recalled or collected in waste pesticide collection programs, HAZWASTE thermostats, and HAZWASTE lamps, such as fluorescent light bulbs.

The USEPA has given authority to regulate special hazard substances by the Toxic Substances Control Act. Asbestos is also regulated by USEPA under the CAA and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The Guam EPA stipulates regulations for the management of HAZMAT on Government of Guam lands. The Guam Code Annotated (GCA) enforces federal and local regulations for the management of hazardous substances. Title 10 GCA 76, *Underground Storage of Hazardous Substances Act*, establishes requirements for the management of hazardous substances stored underground. DoD operations conducted on Guam must comply with all Guam EPA hazardous material management requirements.

The Department of Defense (DoD) established the Defense Environmental Restoration Program (DERP) to facilitate thorough investigation and cleanup of contaminated sites on military installations (active installations, installations subject to Base Realignment and Closure [BRAC], and Formerly Used Defense Sites [FUDS]). The Installation Restoration Program (IRP) and the Military Munitions Response Program (MMRP) are components of the DERP. The IRP requires each DoD installation to identify, investigate, and clean up HAZWASTE disposal or release sites. The MMRP addresses nonoperational rangelands that are suspected or known to contain unexploded ordnance, discarded military munitions, or munitions constituent contamination. The Environmental Restoration Program (ERP) is the Navy's initiative to address DERP. Per DoD Regulation 6055.09, Edition 1, Change 1, *DoD Explosive Safety Standards* (February 23, 2024), site and general construction plans must be submitted to the DoD Explosive Safety Board for review and approval prior to construction actions that may occur in areas proximal to quantity distance arcs, explosive materials, or may present explosive concerns.

The DoD has identified certain per- and polyfluoroalkyl substances (PFAS) as emerging contaminants of concern that have affected DoD installations. PFAS are a class of synthetic compounds that possess a chemical structure that gives them unique properties, including thermal stability and the ability to repel both water and oil. This class of chemicals was developed in the 1940s and includes the chemicals perfluorooctane sulfonate (PFOS), perfluorooctanoic acid, perfluorobutanesulfonic acid, perfluorononanoic acid, and perfluorohexane sulfonate. Aqueous film forming foam (AFFF)-containing PFAS was developed in the early 1960s and used at airports, municipal fire stations, petroleum facilities, and in other industries in the United States to extinguish hydrocarbon-based fires effectively. The Navy began using AFFF-containing PFAS as a firefighting agent to extinguish petroleum fires in the 1970s. Firefighters at military installations regularly used AFFF in emergencies or were training with AFFF in an unconfined manner. As awareness of PFAS-related health risks has increased, the Navy has limited the use of PFAS at its installations and continues to investigate and mitigate PFAS-related environmental impacts under CERCLA.

3.6.3 Affected Environment

The following discussions provide a description of the existing conditions for HAZMAT and HAZWASTE potentially impacted by the Proposed Action. **Figure 3-5** shows the locations of known IRP, MMRP, and PFAS sites including known areas with potential explosive concern.

The Navy has implemented a strict Hazardous Material Control and Management Program and a Hazardous Waste Minimization Program for all activities. These programs are governed Navy-wide by applicable Office of the Chief of Naval Operations instructions and at NBG, Apra Harbor by specific instructions issued by the Base Commander. The Navy continuously monitors its operations to find ways to minimize the use of HAZMAT and to reduce the generation of HAZWASTE.

3.6.3.1 Hazardous Materials

HAZMAT Storage, Use, and Handling

Routine operations at DoD installations require the storage, use, and handling of a variety of HAZMAT. Bulk quantities of fuels and other POLs are stored and distributed in aboveground storage tanks and underground storage tanks, pumps, and pipelines. Fueling operations to support aircraft, watercraft, vehicle operations, and emergency power generation require the storage of these bulk quantities of this POL. These POL storage areas represent potential sources of leaks, releases, or spills. DoD installations have management plans for fuels management, spill containment, and cleanup of POL spills and releases. These plans specify that fuel storage facilities have primary and secondary containment and

leak detection features to identify and contain unintended releases, spills, and leaks. In addition, these plans require that the use of HAZMAT be minimized by substituting fewer toxic products, modifying processes, and designing processes to be more efficient, thus requiring the use of less hazardous substances. Naval Supply Command is responsible for issuing HAZMAT to DoD installations and operations at Guam through the Joint Environmental Material Management Services. No HAZMAT or POLs are stored within the proposed project areas.

3.6.3.2 Hazardous Waste

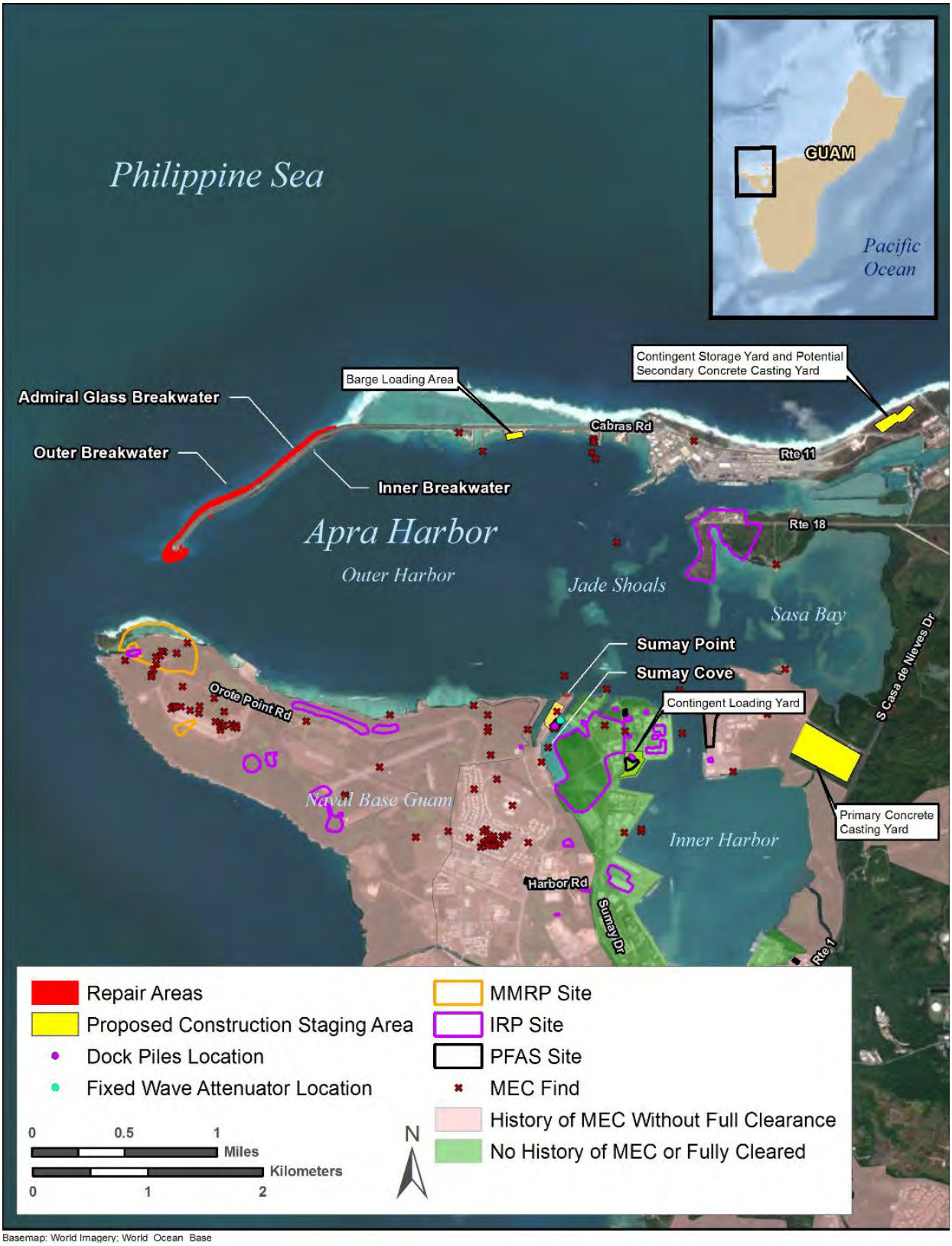
Hazardous Waste Generation and Disposal

Operations at DoD installations generate a variety of HAZWASTE, including, but not limited to medical and dental supplies, adhesives, solvents, lubricants, contaminated absorbents, corrosive liquids, aerosols, herbicides, pesticides, and sludges. In accordance with DoD policies, all facilities must seek to reduce or eliminate HAZWASTE generation by implementing BMPs, SOPs, and best available technologies. DoD 4160.21-M, *Defense Material Disposition Manual*, August 1997, sets forth DoD policy and prescribes uniform procedures for the disposition of DoD waste, including HAZWASTE. The DoD Instruction 4715.4, *Pollution Prevention*, contains general HAZWASTE policy. By policy, the generation and subsequent disposal of HAZWASTE is considered by DoD to be a means of last resort. There are numerous BMPs and SOPs used by DoD to minimize or eliminate the generation of HAZWASTE.

Disposal of HAZWASTE generated at DoD facilities in Guam is arranged by the Defense Logistics Agency Disposition Services (DLADS), formerly known as the Defense Reutilization and Marketing Office (DRMO). Specifically, licensed HAZWASTE contractors transport and dispose of HAZWASTE at permitted facilities. Under this arrangement, DLADS maintains all HAZWASTE documentation and ensures that all disposal actions are performed in accordance with pertinent federal, state, and local laws and regulations. As part of the DLADS waste management system, centralized accumulation points and satellite accumulation points are utilized at DoD installations on Guam. The accumulation points often contain a variety of wastes, typically stored in 5-gallon pails, 55-gallon drums, and other approved HAZWASTE containers. DLADS arranges for the disposal of HAZWASTE from DoD Guam operations.

The Navy on Guam is a Large Quantity Generator (40 CFR 262.34 [d], [e], and [f]) of HAZWASTE with USEPA identification handler number GU5170022680. Disposal of Navy HAZWASTE is arranged through DLADS and performed by its licensed contractors.

Figure 3-5. IRP, MMRP, and PFAS Sites in Relation to the Proposed Action Project Areas



DLADS maintains all required HAZWASTE documentation and contracts with licensed contractors for proper off-island disposal of the waste at permitted facilities. The Navy has various waste accumulation points as designated in its approved Hazardous Waste Management Plan (HWMP) (NBG 2021). There are no waste accumulation points within the proposed project areas.

It is not anticipated that special hazards, to include asbestos-containing material, polychlorinated biphenyls, and lead-based paint would be encountered during repair or maintenance activities. Therefore, special hazards will not be discussed further in this EA.

Defense Environmental Restoration Program

For this analysis, underwater sediments refer to the marine sediments of Apra Harbor that would be disturbed by Project activities. Since modernization of the Inner Apra Harbor during WWII, military (including warzone), heavy industrial, and shipping/dock activities have occurred near the Proposed project area. A legacy of this activity is found in contaminants in the underwater sediments.

With respect to the Proposed Action, soils refer to the terrestrial soils within the project area that would be disturbed by Project activities. Contaminated soil is any soil or combination matrix of soil and other material that includes sufficient contaminants of concern (e.g., exceeds 85 percent of the environmental screening levels for the soil matrix) to require treatment as HAZMAT, HAZWASTE, or some other action of removal, disposal, or avoidance.

The DERP addresses the identification and cleanup of hazardous substances and military munitions remaining from past activities at DoD installations and FUDS. On Guam, Navy and U.S. Air Force have ongoing DERP site cleanup activities with Guam EPA and USEPA oversight. The Defense and State/Territory Memorandum of Agreement established a program where Guam EPA staff work closely with DoD representatives to discuss and facilitate environmental restoration and clean-up work on Guam. Under the Defense and State/Territory Memorandum of Agreement program, Guam EPA maintains regulatory oversight of environmental restoration efforts undertaken on Guam by DoD to ensure compliance with applicable local and federal laws and regulations. NGB has 20 restoration sites of which 6 have been closed and 4 are pending closure. Cleanup is in progress at six sites and four medium- to low-risk sites are pending cleanup. Long-term groundwater monitoring is ongoing at two sites (DoD 2017). There are no active IRP or MMRP sites within or adjacent to the project areas. Therefore, the DERP will not be discussed further within this EA.

MEC/Material Potentially Presenting an Explosive Hazard

It is unlikely that MEC and/or material potentially presenting an explosive hazard (MPPEH) would be encountered on the land portion of the Proposed Action because these areas have been previously surveyed and cleared. MEC and/or MPPEH may be encountered during the in-water work (e.g., pile driving). WWII-era MEC and/or MPPEH have been encountered in this area, but the likelihood of encountering MEC and/or MPPEH has been substantially reduced due to the extensive post-WWII dredging activities. MEC and/or MPPEH risk remains during dredging and transportation and disposal of dredge material. Therefore, exclusion zones based on the primary munition with the greatest fragmentation distance are established to keep non-essential personnel in the water and on land safe from exposure to potential effects from unintentional detonations (in water and on land). The proposed action does not involve dredging of material.

Any discovered MEC and/or MPPEH must be handled in accordance with procedures per the DoD Regulation 6055.09-compliant site and construction plans. In addition to being a Health and Safety

concern, spent or abandoned munitions may be considered HAZMAT, and if disposed without treatment, may become HAZWASTE.

PFAS Concerns

A preliminary assessment (PA) was conducted at NBG between August 2017 and February 2018. The PA screened 120 potential sites at seven NBG areas for evidence that PFAS may have been released to the environment through leaks and spills or the application of products or materials containing PFAS (e.g., AFFF use during firefighting training, AFFF applied during emergency responses). Of the 120 sites screened within the seven NBG areas, a total of 25 sites, including 10 at NBG Main Base, were identified for further assessment with a focused site inspection (SI). Surface soil, storm drain sediment, and/or groundwater, surface water, and drinking water samples were collected and analyzed during the SI. SI sampling of the 10 sites at NBG were analyzed for 14 PFAS between December 2018 and March 2019. The results were compared to project screening levels (PSLs) that were derived from 2020 USEPA regional screening levels (NAVFAC 2023).

The SI recommended additional evaluation for 7 of the 10 NBG Main Base sites to address the PFAS detections in soil, storm drain sediment, and groundwater; address the four additional PFAS included since the SI was completed; and provide additional data to support proceeding to a remedial investigation (RI) or make a determination of no further investigation at this time. Therefore, a supplemental site inspection (SSI) of the seven sites was conducted between July 22 and August 14, 2023. During the SSI surface soil samples were collected from 25 locations and storm drain sediment samples were collected from 7 locations within the 7 NBG Main Base PFAS sites. The soil and sediment samples were analyzed for 18 common PFAS. Of the seven sites evaluated during the SSI, six of the sites were recommended for no further investigation at this time and one site was recommended for RI (NAVFAC 2023).

One of the PFAS sites, Building 2074 (Former Plating Shop and Leach Field Site), occurs within the contingent loading yard (see **Figure 3-5**); however, this site was recommended for no further investigation at this time in the SSI. Therefore, PFAS does not represent a potential hazard for the Proposed Action and will not be discussed further in this EA.

3.6.4 Environmental Consequences

In this EA, the analysis of HAZMAT and HAZWASTE focuses on the potential impacts associated with HAZMAT and HAZWASTE resulting from implementing the Proposed Action. During construction activities, HAZMAT and HAZWASTE may be encountered or generated. HAZMAT and HAZWASTE hazards are meticulously surveyed, documented, and characterized in advance. Handling plans, procedures, and training are developed and completed prior to any construction activities. Potentially significant HAZMAT and HAZWASTE hazards are avoided through the implementation of this approach.

3.6.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur, and there would be no change to baseline HAZMAT and HAZWASTE conditions. Therefore, no significant impacts related to HAZMAT and HAZWASTE would occur under the No Action Alternative.

3.6.4.2 Alternative 1

Construction for Alternative 1 would include the use and storage of HAZMAT, to include POLs. Construction contractors would ensure the handling and storage of any HAZMAT and petroleum product is carried out in compliance with applicable laws and regulations. Construction equipment, vehicles, and

vessels would be fueled by diesel or gasoline and use small quantities of HAZMAT and petroleum products such as solvents, hydraulic fluid, oil, antifreeze, and other HAZMAT. HAZMAT could be used for minor equipment servicing and repair activities. Should any HAZMAT or POL be released into the environment, adherence to applicable management plans such as the installation's Spill Prevention, Control, and Countermeasure (SPCC) Plan would reduce potential impacts. The severity of a potential impact from an accidental release would vary based on the extent of a release and the substance involved. Implementation of BMPs and environmental protection measures (see **Table 2-2**) would reduce the potential for an accidental release of these materials. All equipment would be maintained in accordance with the manufacturer's specifications, and drip mats would be placed under parked equipment as needed.

It is anticipated that the quantity of hazardous and petroleum wastes generated during construction would be negligible. All wastes generated during construction would be characterized and documented by contractors and site personnel in accordance with 40 CFR Section 262.11. Any wastes characterized as universal or hazardous would be disposed of in accordance with the installation's HWMP, SOPs, and federal, state, and local laws and regulations. No impacts on HAZMAT and HAZWASTE management would be anticipated following construction.

MEC and/or MPPEH may be encountered in the underwater sediments within Sumay Point and the western portion of Sumay Cove during the in-water work (e.g., pile driving) despite past dredging activities. Therefore, an Explosive Site Survey (ESS) would be conducted in areas where there is a potential for MEC and/or MPPEH, and exclusion zones based on the primary munition with the greatest fragmentation distance would be established to keep non-essential personnel in the water and on land safe from exposure to potential effects from unintentional detonations (in water and on land). Any MEC or MPPEH identified during screening would be handled in accordance with procedures outlined in the ESS.

Therefore, implementation of Alternative 1 would not result in significant impacts on HAZMAT and HAZWASTE management.

3.6.4.3 Cumulative Impacts

Cumulative impacts to HAZMAT and HAZWASTE from past, present, and future actions within the ROI would be less than significant. The installation's HWMP and SPCC Plan would be implemented throughout the process. Any HAZWASTE generated (used oil, etc.) would be handled appropriately and in accordance with the HWMP, and any spills or incidents would be responded to quickly and effectively in accordance with the SPCC. Contractors would manage HAZMAT and HAZWASTE in accordance with NBG management plans and Navy and federal, state, and local regulations. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects would not result in significant impacts within the HAZMAT and HAZWASTE ROI.

3.7 Infrastructure and Transportation

3.7.1 Description of the Resource

Infrastructure includes utilities such as potable water, wastewater, and energy; solid waste management; and stormwater management. Transportation includes roadway and waterway networks. This section discusses infrastructure such as utilities (including drinking water production, storage, and distribution; wastewater collection treatment and disposal; stormwater management; solid waste management; energy production, transmission, and distribution; and communications) and facilities (including airfields, buildings, ranges, training and testing areas, wharves, piers, housing, etc.).

3.7.2 Regulatory Setting

Potable water is regulated by the Guam EPA under the Guam Safe Drinking Water Act (Guam Public Law 14–90) of 1977 and program regulations at Title 22 of the GARR.

The CWA (33 U.S.C. §1251 *et seq*., as amended) establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES), on the amounts of specific pollutants that can be discharged into surface waters to restore and maintain the chemical, physical, and biological integrity of U.S. waters. The USEPA Region 9 administers the CWA in Guam with the NPDES Permitting Program. In addition, the Guam EPA Water Pollution Control Program issues permits for pollution discharge and CWA Section 401 Water Quality Certifications (WQC) for discharges into navigable waters.

The management and disposal of non-hazardous solid waste is regulated under Subtitle D of the federal RCRA of 1976. Guam EPA regulates solid waste in accordance with the Solid Waste Management and Litter Control Act (10 Guam Code Annotated Chapter 51).

Stormwater management infrastructure on Guam must meet the standards of the 2006 *Commonwealth of the Northern Mariana Islands and Guam Stormwater Management Manual* (CNMI and Guam 2006), the 2010 *Guam Transportation Stormwater Drainage Manual* (GDPW 2010), and the low-impact development requirements specified in United Facilities Criteria 3-210-10, *Low Impact Development*. In addition, Section 438 of the Energy Independence and Security Act requires federal facility projects larger than 5,000 square feet to "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

The GDPW, in cooperation with the Guam Regional Transit Authority, Federal Highway Administration, and Federal Transit Administration, prepared the *2030 Guam Transportation Plan* (GDPW 2008) to support Guam's future transportation needs as well as address laws and regulations applicable to transportation planning. The *2030 Guam Transportation Plan* functions as a regional short- and long-term transportation planning document to increase the safety of the transportation system for all motorized and non-motorized users, increase accessibility and mobility of people and freight, and address anticipated increases in regional traffic over time (GDPW 2008). All major highways and village streets on Guam are under the jurisdiction of the GDPW. The Federal Highway Administration contributes to ongoing improvements to Guam's transportation system through federal-aid roadway projects.

Antiterrorism Force Protection Standards have been adopted by DoD Instruction 2000.16 of October 2006. The standards require all DoD components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats.

3.7.3 Affected Environment

The following discussions provide a description of the existing conditions for infrastructure and transportation potentially impacted by the Proposed Action.

3.7.3.1 Utilities

Potable Water. The Fena Valley Reservoir, located on NBG in the southern portion of Guam, is the primary source of water for NBG and surrounding villages. The reservoir is fed by runoff and the Imong, Almagosa, Maulap, Sadog Gaso, and Mahlac Rivers. The Navy operates the Fena Navy Water Treatment Plant (NWTP), which treats water from the reservoir, along with water sourced from Almagosa Springs and Bona Springs. Once treated, water is transmitted through a network of storage tanks, transmission

lines, and pump stations. The Navy water transmission system is interconnected with the Guam Waterworks Authority (GWA) water distribution system, allowing the transfer of water between the two systems. Under a 1991 Memorandum of Understanding with the Government of Guam, the Navy system can provide up to 4 million gallons per day (MGD) to the GWA water system. The Fena NWTP produces an average of 8 MGD and sends approximately 6 MGD to NBG and its tenants and approximately 2 MGD to Santa Rita Village through GWD. The maximum capacity of Fena NWTP is 12 MGD (NBG PWD 2024). Over the last approximately 15 years, GWA has been reducing its dependence on Navy-supplied water by connecting their customers directly to GWA-supplied water lines and is investigating options to eventually eliminate the need to purchase water from the Navy (GWA 2018a). There are no potable water lines within the breakwater repair area. Navy and GWA water lines are present along the breakwater maintenance road, terminating at the proposed barge loading area (DoN 2010, GWA 2018a). Navy water lines along San Luis Road provide potable water to Sumay Marina; however, these lines do not extend to Sumay Point. In addition, Navy water lines are present within the proposed contingent loading yard, primary concrete casting yard, and contingent storage yard/secondary concrete casting yard (DoN 2010).

Wastewater. The Navy owns and operates the Apra Harbor Wastewater Treatment Plant (WWTP), which is a secondary treatment plant that services Naval facilities at NBG, including the Sumay Marina, Apra Heights, and Naval Munitions Site, as well as discharged sludge flow from the Fena NWTP. The Apra Harbor WWTP is designed to treat an average daily flow of 4.3 MGD and a peak flow of 6 MGD. Flows are typically 1.8 MGD during the dry season and 2.5 MGD the rest of the year, with a typical maximum of 3 MGD (USEPA 2023b). Treated effluent is discharged through an ocean outfall into Tipalao Bay under NPDES Permit No. GU0110019. The Navy-owned outfall also discharges effluent from the GWA Agat-Santa Rita WWTP (NPDES Permit No. GU0020222) (USEPA 2023c). In 2008, USEPA issued a Finding of Violation at NBG for violations of its permitted effluent limits for pollutants. The Navy carried out major infrastructure upgrades over a 12-year period that included upgrading the Apra Harbor WWTP, instituting an installation-wide pollution prevention program, and replacing or repairing over 30 miles of sewer pipes, manholes, force mains, and pump stations. In February 2023, the USEPA verified completion of all compliance actions, meaning effluent from the Apra Harbor WWTP meets CWA requirements (Pacific Daily News 2023).

The Apra Harbor WWTP is a Navy-owned Treatment Works as defined by USEPA regulations. Navy-owned Treatment Works are not required by regulation to have pretreatment programs, which control industrial discharges to sewage plants and may require pretreatment of these waste streams. However, an internal Navy pretreatment program is in place under Instruction 5090.3A, *Joint Region Marianas Wastewater Pollutant Minimization and Pretreatment Program***,** dated January 14, 2003. This instruction covers basic pretreatment requirements, such as a requirement for grease traps for base galley and restaurant wastewater, oil/water separators for industrial wastewaters containing petroleum products, and Navy Bilge and Oily Wastewater Treatment System for shipboard bilge and oily wastes that employ advanced oil/water separation and air flotation for oil removal. The Apra Harbor WWTP NPDES permit requires the Navy to implement the Industrial Wastewater Discharge Certification Program for all non-domestic discharges (USEPA 2023b).

GWA owns and operates the Agaña/Hagåtña Sewage Treatment Plant, which collects and treats wastewater from the central region of Guam, including from the Port of Guam on the eastern terminus of the Glass Breakwater (GWA 2018b). The WWTP is designed to treat an average daily flow of 12 MGB and a peak flow of 34.1 MGD. The average and maximum daily flow discharge was 6.11 MGD and 9.23 MGD, respectively, in 2017. Treated effluent is discharged through an ocean outfall in the Philippine Sea

under NPDES Permit No. GU0020087 (USEPA 2019a, USEPA 2019b). No wastewater infrastructure is present within the Glass Breakwater repair area.

Energy. Electricity is produced and distributed throughout Guam through an Island-Wide Power System (IWPS). The IWPS consists of generation units owned by the GPA, generation contracted to GPA, and DoD-owned generation units whose output is available to GPA based on a service agreement between the DoD and GPA. GPA generation units provide the base load for the IWPS, with peaking reserve units managed by GPA and dedicated backup units managed by DoD. The GPA's Cabras and Piti generation units, located approximately 2.5 miles east of the Glass Breakwater repair area, provide the majority of the IWPS's energy with a total rated capacity of approximately 300 MW. On NBG, the Orote Power Plant, operated by the Navy, connects to the IWPS to provide backup power to Navy facilities when needed. The Orote Power Plant has a rated capacity of 19.8 MW (DoN 2010). The IWPS has a total load capacity of 557 MW. As of 2023, 16 percent of the IWPS is fueled by renewable energy via two utility-scale solar farms (GPA 2024).

Electricity is not available within the Glass Breakwater repair area. Underground and overhead electricity lines supported by the IWPS are present near the barge loading area along the breakwater maintenance road, Sumay Marina, the contingent loading yard, the primary concrete casting yard, and the contingent storage yard/secondary concrete casting yard (DoN 2010, NREL 2011).

Stormwater. USEPA authorizes NBG to discharge water from the Navy's Municipal Separate Storm Sewer System under NPDES Multi-Sector General Permit (MSGP) No. GUS040000, which covers NBG, including Sumay Mariana, Sumay Point, and the proposed contingent loading yard. There is no stormwater management infrastructure within the Sumay Marina. Stormwater at the Sumay Marina sheet flows into Sumay Cove and Outer Apra Harbor. During storms, stormwater carries sediments consisting primarily of fine limestone fill. In the water, these sediments are light and are easily resuspended, increasing overall turbidity and reducing visibility in Sumay Cove to less than five feet. Stormwater at the contingency loading yard is managed via stormwater inlets, underground pipe culverts, and vegetated swales and discharges through an outfall into Inner Apra Harbor. Per the NBG's Storm Water Management Program, Navy maintains and implements a SWPPP in accordance with the NPDES MSGP (NAVFAC 2020).

Stormwater discharge from the Glass Breakwater, barge loading area, primary concrete casting yard, and contingent storage yard/secondary concrete casting yard is authorized under GWA's NPDES MSGP No. GUS40001 (USEPA 2022). There is no stormwater management infrastructure in the vicinity of the project area along the Glass Breakwater. Water that falls on the breakwater drains naturally into Apra Harbor and the Philippine Sea. In addition, there is no stormwater management infrastructure within the barge loading area, primary concrete casting yard, or contingent storage yard/secondary concrete casting yard. Stormwater from the barge loading area and contingent storage yard/secondary concrete casting yard flows into Apra Harbor and the Philippine Sea. Stormwater from the primary concrete casting yard infiltrates into the soil, flows directly to Inner Apra Harbor and Sasa Bay, or to stormwater infrastructure at Polaris Point, which then discharges into Inner Apra Harbor (NAVFAC 2020). The GDPW maintains stormwater infrastructure along Guam roadways in accordance with the *Guam Transportation Stormwater Drainage Manual* (GDPW 2010).

Solid Waste Management. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials, and other materials generated during the construction process. The Guam Solid Waste Authority (GSWA) manages the Layon Landfill in Dandan, approximately 20 miles and 25 miles southeast of Sumay Marina and the Glass Breakwater repair area, respectively. The Layon Landfill is an upland landfill that opened in 2011 with an initial

capacity in excess of 15.8 million CY and an expected lifespan of 50 years. In fiscal year (FY) 2023, the landfill accepted 111,126 tons of waste (GSWA 2024).

3.7.3.2 Transportation

Roads and Traffic. The maintenance road at the top of the breakwater crest extends west from the western boundary of the Port of Guam to the end of the breakwater. The crest road is closed to the public and only accessed by Navy personnel and other authorized users. The primary intermodal connection within Guam and the commercial area of Apra Harbor, including the Port of Guam and Glass Breakwater, is Route 11, which connects to Route 1. Route 1, also called Marine Corps Drive, is a major arterial roadway stretching from NBG at Apra Harbor to its connection with Route 9 at Andersen AFB. It serves as a major commercial corridor connecting residential areas to major employment centers, retail shopping centers, businesses, government buildings, and industrial facilities (DoD 2017). South of Route 11, Route 1 is primarily used by Navy personnel traveling to and from NBG and for traffic traveling from southern Guam residential areas to commercial areas in central Guam. Routes 1 and 11 connect the Glass Breakwater and Port of Guam to the proposed primary concrete casting yard. Route 11 connects the Glass Breakwater to the barge loading area and contingent storage yard/secondary concrete casting yard. Both routes are managed by GPDW. The crest road is managed by the Navy.

Sumay Marina and Sumay Point are within NBG property. Vehicle traffic around the area is considered light and restricted to authorized DoD users and their guests (DoN 2011).

Waterways and Vessel Transportation. Apra Harbor is a deep-water port that serves both NBG and the Port of Guam. Outer Apra Harbor, which supports Port of Guam operations, is the main port for transportation and shipping on the island. Apra Harbor is subject to daily vessel traffic from Navy, commercial, and private vessels. The 500-yard-wide, 100-foot-deep entrance to the harbor faces west into the Philippine Sea. Operated by the PAG, the commercial port handles approximately 2 million tons of cargo each year. The cargo facilities at the port accommodate containerized, unitized, break-bulk, and tuna cargo (DoD 2017). In FY 2022, the port handled more than 89,000 containers and more than 141,000 tons of non-containerized cargo. Cargo ships are docked along the port waterfront for an average of 25 hours (PAG 2023).

Inner Apra Harbor and surrounding wharf facilities, Sumay Cove, and Sumay Marina are restricted to the public and only accessed by Navy personnel and other authorized users. Sumay Cove also experiences regular vessel traffic from Navy Security, Port Operations, and MWR users; however, traffic at Sumay Marina is considered relatively low. Traffic at the marina increases on weekends when rental boats may be taken out twice per day, whereas during weekdays rental boats may be taken out two or three times in total.

3.7.4 Environmental Consequences

The ROI for the infrastructure and transportation resources analysis is focused on those resources along Outer Apra Harbor land and water in the vicinity of the Glass Breakwater and Sumay Cove. In this EA, the analysis of infrastructure and transportation also addresses the potential impacts on maritime and land-based transportation associated with the Proposed Action. This section analyzes the magnitude of anticipated increases or decreases in public works infrastructure demands, considering historic levels, existing management practices, and storage capacity, and evaluates potential impacts to public works infrastructure associated with the implementation of the alternatives. Impacts are evaluated by whether they would result in the use of a substantial proportion of the remaining system capacity, reach or

exceed the current capacity of the system, or require development of facilities and sources beyond those existing or currently planned.

3.7.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur, and there would be no change to baseline infrastructure and transportation. However, the Glass Breakwater would continue to degrade over time, and the crest road may become unusable. Continued degradation of the Glass Breakwater without the necessary repairs would increase the risk of partial breach and failure. Other infrastructure in Apra Harbor including, roads, utilities, buildings, wharves, and ports, would be susceptible to damage and destruction from storms and typhoons if the Glass Breakwater breaches and fails, which could lead to major delays in Port of Guam operations and could affect GPA operations at the Cabras and Piti power generation units. The No Action Alternative at Sumay Cove would result in continued and increased degradation of Sumay Marina facilities, resulting in dangerous conditions for USCG, Navy Security and Emergency Response Forces, and MWR operations. Therefore, long-term, significant, adverse impacts on infrastructure and transportation could result from the No Action Alternative.

3.7.4.2 Alternative 1

Glass Breakwater

Short-term, negligible to minor, adverse impacts on potable water, wastewater, and energy utility demand would be expected from Glass Breakwater repairs under Alternative 1 due to the use of utilities during the construction period. The breakwater repairs are not expected to result in utility disruptions. Approximately 20,100 CAUs (25 to 50 tons each) would be cast at either the primary or secondary concrete casting yard. The concrete CAUs would require between approximately 20,100,000 and 40,200,000 gallons of water. Over the 5-year construction period, an average of between 4,020,000 and 8,040,000 gallons per year, or between 12,900 and 26,000 gallons per day, over 312 annual working days, would be needed. The water requirements represent between 0.2 and 0.3 percent of the average potable water production (8 MGD) at the Fena NWTP and would not be expected to exceed the NWTP's maximum capacity of 12 MGD. Additional water may be needed for cleaning equipment and dust suppression; however, it is not expected that the additional water demand would exceed system capacity. Therefore, short-term adverse impacts on potable water demand would be minor.

Wastewater and electricity demand for construction and the approximately 70 (to 85 at peak) construction personnel would increase; however, it is not expected that the increased wastewater or electricity demand would exceed the capacity of the Apra Harbor WWTP, the Agaña/Hagåtña Sewage Treatment Plant, or the IWPS. Therefore, short-term adverse impacts on wastewater and electricity demand would be negligible. Utility impacts would cease following completion of construction, and long-term, adverse impacts would not occur.

Construction vehicles would remain mostly on existing paved roads and designated construction areas, minimizing the disruption of undeveloped land and reducing the potential for soil erosion and compaction. Alternative 1 does not include the addition of impervious surfaces that would prevent water from naturally infiltrating the ground or change the hydrology of the area. As a result, stormwater flows and runoff during construction would be consistent with existing conditions, and Alternative 1 would not result in impacts on storm water management. The Navy submitted an application to the Guam EPA for CWA Section 401 WQC on 28 March 2025, which explained that discharge would be prevented from entering Guam waters to the maximum extent possible and described the measures

(noted in **Table 2-2**) that would be implemented to support protection of water quality. **Appendix A** provides copies of the correspondences regarding the Navy's application for CWA Section 401 water quality certification, which would be obtained prior to work start for construction.

Short-term, minor, adverse impacts on solid waste management may occur from the generation of construction and demolition waste during the 5-year construction period. Glass Breakwater repairs under Alternative 1 are not expected to produce large amounts of construction and demolition waste. Existing rock and CAUs would be removed from the breakwater and reused for the breakwater core, shoreline protection repairs within Apra Harbor, and at Sumay Point. General construction waste may include broken concrete, masonry waste, packaging materials, cleared vegetation, and other general debris. A waste management plan would be developed and implemented that would require participation by all subcontractors, vendors, and suppliers. On-site instruction for the appropriate handling and storage of waste, and appropriate handling, separation, recycling, salvaging, reuse, and return methods to be used by all parties would be provided in the waste management plan.

Short-term, minor, adverse impacts on transportation would occur from Glass Breakwater repairs under Alternative 1. Construction materials would be transported by barge to the Port of Guam, where they would be offloaded and transported via truck to either the project area on Glass Breakwater, Sumay Cove, or staging area(s). The estimated 32 round trips by barges delivering materials (equipment, aggregate material) would add to port activity over the five-year construction period, representing a minor adverse impact on maritime traffic into and out of the Port of Guam. Approximately 75 percent of the CAUs, or approximately 15,075 CAUs, would be transported from the primary or secondary concrete casting yards to breakwater repair areas via truck transport along the crest road, and the remaining 25 percent, or 5,025 CAUs, would be transported via barge from the barge loading area on Route 11. Considering the weight of each CAU, it is likely that 20,100 truck trips from the concrete casting yard to the Glass Breakwater would be needed. Trucks would travel north along Route 1 from the primary concrete casting yard to Route 11, and travel on Route 11 through PAG property to reach the crest road. Trucks transporting CAUs to the barge loading area would continue on Route 11, past the crest road entrance, to reach the loading area. Over the 5-year construction period, an average of more than 13 trips per day would be required. It is assumed trucks would travel between the Glass Breakwater and the primary or secondary concrete casting yards during non-peak travel times to minimize the impacts on traffic for commuters traveling to and from NBG during the morning and evening rush hours. Removal of existing rock and CAUs from the breakwater, totaling approximately 7,800 CY, would result in additional 780 truck trips over the 5-year construction period. Excess load weights on hauling trucks transporting the CAUs may result in degraded roadway infrastructure along older roadway segments. Construction equipment and many of the required construction vehicles would be kept on site for the duration of construction activities, resulting in few additional trips. Barges used for Glass Breakwater repairs could limit the navigable space into Apra Harbor for other vessels; however, barges would operate in water adjacent to the Glass Breakwater, outside of vessel travel lanes, and impacts on vessel traffic would be minimal. Transportation impacts would cease following completion of the construction, and long-term, adverse impacts would not occur.

Repair and improvement of the Glass Breakwater would ensure the viability and resiliency of wharves, ports, and other facilities in Apra Harbor, which would result in long-term, beneficial impacts on vessel transportation, port operations, and GPA operations at the Cabras and Piti power generation units.

Sumay Cove

Short-term, adverse impacts on infrastructure and transportation from Sumay Cove repairs would be similar to those described for Glass Breakwater repairs. Temporary water, wastewater, and power utility

disruptions may be experienced when service lines are disconnected during the floating dock repairs. Utility disruptions would be temporary and coordinated with Sumay Marina prior to construction activities. There is no stormwater management infrastructure within the Sumay Marina or Sumay Point. As described for Glass Breakwater repairs, Sumay Cove repairs would not affect the hydrology of the area or change existing stormwater flow patterns. Construction and demolition debris from the removal of the floating wave attenuator and steel revetment would be disposed of in accordance with a site-specific waste management plan that would follow Navy and Guam EPA regulations.

Construction traffic would be concentrated on Route 1, Route 11, and NBG roadways. Fewer truck trips are expected for Sumay Cove repairs than were estimated for Glass Breakwater repairs. Approximately 90 truck trips would be needed to transport salvaged rock from the Glass Breakwater or imported rock from the Port of Guam to the Sumay Point revetment repair area. It is anticipated that the piles would be fabricated off-island, brought to Port of Guam via ship/barge, and then be transported via truck from the Port to the Sumay Marina project site. Trucks would travel on Routes 1 and 11 and access NBG through the main gate for delivery to Sumay Point and other shoreline protection areas. The additional truck trips would not result in significant adverse impacts on transportation. The in-water construction required for Sumay Cove repairs could limit the navigable space into Sumay Cove for other vessels; however, all construction work would likely occur from the landside, and vessel traffic lanes would likely be maintained and impacts on vessel traffic would be minimal. During construction, fewer slips may be available for vessel parking. Slip access would be restored following construction. Transportation impacts would cease following completion of the construction and long-term, adverse impacts would not occur.

Repair and improvement of the floating dock and wave attenuator at Sumay Marina and revetment restoration at Sumay Point would ensure the viability and resiliency of Sumay Marina and other docks in Sumay Cove, which would result in long-term, beneficial impacts on Navy and MWR operations.

In summary, Alternative 1 would not result in significant impacts on infrastructure and transportation.

3.7.4.3 Cumulative Impacts

Past actions included upgrades and repairs to infrastructure around Apra Harbor to ensure the resiliency of harbor facilities and maintain the effectiveness of the navigable waterway. Present and reasonably foreseeable future actions include further upgrades to harbor infrastructure, including the emergency Glass Breakwater maintenance repairs, Sumay Marina reinforcement and utility improvements, and wharf repairs in Inner Apra Harbor, and Port of Guam improvement in Outer Apra Harbor. Present and reasonably foreseeable actions include utility repairs at LMN wharves and replacement of the Lima wharf substation, adjacent to the proposed contingent loading yard; new utility lines at the Sumay Marina docks; construction of a new fuel pipeline along Marine Corps Drive; and upgrades to existing Inner Apra Harbor general-purpose wharf utilities. No disruption of utilities is expected from Glass Breakwater repairs; however, utility work at Sumay Marina that coincides with the Sumay Cove construction period may exacerbate or extend utility disruptions for users of Sumay Marina, which would result in short-term, minor, adverse cumulative impacts on utilities. Aggregate disruptions would be temporary and likely confined to the Sumay Cove repair area. Utility upgrades at Sumay Marina and NBG wharves, including the Lima substation replacement, would improve the efficiency of the utility systems, which would support the potential additional utility loads needed to support the Proposed Action, resulting in beneficial cumulative impacts.

Construction traffic associated with the present and reasonably foreseeable future actions at NBG and the PAG property, when combined with the Proposed Action at Glass Breakwater and Sumay Cove,

would result in increased vehicle traffic on Guam and Navy roadways beyond what was estimated for the Proposed Action alone, which would result in short-term, minor, adverse, cumulative impacts (delays, longer traffic queues) on transportation. Public and NBG road closures would not be expected from the Proposed Action or present and reasonably foreseeable future actions. The Proposed Action and reasonably foreseeable future construction could be phased to avoid overlapping construction periods and additional traffic when possible. Aggregate increases in temporary construction traffic would cease following the 5-year construction period for the Proposed Action. Similarly, disruptions to vessel traffic in Apra Harbor and Sumay Cove may be intensified during periods when in-water or wharf-line construction coincides with Proposed Action construction. However, it is not expected that in-water construction would obstruct vessel travel lanes or disrupt typical vessel movements.

3.8 Noise

3.8.1 Description of the Resource

This section evaluates potential impacts that could result from noise generated from the implementation of the Proposed Action, including sources of noise and the associated receptors in the human environment and marine environment. Noise in relation to terrestrial biological resources and marine wildlife species is discussed in greater detail in **Section 3.3, *Biological Resources***. Descriptions of in-air and in-water noise are discussed below.

In-Air Noise

Construction vehicles, equipment, and activities, vessel operation, rock and CAU placement, and pile driving associated with the Proposed Action all have the potential to impact the in-air noise environment. Sound pressure level (SPL) is a measurement of the strength of a sound wave, expressed in decibels (dB). In-air noise is discussed in this analysis in terms of A-weighted decibels (dBA), which is a measurement of sound pressure that takes into account the sensitivity of the human ear at different frequencies, essentially giving more weight to the frequencies that humans hear most clearly and less weight to very low and very high frequencies. Noise can adversely affect use of a site, and constant exposure to sounds 90 dB and higher can lead to hearing loss.

In-Water Noise

The Proposed Action would produce elevated in-water noise levels from breakwater construction and placement of CAUs, pre-drilling, pile driving, pile extraction, wave attenuator construction, and vessel operation. Noise transmits differently underwater than on the surface due to the difference in reference pressure. The reference level used in air is 20 dB referenced to 1 micro-Pascal at 1 meter (20 dB re µPa at 1 m) and was selected to match human hearing sensitivity. A different reference level is used for underwater sound dB (1 dB re µPa at 1 m). Therefore, a 150 dB sound in water is not the same as a 150 dB sound in air (NOAA 2011a).

3.8.2 Regulatory Setting

The Noise Control Act of 1972 (Public Law 92-574 1972) establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. Additionally, the Occupational Safety and Health Administration (OSHA) provides occupational noise exposure limits. The Act also requires federal agencies to comply with all federal, state, and local noise control laws and regulations. Noise can adversely affect use of a site, and constant exposure to sounds 90 dB and higher can lead to hearing loss.

While there are no specific regulatory requirements for in-water noise, there are some regulations that indirectly relate to the impacts of in-water noise. Pursuant to the ESA, in-water construction activity and pile driving may result in harassment of and/or adversely affect certain marine species such as fish, sea turtles, and marine mammals. Agency consultation in accordance with Section 7 of the ESA is currently ongoing, and this EA will be updated, as appropriate, to include the results of agency consultation. Additional details regarding ESA consultation are in **Section 3.3, *Biological Resources***.

3.8.3 Affected Environment

The following discussions provide a description of the existing conditions for noise in the vicinity of Apra Harbor and potentially impacted by the Proposed Action.

Glass Breakwater

The Glass Breakwater is located at the mouth of Apra Harbor on the east side of the pass. The Inner Breakwater makes up the northern portion of Outer Apra Harbor, and the Outer Breakwater borders the Philippine Sea. The predominant noise sources consist of ship and harbor operations at the Apra Harbor wharves, commercial and recreational vessels transiting the harbor, wind, waves, and vehicle traffic on local streets. Other components, such as construction, landscape maintenance, aircraft operation, and recreational use of nearby areas, produce noise, but such noise generally represents a transitory and negligible contribution to the average noise level environment. The nearest on-land noise-sensitive receptors to the breakwater are the Family Beach and the recreational dive guide sites located in the recreational area on the leeward side of Luminao Reef, approximately 0.4 miles west of the proposed primary vessel offload site and along the main access road for the breakwater and slightly more than one mile east of the proposed construction activities at the breakwater; refer to **Table 3-4** for specific distances.

The in-water noise environment is characterized by natural sounds, such as waves and marine species, as well as regular vessel traffic noise from military, commercial, and private vessels (tugs, recreational boats, cargo ships, barges, and military vessels) accessing the port. Apra Harbor is a working harbor with a likely ambient SPL >100 dB re 1 µPa (California Department of Transportation 2024). Marine fauna residing in this environment function and thrive within an acoustic background of relatively high ambient sound levels (DoN 2020a).

Marine mammals are uncommon within Apra Harbor and Sumay Cove (NAVFAC Pacific 2007). The shallow water, limited foraging habitat, and frequent vessel traffic within and near the project area do not provide suitable habitat for marine mammal species. Although marine mammals are frequently observed in the waters surrounding Apra Harbor, it is not likely that marine mammals would occur in Apra Harbor.

ESA-protected species such as sea turtles and the scalloped hammerhead shark may occur in or near Apra Harbor.

Sumay Cove

Sumay Cove is located at the southern portion of Outer Apra Harbor. The project area is an active marina, separated from non-marina uses. Existing noise levels are relatively low and limited to light authorized military vehicle traffic. Light traffic is calculated to average 50 dB at 50 feet. Sumay Cove is a "No Wake Area", so vessels are required to operate at minimal speeds. When the rotation of the propeller is reduced and a boat is traveling slowly, the turbulence is minimal, and both the frequency and power spectrum of the noise are reduced (Gerstein 2002).

The nearest on-land noise-sensitive receptors are the on-base housing area and the recreational ball fields to the southwest, Gab Gab and San Luis recreational beaches to the west on Navy property, and Sumay Marina; all are located within one mile of the proposed Sumay Cove repair activities (refer to **Table 3-4** for specific distances).

Marine mammals that may be subject to noise have not been documented in Sumay Cove, and are not likely to enter the water area. Protected sea turtle and shark species are not expected to be in the area but do have the potential to occur.

Table 3-15 presents reported sound levels associated with common household and construction equipment.

Table 3-15. Decibel Levels of Common Equipment, Vehicles, and Tools

Intensity Levels for Common Sounds	dBA	Common Construction Equipment with actual measured dB at 50 feet (samples averaged)
Jet aircraft taking off *Pain threshold*	140	
Air Raid Siren	130	
Ambulance siren *Discomfort threshold (pure tones)*	120	
Live Band	115	
	101	Pile Driver (in-air)
Passing subway train at 10 feet	100	
Blender at 3 feet	92	
Lawnmower at 3 feet	90	Concrete saw, Pavement Scarifier
Tractor; Shouted Conversation	89	Jack Hammer
Hand saw	84	Scraper
	83	Ground Compactor
Food Mixer or Processor	82	Bulldozer
Motorcycle at 25 feet	81	Crane, Excavator
	78	Backhoe, Air Compressor, Concrete Mixer Truck
	77	Paver
TV volume or Vacuum Cleaner at 10 feet	70	
Conversation	60	
Dishwasher in next room	50	
Faint speech (3 feet away)	40	
Watch Ticking	30	
Quiet house interior	20	
Hearing threshold (young adult)	0	

Sources: US Department of Transportation 2006, NoiseAwareness.org 2024
Key: dB = decibel; dBA = A-weighted decibels

3.8.4 Environmental Consequences

The ROI for the analysis of the effects of noise includes the terrestrial and underwater environments surrounding Apra Harbor and in the vicinity of the Glass Breakwater and Sumay Cove. The Proposed Action has the potential to produce temporary and intermittent elevated in-air and in-water noise levels. Activities that have the potential to produce elevated in-air and in-water noise include:

- Placement of armor stone and CAUs above and in the water

- Operation of construction trucks and equipment use on the roads to access the breakwater and the Sumay Cove landside areas
- Vessel use, including anchoring near Inner Glass Breakwater
- Pile driving

Changes in noise from the Proposed Action would be considered significant if they would lead to a violation of any federal, state, or local noise ordinance or substantially increase areas of incompatible land use outside the installation. Impacts from noise on wildlife are discussed in **Section 3.3.4.**

3.8.4.1 No Action Alternative

No significant impacts related to noise would occur with implementation of the No Action Alternative. Under the No Action Alternative, the Proposed Action would not occur and there would be no change to the baseline noise environment of ongoing road and vessel traffic within and around the harbor industrial operations in and around NBG as long as the breakwater remains in its current condition. In the event of impending breakwater breach, port operations would be halted resulting in appreciably reduced in-air and in-water noise from reduced or stopped vessel traffic and related equipment operation to load/unload cargo vessels.

3.8.4.2 Alternative 1

Glass Breakwater

Construction of Alternative 1, including pile driving, in-water work, and vessel operations, may temporarily, adversely affect the in-water noise environment surrounding the Glass Breakwater and Sumay Cove. These impacts would be less than significant.

Construction Noise Impacts (excluding pile driving) – Construction noise would produce a minor short-term adverse effect on marina users and terrestrial wildlife during the construction period. Following construction noise, it is likely that birds and mammals would return to the site. Under the Proposed Action, noise during construction would increase to above ambient levels due to construction vehicles and activity. As presented in **Table 3-15** average construction equipment can vary from 76 dBA to 90 dBA. This is greater than the ambient noise, but below the level that might produce harm (90 dBA). The USEPA recommends noise levels average 70 dBA over a 24-hour period in order to protect human health and safety. This allows for high single event and peak levels to exceed 70 dBA as long as the noise does not consistently occur (USEPA 1974).

The project would make the maximum use of low-noise emission products, as certified by the USEPA under criteria found in 40 CFR part 203 and Section 15 of the Noise Control Act. Nearly all construction activities would occur during the daytime, and after construction, sound levels would return to near the acceptable background levels of 70 dBA. While some construction activity, such as fabrication and transport of CAUs to the breakwater from the casting yard or staging areas may occur at night, there would be no heavy construction or in-water construction at night. The nearest residential development to the Glass Breakwater site is located on NBG approximately 1.9 miles east across the harbor. The nearest private housing, located in Piti, is more than 3.5 miles east of the project area. From those distances, equipment and vessel noise would not be perceptible; therefore, impacts on those residential communities from general construction noise along the breakwater would not be anticipated. Public access to Family Beach and the recreational dive site guides located along Highway 11 on the leeward side of Outer Apra Harbor at Luminao Reef may be limited during construction. If accessible, individuals at these locations would experience construction traffic noise from trucks, vessels, equipment moving

materials to or from the breakwater, and potentially piledriving if opted to support vessel mooring at the breakwater.

The CAUs and armor rocks would be placed carefully, as each unit must interlock with its neighboring units to form a strong structure. Careful placement would minimize both in-air and in-water noise levels associated with armor placement. Operation of heavy equipment, such as a crane or trucks carrying aggregate, rock, or CAUs along the breakwater road, is highly unlikely to generate sound or vibration levels high enough to disturb marine animals in the water column. Sound does not transmit well through the air-water interface, and most of the sound energy moving from air to water will be scattered and dispersed in the irregular, rocky nearshore environment. BMPs would be implemented to avoid potential exposure to elevated noise. Outer Apra Harbor is an active commercial and military port thus, the ambient in-water noise levels reflect regular vessel traffic. As a result, any marine mammals, sea turtles, and scalloped hammerhead sharks that may be present in the area may already be habituated to moderate levels of anthropogenic noise.

No general construction elements of the Proposed Action have the potential to generate sound levels intense enough to cause injury or harm to marine species likely to occur in the Action Area. BMPs would further reduce the potential for acoustic impacts, because all in-water work would stop when an ESA-listed sea turtle, shark, or marine mammal approaches or is sighted within a shutdown zone of 46 meters (50 yards) of the proposed in-water work.

Project-related activity in the Action Area would increase human presence, ambient noise levels, and potential for interaction with ESA-listed sea turtles and sharks. Apra Harbor is, however, a site of regular human and mechanical activity onshore and in the water, and animals that enter and remain in Apra Harbor are expected to be habituated to some degree to human activity. Despite their likely habituation to ambient activity levels, increased human activity has the potential to disturb normal behavior of ESA-listed sea turtles and sharks in Apra Harbor. Expected reactions range from benign investigation of or attraction to the activity, avoidance of the area, or the extreme, panicked fleeing with potential self-injury during flight.

Green and hawksbill turtles are known to be present in Apra Harbor, although occurrences are expected to be rare for hawksbill turtles and low for green turtles. In the unlikely case that either species would swim into the marine portion of the Action Area, it is expected that they would avoid Project activity along the nearshore and affected in-water work areas. Because scalloped hammerheads have not been visually observed in the harbor for over a decade, it is unlikely that they occur in numbers or at frequencies that would expose individual sharks to Project-related disturbance.

BMPs would be implemented to ensure that intentional interactions with ESA-listed sea turtles and sharks are avoided and that unintentional interactions are minimized to the greatest extent practicable.

In general, exposure to construction and vessel noise could cause marine species, including fish and sea turtles, to avoid the area, producing a short-term minor adverse impact on these species. General construction noise levels associated with the Proposed Action at Glass Breakwater would fall below the NMFS-recommended limit of 150 dB re 1 µPa, which is the level which can cause temporary behavioral changes (startle and stress) that could decrease a fish's ability to avoid predators.

Therefore, general construction at Glass Breakwater under Alternative 1 would result in less than significant impacts related to noise.

Pile Driving Noise – Pile driving would exceed the standard threshold of 90 dBA for in-air noise at Glass Breakwater. Pile driving might produce short-term major adverse impact on Family Beach or other

recreational users due to the noise created by the action during construction. Because the construction plan would install one pile per day, and the estimated time for installation of a pile is brief (approximately 15 minutes of impact hammering), these anticipated noise impacts would be minor. No pile driving would occur outside of daytime work hours or within or within 50 feet of any occupied vessels. The calculated 24-hour average would be within the USEPA recommended 70 dBA (USEPA 1974), reducing the impact on the public. Vehicle and construction equipment noise is highly unlikely to generate sound or vibration levels high enough to disturb marine species in the water column, as most sound would be dissipated by the air-water interface.

All Project pile driving will occur within the confines of outer Apra Harbor. Because in-water noise transmission will cease when sound intersects a land mass, the area affected by in-water noise will be limited to Outer Apra Harbor, likely limited within Outer Apra Harbor by shallow reefs that block sound transmission.

Vibratory pile driving is typically considered a noise mitigation measure, resulting in a 15 to 20 dB reduction in source levels compared to impact pile driving (Matuschek & Betke, 2009; Elmer et al., 2007). If vibratory pile driving occurs in conjunction with impact pile driving, the latter would dominate acoustic impacts.

ESA-listed corals may be affected by elevated noise levels during larval dispersal and settlement. Research shows that healthy coral reef soundscapes act as habitat cues for coral larvae and other marine species to settle. However, anthropogenic noises, like vessel traffic, can disrupt coral planulae settlement. To mitigate this, the proposed project would not conduct in-water pile driving activities during coral spawning seasons (BMP-E). As a result, elevated noise from the project would not be expected to impact established ESA-listed coral colonies.

ESA-listed endangered hawksbill turtles and green turtles, as well as ESA-listed threatened scalloped hammerhead sharks, may occur but are unlikely to occur in the Glass Breakwater Action Area. Because scalloped hammerhead sharks have not been observed in Apra Harbor for over a decade, it is unlikely that they occur in numbers or frequencies that would expose individual sharks to Project-related disturbance. Noise and vibration harassment could cause a behavioral response, such as avoidance of an area or interrupt swimming, foraging, resting, or other behaviors of sea turtles. Under Section 3(18) of the federal ESA, harassment can be considered a “take”. The direct, physiological effects from acoustic impacts include hearing damage, injury or mortality. Permanent threshold shifts (PTS) occur when an animal experiences a shift in their hearing threshold caused by prolonged or repeated exposure to high SPLs that results in permanent and irreversible damage.

There are no studies specifically on the auditory sensitivity of scalloped hammerhead sharks, but their hearing is likely similar to other sharks, which have poor hearing sensitivities and likely cannot detect sound pressure. Sharks lack swim bladders or structures that convert acoustic pressure into displacement, so they are thought to respond only to the particle motion (acceleration, velocity, or displacement) of sound. Compared to bony fishes, sharks are less sensitive to sound due to their lack of pressure-to-displacement transduction mechanisms and less dense otoconial masses (structures found in the inner ear of many vertebrates, including sharks). Research shows sharks may be attracted to low-frequency sounds, sometimes from hundreds of meters away, and startled by loud, sudden

sounds though they typically habituate after a few trials. Consequently, acoustic impacts on scalloped hammerhead sharks are discountable and not included in the following analysis.

NMFS provides technical guidance for pile driving impacts on turtle species (Optional Multi-Species Pile Driving Calculator; Version 2.0-Multi-Species: 2024). Acoustic impact thresholds (i.e., the received sound level in which an acoustic impact is likely to occur) for sea turtles are displayed in **Table 3-16** for both impulsive sound (impact pile driving) and non-impulsive sound (vibratory pile driving). Behavioral response and PTS thresholds are included.

Table 3-16. Acoustic Impact Thresholds for Sea Turtles

Sea Turtles	Metric	Threshold Non-Impulsive Sound (dB)	Threshold Impulsive Sound (dB)
Behavioral Response	Single strike RMS	175	175
Permanent Threshold Shift	$SEL_{cumulative}$	220	204

Acoustic impact isopleths represent the range in meters in which the received level exceeds the acoustic impact threshold (**Table 3-16**). The received level of a sound will decrease with range from the sound source due to sound propagation transmission loss. Behavioral response and PTS isopleths were estimated using the Optional Multi-Species Pile Driving Calculator; Version 2.0-Multi-Species: 2024 NMFS pile driver calculator. A literature search determined source levels for specific pile types (e.g., 20 -inch concrete) and pile driving activity (e.g., vibratory or impact pile driving). When transmission loss properties for a given Action Area are unknown, NMFS recommends using a value of 15.

Table 3-17 displays impact and vibratory pile driving data used to estimate acoustic impact isopleths for sea turtle behavioral responses and PTS for each unique pile type, pile size, and location. Shutdown zones were calculated by taking the largest isopleth (from behavioral responses or PTS) that occurred at a given structure and pile type and adding an additional 20 m and rounding up to the nearest 10. This provides an additional protective buffer zone beyond the impact isopleth that will reduce the probability of behavioral response or PTS occurrence.

BMP-A in **Table 2-2** in **Section 2.5** establishes the standard shut-down zone of 46 m (50 yd) for all work which covers the requirements with an added buffer, as well as enacts a special shut-down zone of 120 m (131 yd) when impact pile driving any 36-inch or smaller steel pipe piles.

Projected pile driving noise at Glass Breakwater exceeds the NMFS recommended levels, but noise can be reduced through distance. Impacts on sea turtles from pile driving may include avoidance of the project area which would cause the alteration of normal behaviors such as foraging, swimming, and resting. In addition, the sound and vibration from pile driving could impact females from choosing a nesting site and slow or disturb the development of sea turtle embryos if nests are within the vicinity of the project area.

Pile driving would be temporary, limited to daylight hours, and would use minimization measures identified below to reduce impacts to sea turtles. Sea turtles are mobile, and observers would ensure that sea turtles do not enter the work area during construction, or they could be prevented from entering the work area through the use of silt curtains, reducing the impact of auditory trauma such as temporary or permanent threshold shifts.

This analysis and determination of impacts from the Proposed Action on sea turtles and sharks is consistent with prior and current agency consultations related to similar in-water construction projects, including the *Sumay Cove Repair and Modernization Biological Opinion*; *Lima, Mike, and November Wharves Repair Letter of Concurrence*; and *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 Biological Opinion* (NMFS 2011, NMFS 2020a, NMFS 2022). In these consultations, NMFS concluded that no protected species would be expected to be exposed to in-water sound levels capable of causing injury. Consequently, the Proposed Action would not likely reduce the abundance of protected species in Guam or reduce the likelihood of both survival and recovery of ESA-protected species in Guam or across Oceania. Additional details on potential impacts on protected species, agency consultation, and proposed BMPs are provided in **Section 3.3** and **Appendix C**.

Table 3-17. Sea Turtle Isopleths for Impact and Vibratory Pile Driving

	Pile Type and Location		Source Level for Single Strike			Pile Driving Parameters						Isopleth Sea Turtle (meters)	
Location	**Structure**	**Pile Type**	**dB Peak**	**dB RMS**	**dB SEL**	**Total Days**	**Strikes per Pile**	**Piles installed per day**	**Total Strikes per day**	**$SEL_{cumulative}$**	**Transmission Loss Coefficient**	**Behavioral**	**PTS**
Impact Pile Driving													
Inner Glass Breakwater	Temporary Mooring Piles	36-inch Steel Pipe	208	190	180	16	2,400	1.0	2,400	214.0	15	100.0	45.1
Sumay Marina	Wave Attenuator	20-inch Square Concrete	185	175	162	32	200	1.0	200	185.0	15	10.0	0.5
Sumay Marina	Wave Attenuator	36-inch Steel Pipe	208	190	180	16	2,400	1.0	2,400	214.0	15	100.0	45.1
Sumay Marina	Finger Dock Guide Piles	16-inch Octagonal Concrete	192	172	160	12	200	1.0	200	183.0	15	6.3	0.4
Sumay Marina	Main Dock Guide Piles	16-inch Octagonal Concrete	192	172	160	12	200	1.0	200	183.0	15	6.3	0.4
Vibratory Pile Driving													
Inner Glass Breakwater	Temporary Mooring Piles	36-inch Steel Pipe	-	175	-	16	60	1.0	60	210.6	15	10.0	2.4
Sumay Marina	Wave Attenuator	20-inch Square Concrete	-	158	-	32	10	1.0	10	185.8	15	0.7	0.1
Sumay Marina	Wave Attenuator	36-inch Steel Pipe	-	175	-	16	60	1.0	60	210.6	15	10.0	2.4
Sumay Marina	Finger Dock Guide Piles	20-inch Octagonal Concrete	-	158	-	12	10	1.0	10	185.8	15	0.7	0.1
Sumay Marina	Main Dock Guide Piles	16-inch Octagonal Concrete	-	158	-	12	10	1.0	10	202.6	15	0.7	0.1
Sumay Marina	Temporary Construction Trestle	24-inch Steel Pipe	-	153	-	10	120	1.0	120	191.6	15	10.0	2.4

Source(s): California Department of Transportation 2015; California Department of Transportation 2020; NMFS 2024b

Key: dB = decibel; PTS = permanent threshold shift; RMS = root mean square; SEL = sound exposure level
Table Notes: Unit of measure for SPL is dB re 1 µPa; Unit of measure for SEL is re 1 $\mu Pa^{2}{\cdot}s$.

The Navy determined that exposure to elevated noise levels from the Proposed Action ***may affect*** but is ***not likely to adversely affect*** ESA-listed *A. globiceps*. With the implementation of BMP-D described in **Section 2.5**, potential acoustic effects on ESA-listed corals from exposure to elevated noise levels from proposed activities would be less than significant.

The Navy determined that exposure to elevated noise levels from the Proposed Action ***may affect*** but is ***not likely to adversely affect*** green sea turtles, hawksbill sea turtles, and scalloped hammerhead sharks. With the implementation of minimization measures summarized below and BMPs described in **Table 2-2** in **Section 2.5** (e.g., BMP-A1, BMP-A2, BMP-B, and BMP-C), and the regular occurrence of green sea turtles, rare occurrence of hawksbill sea turtles and scalloped hammerhead sharks, potential acoustic effects on ESA-listed sea turtles and sharks from exposure to elevated noise levels from proposed activities would be less than significant.

Vessel Noise - There would be a minor, short-term adverse impact on marine species during construction activities due to noise from the operation of additional marine vessels/engines. Vessels supporting construction (including tugboats/barges and support vessels) would be operating at relatively slow speeds in the vicinity of Apra Harbor.

Sumay Cove

Construction under Alternative 1, including pile driving, in-water work, and vessel operations, may temporarily affect the in-water noise environment surrounding Sumay Cove.

Construction Noise (excluding pile driving) – Impacts from construction noise in Sumay Cove would be similar to those discussed for the Glass Breakwater. Similar types of equipment and construction activities would occur in Sumay Cove. Impacts from construction activities on recreational users of the marina would be minimal during weekdays because most marina users visit during the weekends.

During construction, the on-base residences and recreational ball field located southwest of the marina may be exposed to general construction noise up to approximately 57 dB and 48 dB, respectively. These noise levels may be audible but would be consistent with existing ambient noise on the base. Due to the relative isolation of the project area from housing and the average calculated dBA noise levels, construction impacts would be considered less than significant.

Pile Driving Noise – In-air noise from pile driving at Sumay Cove would be similar to that discussed above for Glass Breakwater. Pile driving would exceed the standard threshold of 90 dBA for in-air noise, and might produce short-term major adverse impact on marina users due to the noise created by the action during construction. Due to the temporary and intermittent nature of pile driving activities and avoidance of conducting pile driving at night or within 50 feet of occupied vessels, impacts would be minor. Vehicle and construction equipment noise would be dissipated by the air-water interface and would not be expected to disturb marine species in the water column.

ESA-listed endangered hawksbill turtles and green turtles, as well as ESA-listed threatened scalloped hammerhead sharks, may occur but are unlikely to occur in the Sumay Cove Action Area. As discussed above, noise impacts to scalloped hammerhead sharks can be discounted. **Table 3-17** above provides estimated in-water noise levels and acoustic impact isopleths for behavioral responses and PTS for sea turtles for each unique pile type, pile size, and location.

Noise impacts from pile driving at Sumay Cove would be the same as those discussed above for Glass Breakwater. Through implementation of minimization measures and BMPs (**Table 2-2**), the Proposed

Action ***may affect*** but is ***not likely to adversely affect*** ESA-listed *A. globiceps*, sea turtles, and sharks, and impacts from exposure to elevated noise levels from proposed activities would be less than significant. Additional details on potential impacts on protected species, agency consultation, and proposed BMPs are provided in **Section 3.3** and **Appendix C**.

Vessel Noise - A "No Wake" zone extends from the boat ramp to the Sumay Cove exit, which limits boat speed and associated noise. The USCG recommends a maximum of 86 dBA for motorboat engine noise. The USEPA recommends 75 dBA for motorboats at 15 meters (50 feet) as acceptable for public health and welfare (USEPA 1974). Guam does not require additional muffling besides requiring that the motor's engine "…not create excessive or unusual noise. The discharge of cooling water through the exhaust of an inboard engine is considered an adequate muffling device" (10 GAR Section 4159). There is potential for construction support vessels to cause short-term, minor, and adverse increases in noise affecting recreational users in the area. Any vessels used during construction would obey the "No Wake" requirements of Sumay Cove to reduce noise. Long-term, minor, and adverse impacts on marina users may result from the additional noise produced by an increase in motorboats entering and exiting Sumay Cove.

Alternative 1 would implement the BMPs listed in **Sections 2.5** and **3.3** and the following minimization measures to reduce noise and the potential for noise impacts on the public and protected marine species:

- Noise would be limited to normal working hours and would return to ambient levels at the conclusion of the construction. The Project would use low-noise emission products, as certified by the USEPA.
- A competent observer would be used to check if sea turtles are in the vicinity prior to beginning construction. Any species sighted would be registered. Using pre-coordinated communication, the observers would inform the operators to stop construction if sea turtles were observed.
- Project sites could be completely or partially closed off by silt curtains as practicable.
- For impact hammers used during pile driving, the power of the hammer would be reduced to minimum energy levels necessary, reducing the amount of noise produced in the marine environment.
- All construction-related boats would follow the "No Wake" restriction in Sumay Cove.
- Vessel operators and construction personnel would abide by the established 46 meter (50 yard) shutdown zone for ESA-protected sea turtles and sharks, as well as a special shut-down zone of 120 m (131 yd) when impact pile driving any 36-inch or smaller steel pipe piles..

3.8.4.3 Cumulative Impacts

The ROI for cumulative impacts related to noise includes both the terrestrial areas in the vicinity of Glass Breakwater, the construction staging areas, and Sumay Cove, as well as the underwater environment in the vicinity of Apra Harbor.

Because noise impacts would be temporary, lasting only during the construction period, past and future actions outside of the 5-year construction period would not have the potential to result in cumulative impacts. Only current and near-future projects, such as the Polaris Point beach restoration and seawall repair, would have the potential to result in cumulative noise impacts in Apra Harbor.

Cumulative impacts related to noise from past, present, and future actions within the ROI would be less than significant. Construction noise may temporarily impact the terrestrial environment near Glass Breakwater. This area is generally industrial or commercial in nature and is not near any homes or other sensitive receptors such as schools, places of worship, daycares, or hospitals. In-water construction efforts at Glass Breakwater would temporarily impact the in-water noise environment, but CAUs would be strategically placed, as opposed to dropped, so both terrestrial and in-water noise would be relatively low. Pile driving has the potential to create substantial noise, but the duration would be short, and with the implementation of BMPs such as the use of low-noise equipment and monitoring for marine species, impacts would be minimized. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects would not result in significant impacts within the ROI.

3.9 Health and Safety

3.9.1 Description of the Resource

This discussion of Public Health and Safety includes consideration for any activities, occurrences, or operations that have the potential to affect the safety, well-being, or health of members of the public. A safe environment is one in which there is no, or optimally reduced, potential for death, serious bodily injury or illness, or property damage. The primary goal is to identify and prevent potential accidents or impacts on the general public. Public Health and Safety within this EA discusses information pertaining to construction activities and operational safety:

- Public Health and Safety during construction activities is generally associated with construction traffic, as well as the safety of personnel within or adjacent to the construction zones.
- Operational safety refers to the actual use of the built-out proposed Project and potential risks to inhabitants or users of adjacent or nearby land and water parcels.

3.9.2 Regulatory Setting

The OSHA (29 U.S.C. Section 651, *Congressional Statement of Findings and Declaration of Purpose and Policy*) and other relevant laws ensure safe and healthy working conditions for civilian workers by setting and enforcing standards and providing health and safety training, outreach, education, and assistance. The health and safety of on-site military and civilian workers are also safeguarded by numerous DoD and Navy regulations designed to comply with the standards issued by the OSHA and USEPA. These standards specify the amount and type of training required for industrial workers, the use of personal protective equipment (PPE) and clothing, engineering controls, and maximum exposure limits for workplace stressors.

The DoD Safety and Occupation Health Program, outlined in DoD Instruction 6055.1, provides DoD safety policies and assigns responsibilities (DoD 2021). Secretary of the Navy Instruction 5100.10L establishes the Navy Safety Program policy and assigns responsibilities within the Navy (DoN 2021). Guidelines for implementing and adhering to the Navy Safety Program are described in Chief of Naval Operations Manual 5100.23, *Navy Safety and Occupational Health Manual* (DoN 2024c).

3.9.3 Affected Environment

Typhoons and heavy weather events present hazards to the Sumay Peninsula. Guam is located in a hotspot of typhoon activity, with intense tropical storms. Winds can exceed 180 miles per hour,

destroying everything in their path. Glass Breakwater is a critical infrastructure component protecting Apra Harbor and facilities, vessels, structures, roads, and other features on land nearby.

The worsening condition of the breakwater affects the position of an existing USCG aid to navigation (ATON) tower. The affected ATON tower is the only physical means to guide all incoming vessels into the mouth of the Outer Apra Harbor. Maintenance of the Guam Glass Breakwater is required to provide safe navigation of Outer Apra Harbor for both military logistics as well as the protection of life and safety of the civilian population.

The Sumay wave attenuator provides protection for docked vessels in Sumay Marina but failed completely during Super Typhoon Mawar. The damaged condition of the attenuator is creating unsafe conditions for vessels moored in the marina from routine waves and storms.

3.9.4 Environmental Consequences

The ROI for Public Health and Safety concerns during construction and operational activities includes the health and well-being of military personnel and civilians living on or in the vicinity of NBG. Impacts on safety were assessed according to the magnitude of changes potentially impacting the well-being of personnel, the public, and DoN property. The Proposed Action was evaluated to determine where additional or unique safety risks are associated with its implementation. Any increase in safety risks is considered an adverse impact on safety. A proposed action would have significant impacts on safety if any of the following were to occur:

- Substantial increase in risks associated with the safety of DoN personnel or the general public;
- Introduction of a new safety risk for which DoN is not prepared or does not have adequate management and response plans in place; and
- Hinderance to the ability for a quick response to an emergency.

3.9.4.1 No Action Alternative

Under the No Action Alternative, the critical repairs identified for the Proposed Action would not be implemented, and the breakwater, at risk of imminent breach, would continue to degrade, resulting in long-term, moderate to significant, adverse impacts on Public Health and Safety.

A fully maintained and functioning breakwater provides for the safe navigation of Outer Apra Harbor for both military logistics at NBG, as well as the protection of life and safety of the civilian population on Guam. The island is affected by seasonal and extreme storm events. In these conditions, if the breakwater is breached, severe wave action and siltation of the Outer Apra Harbor would likely occur. This would adversely impact marine navigation channels and make it impassable for commercial vessels, military vessels, and submarines. Commercial vessels support fuel, bulk materials, produce, and container transport, which are critical to maintaining essential services and safety for personnel and civilians, such as power, transportation, medical care, and supplies. Additionally, the position of the existing USCG ATON would worsen, affecting the safety of all incoming and outgoing vessels through the mouth of the Outer Apra Harbor.

Without improved marina infrastructure at Sumay Cove, the degraded state of the floating docks and failed wave attenuator in Sumay Marina would continue to present occupational and property hazards for USCG, Port Operations, Navy Security and Emergency Responses Forces, MSC, and MWR vessels, personnel, and other users, likely leading to a required relocation of the docks or construction of a new marina.

3.9.4.2 Alternative 1

Short-term, minor, adverse impacts on contractor, personnel, and marina user safety during breakwater and related waterfront repairs may include potential slips, falls, unfamiliar working environments, noise exposure, and specific hazards such as handling power tools and working with heavy equipment, trucks, and machinery.

Repair efforts are also expected to have inherent danger from noise associated with machinery and equipment, particularly pile driving activities. See **Section 3.8.4** for additional information on noise impacts as expected under the Proposed Action. All proposed construction activities would be conducted in accordance with applicable DoD and Navy safety protocols, standards, and BMPs, and OSHA regulations. Construction personnel would be provided with proper training on potential hazards and given all necessary PPE to mitigate potential safety risks. PPE may include hard hats, steel-toed boots, hearing protection, signage, safety harnesses, communication devices, and any other equipment deemed necessary for the proposed projects. Access would be restricted to authorized workers as needed during construction activities.

Short-term, minor, adverse impacts could be expected from an increase in potential risk during construction from increased roadway traffic due to the transport of construction, repair materials, and debris, and the potential for associated accidents or roadway mishaps. Additional information regarding impacts on transportation and traffic can be found in **Section 3.7**.

Long-term, beneficial impacts on safety would occur under Alternative 1, as the necessary repairs would be made to the Glass Breakwater to prevent further deterioration, therefore safeguarding the shore facilities and infrastructure within the harbor from severe wave action during typhoons and other heavy weather events. Military and commercial vessels would be able to safely and effectively pass through the marine navigation channels, thus continuing to support and provide vital services to the island of Guam. Under Alternative 1, the repairs at Sumay Cove would also enhance the safety of vessels and operators mooring and transiting in and out of Sumay Cove Marina.

See **Section 3.6** for discussion of safety impacts regarding hazardous waste and materials and MEC under the Proposed Action.

Implementation of Alternative 1 would not result in significant impacts on Public Health and Safety.

3.9.4.3 Cumulative Impacts

Cumulative Public Health and Safety impacts from past, present, and future actions within the ROI would be less than significant because Public Health and Safety effects of past actions would not overlap temporally or spatially with the Proposed Action's temporary construction period impacts. In addition, the construction contractor would follow all applicable DoD, Navy, and OSHA standards and BMPs. The public, including marina users, would be excluded from the construction areas during active construction and would not have the potential to have their health or safety adversely impacted. Cumulative, beneficial impacts would be expected from the Proposed Action when combined with the cumulative projects related to the emergency breakwater repairs to at least refill the gaping segments where erosion has led to failure of the breakwater structure as well as repair and improvements of the wharf, harbor, and shoreline infrastructure in the ROI, along with dredging maintenance, due to the increased overall safety of the ROI for vessels, personnel, and civilians during day-to-day operations and heavy weather events.

3.10 Socioeconomics

3.10.1 Description of the Resource

Socioeconomics describes the local economic and social conditions in an area. Community and socioeconomic indicators, such as changes in population and demographics, housing, employment, income, access to community services, and regional economic activity, inform the assessment of socioeconomics and are used to understand the community potentially affected by the proposed action. This analysis focuses on the potential impacts associated with the Glass Breakwater and the Sumay Cove repairs, as well as the addition of construction personnel that could impact the indicators listed above.

3.10.2 Regulatory Setting

The Navy has prepared this EA based on federal and state laws, statutes, regulations, and policies pertinent to the implementation of the Proposed Action, as detailed in **Section 1.7**. NEPA directs federal agencies to consider the potential economic and social effects of proposed projects on the human environment. Additionally, the Navy's Environmental Readiness Program Manual implements the policy set forth in Chief of Naval Operations Instruction 5090.1E, which mandates the analysis of social and economic impacts associated with proposed actions requiring environmental planning (DoN 2021).

3.10.3 Affected Environment

The following discussions provide a description of the existing conditions for socioeconomics potentially impacted by the Proposed Action. The project area for all proposed activities for the Proposed Action at the breakwater and Sumay Cove are encompassed within census tracts 9544 (Piti) and 9545 (Santa Rita).

3.10.3.1 Population and Communities

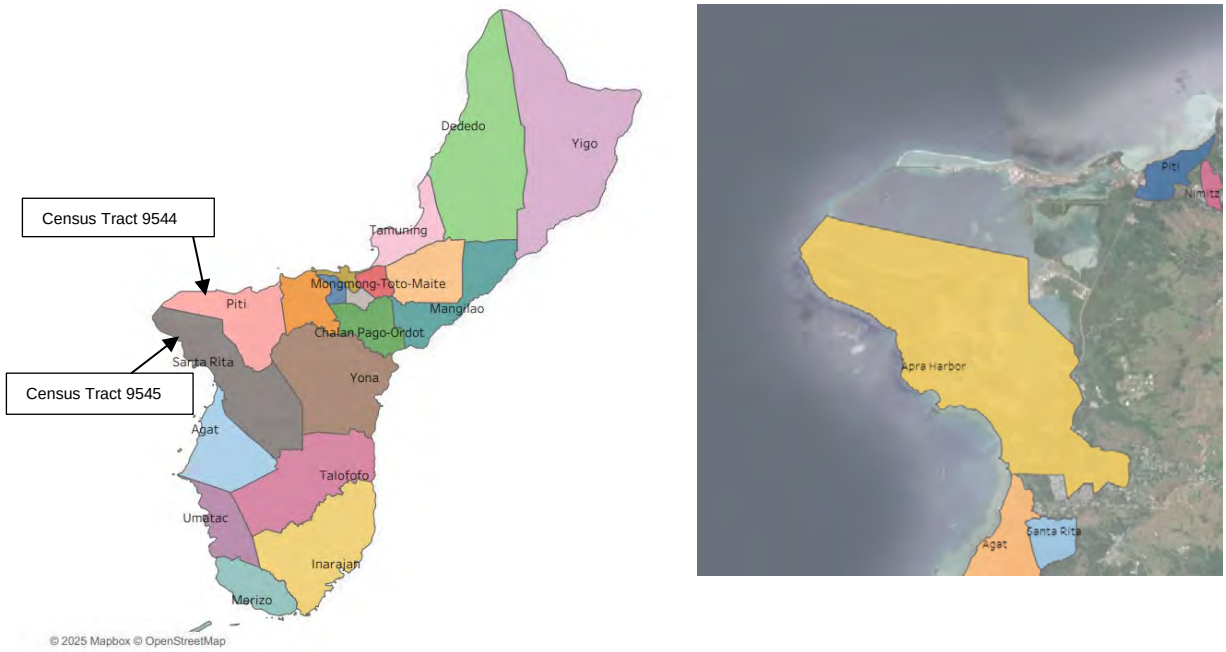
In 2020, Guam had a total civilian population of 153,836 (U.S. Census Bureau [USCB] 2020a). An additional 21,700 military members and their families also reside on the island (Military INSTALLATIONS 2024). In November 2024, reports indicated the population on Guam is rapidly increasing, and part of this population growth is due to the influx of off-island (H-2B) workforce (currently estimated at around 5,000 workers) required to support existing and planned development on the island.

The island is divided into 19 municipalities. NBG (and Sumay Cove) is located within the municipality (village) of Santa Rita, while Glass Breakwater is located within the adjacent municipality (village) of Piti. For U.S. Census purposes, Guam is further divided into Census Designated Places (CDPs). These areas represent closely settled, unincorporated communities recognized and identified by their local names. The Glass Breakwater repairs are located within Piti Village and CDP, and the Sumay Cove repairs are located within Santa Rita Village and Apra Harbor CDP (see **Figure 3-6**).

By land, the nearest CDP to the Glass Breakwater is Piti, which is located immediately east of Glass Breakwater. The population of Piti CDP (identified in USCB data as Tract 9544) is 72.8 percent Native Hawaiian and Other Pacific Islander, 6.2 percent Asian, and 4.5 percent White. The minority population of this region, at 95.5 percent, is slightly higher than the island's overall average (USCB 2020a, and USCB 2024b).

Sumay Cove is located completely within NBG, in the Apra Harbor CDP. The 2020 U.S. Census identified a total population of 2,930. Apra Harbor CDP contains 809 housing units, of which 627 are occupied. NBG comprises a majority of Apra Harbor CDP, which only has 33 non-military housing units (USCB 2024b).

Figure 3-6. U.S. Census Map of Guam Villages and Census Tracts (Left) and CDPs (Right) Encompassing the Project Areas at Glass Breakwater and Sumay Cove



Source: Guam BSP 2020
Note: Left shows the Guam Villages of Piti and Santa Rita with Census Tracts labeled for the each. Right shows the Apra Harbor and Piti Census Designated Places (CDPs).

Due to the presence of NBG, demographics in Tract 9545 (Santa Rita) differ substantially from those of Guam. Chiefly, the NBG area (located within the Apra Harbor CDP) has a total minority population of approximately 34 percent. The Native Hawaiian and Other Pacific Islander population makes up only 2.5 percent; the Asian population, 7.7 percent; and the White population, 66.1 percent. Notably, while the Black or African American population in Guam was reported at 0.9 percent, Apra Harbor CDP reported a higher percentage of 9.0 percent Black or African American residents (USCB 2020a and USCB 2024b). The 2020 Census did not report on the minority population percentage for NBG.

The percent populations for children and the elderly in Tract 9544 (39 percent) were similar to that of Guam (38 percent), while the respective population percentages in Tract 9545 (45 percent) were slightly higher than for Guam.

The per capita income for Apra Harbor CDP is $19,031 USD, with 33.3 percent of individuals (24 percent of families) living below the poverty level (USCB 2020b, USCB 2024b). It is important to note that these income figures exclude individuals residing in military housing units. Given that the majority of Apra Harbor CDPs population is on NBG, the reported values are not representative of the entire CDP. The Apra Harbor CDP is encompassed within Guam Tract 9545 (Village of Santa Rita).

3.10.3.2 Housing

Guam encompasses 51,555 civilian and military housing units, 43,381 of which are occupied (USCB 2024a). CDP encompasses 206 housing units, of which 171 are occupied (USCB 2024b). Further, a housing shortage has been reported as limiting the numbers of off-island (H-2B) construction workers that could come to Guam (Pacific Daily News 2024). Following review of the latest workforce and housing data, the Guam Land Use Commission reported that some contractor teams have existing

agreements for on-island housing (barracks, temporary apartments, temporary housing facilities) to accommodate workforce needs, and that not every contractor is using their full permitted capacity (Pacific Daily News 2024).

3.10.3.3 Income and Industry

The per capita income in Guam is $21,545 U.S. dollars (USD), and 20.2 percent of individuals (17 percent of families) have an income below the poverty level, excluding people in military housing units (USCB 2024a). The per capita income for Piti CDP is $21,668 USD, and the percentage of individuals with an income below the poverty level is 24.8 percent, excluding people in military housing units (USCB 2020a). The per capita income for Apra Harbor CDP is $19,031 USD, with 33.3 percent of individuals (24 percent of families) living below the poverty level (USCB 2020a, USCB 2024b). It is important to note that these income figures exclude individuals residing in military housing units. Given that the majority of Apra Harbor CDPs population is on NBG, the reported values are not representative of the entire CDP. The Apra Harbor CDP is encompassed within Guam Tract 9545 (Village of Santa Rita).

Table 3-18 presents 2020-reported Census data for workforce by industry on Guam, in Piti, and in Santa Rita as reported by the Guam BSP (Guam BSP 2020). In Piti (Tract 9544) and Santa Rita (Tract 9545), the predominant workforce supported education and healthcare and public administration, both at population percentages substantially higher than Guam. And the reported construction workforce in those areas comprised between 6 and 7 percent of their respective village populations, as compared with the nearly 11 percent employed in construction for Guam as a whole. In 2024, following the economic shifts and amid the economic and workforce recovery following the 2020 COVID-19 pandemic, the island is reporting a shortage of workers (Guam BSP 2020, Pacific Daily News 2024). Notably, the shortage has particularly affected the construction industry because so much investment for development and project work is ongoing on the island. To meet the growing demand for highly skilled workers, Guam continues to rely on the H-2B waiver program, which enables the military and construction contractors to bring in foreign workers to supplement the resident workforce (Guam BSP 2020, Pacific Daily News 2024).

Table 3-18. Industry and Workforce for Guam, Piti (Tract 9544), and Santa Rita (Tract 9545)

Industry	Guam	Piti (Tract 9544)	Santa Rita (Tract 9545)
	Total Workforce Population		
	58,032	646	1,352
	Total Workforce Population Percent		
Agriculture, Forestry, Fishing, Hunting, and Mining	0.3	0	0.5
Construction	10.7	6.3	7.2
Manufacturing	2.2	2.2	1.9
Wholesale Trade	3.4	3.1	1.9
Retail Trade	12.6	12.1	11.4
Transportation, Warehousing, and Utilities	7.1	6.8	8.7
Information	2.3	5.1	2.3
Finance, Insurance, and Real Estate	5.7	6.7	3.9
Professional, Scientific, Management and Administration	9.6	12.7	10.9
Education, Healthcare, Social Services	16.5	16.4	20.3
Arts, Entertainment, Recreation, Accommodation	16.7	10.7	10.1
Other Services (except Public Administration)	3.5	2.0	3.5
Public Administration	9.4	15.9	17.4

Source: Guam BSP 2020

3.10.3.4 Economic Activity

The three primary sources of funds for Guam are tourism, construction capital investment, and federal expenditures (Government of Guam 2023). Tourism, typically the highest contributor to funds flowing into Guam's economy, has been recovering following a substantial decline related to the coronavirus pandemic that began in 2020. Federal government expenditures, typically the second-largest source of funds flowing to Guam, are currently the largest funding source. During the pandemic, slowed tourism followed by an increase in federal expenditures to support families resulted in that transition.

Meanwhile, construction projects have been increasing substantially in recent years (Government of Guam 2023). Appropriations for U.S. military construction projects increased from $248.7 million in FY 2017 to $523.0 million in FY 2023 (representing a 110 percent increase), and the associated list of DoD projects currently under construction is also substantial at over $2.2 billion in project cost, with more than $1.1 billion in FY 2023 work remaining to be completed. Further, it estimated that approximately $4.8 billion in military construction work is planned or ongoing on the island currently (Pacific Daily News 2024). Development projects and associated appropriations from the Government of Japan and other U.S. federal agency actions have also trended upward with increased investment and plans for development (Government of Guam 2023).

As an island, Guam relies on imports – and to a lesser extent, exports – to maintain daily operations. In 2022, Guam's exports were valued at $27.7 million USD, while imports totaled $1.28 billion USD (Observatory of Economic Complexity 2024). The Port of Guam, located in Apra Harbor, handles more than 90 percent of the island's total imports (PAG 2024). The Port of Guam also offers transshipment services to the entire western Pacific, making it a critical component of Guam's economic infrastructure and that of the broader region.

3.10.4 Environmental Consequences

The ROI for socioeconomic analysis includes the Villages (and Census Tracts) of Piti and Santa Rita, which encompass the breakwater, roadways, and Sumay Cove areas where Project activities would occur and nearby communities that could be affected by those actions. Impacts on socioeconomics from the Proposed Action would be considered significant if they resulted in a substantial change in the local or regional population, housing, and/or public services (health, police, fire); a substantial change in social conditions from the demands of additional population/population shifts; and/or a substantial change in the local or regional economy, employment, or spending of earnings patterns.

3.10.4.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur; Glass Breakwater, Sumay Marina and Sumay Point revetment would not be repaired. There would be no change in socioeconomic and community conditions if the breakwater remains in its current condition. Not repairing the breakwater, however, would increase the risk of a breach leading to damage in Apra Harbor and threatening the capabilities of the Port of Guam. Even under normal wave action, degradation of the breakwater will continue, and there would be spread of failed sections of the breakwater over time. As sections continue to break away leaving voids, the risk of breach would only increase. Given Guam's heavy reliance on imported goods through the Port of Guam, as well as its role in regional shipment transfers, any disruption to the Port of Guam operations could threaten the economic stability and health of Guam and the broader Pacific region. In the impending event of a breach, harbor access and port operations would be severely affected, yielding potentially devastating impacts on public services and shipment of goods to or from the island. Halting of Port of Guam operations would threaten the

economic and community health and stability of Guam and the broader Pacific region. Adverse impacts from such an event would be significant.

3.10.4.2 Alternative 1

Construction for the Proposed Action would not result in an appreciable shift or change in socioeconomic conditions, population and community, housing, or cause notable adverse or beneficial effects on local income or industries. Construction-related impacts would be temporary, negligible to minor adverse as well as beneficial. Long-term beneficial effects on Guam and the region's communities, services, workforce, and economy would be expected from maintaining a safe, accessible port.

Construction activities for the Proposed Action at the casting yards, loading areas, and transport of materials along Marine Corps Drive and Highway 11 would be the most likely on-land areas where there would be potential to result in adverse effects on the local communities. Impacts in these areas would be due to increased construction-related traffic, potential for degraded roadway infrastructure from repeated heavy-load truck hauls with CAU, and increased air emissions from construction vehicles, vessels, and equipment that would be located and active in the near-shore areas around the harbor. Additionally, existing wind patterns (described in **Section 3.2.3**) would transport construction-related air emissions away from on-land areas, such as Family Beach and Sumay Marina, most of the time. However, vessels transiting through Sumay Cove and individual recreational users of Sumay Point may be adversely affected by the presence of construction vessels and activities and related air emissions. It is anticipated that transport of air emissions to public areas and sensitive receptors would be infrequent, and when they occur, air pollutant concentrations are expected to be low, commensurate with the activity level. It is anticipated that transport of air emissions to public areas and sensitive receptors would be infrequent, and when they occur, air pollutant concentrations are expected to be low, commensurate with the activity level. Construction-related noise would not likely affect residential areas in either Piti (Tract 9544) or Santa Rita (Tract 9545) but may be noticeable along the main roadways within the project area. Because most schools, residences, and commercial areas are located north of the project area, these impacts would likely be limited to the driving commute for those individuals transiting the area while construction was occurring.

Furthermore, the Proposed Action would reinforce the breakwater at Apra Harbor and the Sumay Marina and shoreline protection, providing enhanced protection for the USCG, Port Operations, and Navy Security and Emergency Response Forces, as well as enhanced protection for import-export activities at the Port of Guam. Guam's local economy relies on the goods and services imported through the Port of Guam; the Port of Guam also offers transshipment services to the entire western Pacific. Consequently, a safe harbor is vital to the economic stability of both Guam and the western Pacific.

The presence of construction activities and the off-island workforce to support implementation of the Proposed Action may increase demand but would not result in an appreciable impact on access to and quality of public and health services geared to support communities.

Temporary, negligible to minor, adverse impacts on housing would be expected from the short-term increase in Guam's population, which would be housed off-installation. The nearby towns have sufficient housing capacity to accommodate the anticipated off-island (H2B) personnel. While Apra Harbor CDP, primarily composed of NBG and military housing, would have limited ability to house off-installation residents, there are approximately 35 vacant homes in the Piti CDP (USCB 2024b). Additionally, several larger towns within 10 miles of the project area, including the capital city of Hagåtña, offer greater capacity for additional workforce housing. As a result, the influx of off-island

workers would have a short-term beneficial impact with no significant long-term impact on socioeconomics.

The Proposed Action would generate an estimated average of 70 jobs with a peak of 85 jobs over the course of the five-year construction period. Approximately 20 percent of these jobs would be filled by local workers, providing approximately 14 temporary positions to the local community, in addition to the associated construction-related expenditures. An estimated average of 56 off-island (H-2B) personnel would generate a modest amount of additional revenue for the community through spending on housing, transportation, food, and other goods and services. Temporary construction employment created by the Proposed Action would result in wages paid, increases in business sales volume, and an increase in demand for local and regional services, housing, and goods. Such beneficial changes would assist in Guam's economic recovery from the impacts of the COVID-19 pandemic. Additionally, construction-related spending on the island for fuel, food, and materials would also benefit the local economy.

Temporary, negligible to minor, adverse impacts on housing would be expected from the long-term increase in Guam's population, which would be housed off-installation. The nearby towns have sufficient housing capacity to accommodate the anticipated off-island (H2B) personnel. While Apra Harbor CDP, primarily composed of NBG and military housing, would have limited ability to house off-installation residents, there are approximately 35 vacant homes in the Piti CDP (USCB 2024b). Additionally, several larger towns within 10 miles of the project area, including the capital city of Hagåtña, offer greater capacity for additional workforce housing. As a result, the influx of off-island workers would have a short-term beneficial impact with no significant long-term impact on socioeconomics.

3.10.4.3 Cumulative Impacts

The ROI for socioeconomics includes the entire island of Guam. In recent years, construction activities have presented an expanding source of economic activity throughout the ROI. Many of the past, present, and future actions involve wharf and dock repairs in and around the area of the Proposed Action. Any actions that may overlap temporally or spatially are small in scale and unlikely to cause a strain on the construction workforce. The largest foreseeable action in the ROI is the Guam and Commonwealth of the Northern Mariana Islands Military Relocation. This Project would overlap temporally with the Proposed Action; however, the two Projects would occur in different areas, thus dispersing the workforce housing needs throughout the central and northern portions of the island. Due to variable weather activity, there is ongoing potential for construction delays that could result in overlap of the timing of the Proposed Action with the new fuel pipeline to be constructed along Marine Corps Drive. If that occurs, additional traffic delays would be expected.

The combination of reasonably foreseeable actions would provide consistent construction-related job opportunities for residents of Guam and off-island personnel over the next several years and beyond. It is reported that Guam's current population of approximately 5,000 off-island (H-2B) workers will need to grow to approximately 12,000 to support existing and projected plans for development on the island (Pacific Daily News 2024). Depending on how projects are implemented within the same timeframe as the Proposed Action, cumulative impacts on housing may be moderate and adverse for the duration of overlapping construction periods. Additionally, access to and quality of public and health services would not be appreciably affected. However, it is likely that the additional off-island workers required for all of the identified cumulative projects would increase demand on these services. Completion of the Proposed Action would have the beneficial effect of providing reliable protection to the Apra Harbor

entrance and ensuring the safety and reliability of the Port of Guam, which is essential to the island and regional economy. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects would not result in significant impacts within the ROI.

The Proposed Action and other cumulative projects in and around Apra Harbor would not likely result in appreciable cumulative noise impacts on residential areas in Piti or Santa Rita. Access to recreational areas such as Family Beach, recreational dive sites, and boating access may be limited during construction efforts for the various projects. Each of the reasonably foreseeable projects, in addition to the Proposed Action, would benefit local socioeconomics and community conditions by providing jobs and facilitating the flow of goods and services, which could result in increased funding for public services and improved care the local communities, and regional economic stability through maintenance of a safe and accessible port.

3.11 Water Resources

3.11.1 Description of the Resource

This discussion of water resources focuses on marine waters, wetlands, and floodplains. While groundwater resources are important elsewhere in Guam, there is no groundwater of consequence in the proposed project area. There is a sole source aquifer, the Northern Guam Lens Aquifer, in northern Guam, which provides the majority of the island with drinking water. The project area lies outside of the recharge area for the aquifer. All surface runoff at the sites flows into marine waters. Additionally, there are no surface water features in the project area separate from marine waters or wetlands. Therefore, groundwater and surface water are not discussed further in this EA.

Marine Waters. Marine waters typically include estuaries, waters seaward of the historic height of tidal influence, and offshore high salinity waters. Marine water quality is described as the chemical and physical composition of the water as affected by natural conditions and human activities. Additionally, marine waters may include areas that require special protection to avoid adverse water quality impacts in order to prevent damage to marine resources.

Wetlands. USACE defines wetlands as “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas” (33 CFR 328.3[c][1]). Wetlands are an important natural system and habitat because of the diverse biological and hydrological functions they perform. These functions include water quality improvement, groundwater recharge and discharge, pollution mitigation, nutrient cycling, wildlife habitat provision, and erosion protection.

Floodplains. Floodplains are areas of low-level ground present along rivers, stream channels, large wetlands, or coastal waters. Such lands might be subject to periodic or infrequent inundation from rain or melting snow. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, and nutrient cycling. Floodplains also help to maintain water quality and are often home to a diverse array of plants and animals. In their natural vegetated state, floodplains slow the rate at which the incoming overland flow reaches the main water body.

The risk of flooding typically depends on local topography, the frequency and intensity of precipitation events, and the size of the watershed above the floodplain. Flood potential is evaluated by the Federal Emergency Management Agency (FEMA), which defines 100- and 500-year floodplains. The 100-year floodplain is an area that has a 1 percent chance of inundation by a flood event in a given year, while

500-year floodplains have a 0.2 percent chance of inundation in a given year. In addition to the 100- and 500-year floodplains, FEMA designates Coastal High Hazard Areas (or Special Flood Hazard Areas) along the coasts that have additional hazards due to wind and wave action.

Coastal Zone. The term "coastal zone" means the coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. The “coastal zone” of Guam includes all non-federal property on the island, including offshore islands and submerged lands and waters extending seaward to a distance of three nautical miles.

3.11.2 Regulatory Setting

Marine Waters and Wetlands. Similar to wetlands, marine waters are regulated as Waters of the U.S. (WOTUS) under the CWA. The CWA (33 U.S.C. Section 1251 *et seq*.) includes sections and measures to regulate and protect marine waters in the U.S. Under Section 404 of the CWA, the USACE regulates the discharge of dredge or fill material into WOTUS. The term “WOTUS” contains relatively permanent bodies of water forming geographic features such as lakes, rivers, streams, and oceans. Also incorporated are special aquatic habitats, including wetlands when they have a continuous surface connection to water bodies that are WOTUS. The final conforming rule amendments to the “Revised Definition of ‘WOTUS’” were issued on September 8, 2023, by the USEPA (88 FR 61964). Section 404(b) provides criteria the USACE uses to issue permits allowing dredge or fill activities. The USEPA, under Section 404(c), can also be involved in this regulatory decision. Guam EPA, with delegated authority from the USEPA, administers the issuance of WQC pursuant to Section 401 of the CWA. Section 404 and 401 WQCs are typically issued together for dredge and fill activities in WOTUS. Section 402 of the CWA includes rules to reduce the adverse effects of stormwater discharges to WOTUS and in-water sensitive habitats and species. Stormwater management permits are required during the temporary construction phase as well as for long-term use of repaired infrastructure and land development. The CWA also requires that Guam establish a Section 303(d) list to identify impaired waters and establish Total Maximum Daily Loads for the sources causing the impairment.

The CWA Section 404 and the RHA Section 10 stipulate USACE permit requirements for any in-water construction in navigable waters. USACE and some states, including Guam, require a permit for any in-water construction. Permits are required for (1) construction of piers, wharfs, bulkheads, pilings, marinas, docks, ramps, floats, moorings, and like structures; (2) construction of wires and cables over the water and pipes, cables, or tunnels under the water; (3) dredging and excavation; (4) any obstruction or alteration of navigable waters; (5) depositing fill and dredged material; (6) filling of wetlands adjacent or contiguous to navigable waters; and (7) construction of riprap, revetments, groins, breakwaters, and levees. It is the Navy’s responsibility to coordinate with the USACE to determine the appropriate permit requirements for a proposed in-water construction activity.

EO 11990, *Protection of Wetlands*, requires minimization of the destruction, loss, or degradation of wetlands and encourages preservation and enhancement of their natural and beneficial values.

Floodplains. EO 11988, *Floodplain Management*, requires that federal activities avoid impacts to floodplains and direct and indirect support of floodplain development to the extent practicable. EO 13690, Federal Flood *Risk Management Standard*, amended EO 11988 by setting standards for federal agencies for identifying floodplains, soliciting public input, and developing mitigation measures to minimize adverse impacts. EO 14030, established in May 2021, confirmed that guidelines for implementing EO 13690 remain in effect.

EO 14008; DoD's 2020 UFC-2-100-01, Installation Master Planning; and DoD's 2021 Climate Adaptation Plan mandate and guide planning and development to reduce resource consumption, emissions, and inefficiency and to ensure the climate resiliency of newly constructed buildings and infrastructure amid impacts on floodplains, projected sea level rise, storm surges, and climate shifts.

Coastal Zone. The CZMA (16 U.S.C. Chapter 33 §§ 1451 through 1464) was established to assist states and U.S. territories, in cooperation with federal and local agencies, for developing land and water use programs in coastal zones that preserve, protect, develop, and restore or enhance, where possible, the nation's natural coastal zone resources. The CZMA specifies that lands managed by the federal government are excluded from the coastal zone. However, federal actions on coastal lands may be subject to federal consistency requirements if they potentially generate secondary or spillover impacts that affect the coastal zone, its uses, or resources within the purview of the Guam Coastal Management Program (CMP), Section 307(c)(1) (Guam BSP 2011). The review to establish consistency with Guam CMP policies (at EO 78-37) must conducted as specified in 15 CFR Part 930 (*Federal Consistency with Approved Coastal Management Programs)*. As a federal agency, it is the Navy's responsibility to prepare a CCD for actions that may affect a coastal zone and seek concurrence from the Guam CMP.

3.11.3 Affected Environment

The following discussions provide a description of the existing conditions for water resources near the Glass Breakwater and Sumay Cove.

3.11.3.1 Marine Waters

The project area is surrounded by the marine waters of the Philippine Sea, Outer Apra Harbor, and Sumay Cove adjacent to Outer Apra Harbor. Apra Harbor is the largest U.S. deep-water port in the western Pacific and the busiest port in Micronesia. The harbor is the only deep lagoon in Guam and is enclosed on its north and northwest sides by the Glass Breakwater and on its southwest by Orote Peninsula. There are four distinct areas of the harbor: (1) Outer Apra Harbor, deep water with direct access to the Philippine Sea at Orote Point; (2) Commercial Port (dredged by the Government of Guam); (3) Sasa Bay, located north of Polaris Point; and (4) Inner Apra Harbor. Outer Apra Harbor extends from Polaris Point and the Ship Repair Facility wharves north and westward to Orote Island (at the northwest extent of Orote Peninsula) and the tip of the Glass Breakwater. The Commercial Port is located at the northeast extent of the outer harbor. Inner Apra Harbor extends from Abo Cove northward to Polaris Point and the Ship Repair Facility wharves.

Guam tides are semidiurnal with a mean range of 1.6 feet and a diurnal range of 2.3 feet (NOAA 2024). Extreme predicted tide range is about 3.5 feet (Pacific Islands Ocean Observing System 2024).

Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes operating continuously in the ocean system. This dynamic equilibrium is expressed by a variety of indicators, including temperature, salinity, dissolved oxygen, and nutrient levels. Nutrients are chemicals necessary to produce organic matter. Basic nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. Water pollutants alter the basic chemistry of seawater in various ways (Sinay Maritime Data Solution 2022, DoN 2024a).

The expanse of offshore waters, their distance from the shore, and the mixing and transport effects of currents work together to generally maintain a high level of water quality. The major chemical parameters of marine water quality include potential amounts of hydrogen, dissolved oxygen, and

nutrient concentrations. The quality of coastal ocean waters and nearshore waters is strongly affected by nonpoint source pollution.

Apra Harbor receives freshwater inflows from the Atantano, Sasa, Aguada, and Laghas rivers, with the Atantano River emptying into Inner Apra Harbor (and the other three emptying into Sasa Bay). These rivers primarily drain the areas around the municipalities of Piti and Santa Rita. Stormwater runoff from these areas carries large amounts of sediments, most of which originates from the widespread soil erosion that occurs in the highlands and from improperly managed construction activities within the drainage basin (NAVFAC PAC 2011, DoN 2022a, DoN 2024a). Over time, the sediments deposited by rivers and streams flowing into the Inner Apra Harbor and Sasa Bay are transported by the combined actions of winds, waves, currents, and tides to Outer Apra Harbor where they adversely impact in-harbor water quality and coral reefs (NAVFAC PAC 2011, DoN 2022a, DoN 2024a).

Guam Water Quality Standards, adopted by Guam EPA in 2001, established three categories of waters: groundwater, marine waters, and surface waters. The waters of Outer Apra Harbor are categorized as "marine waters." Marine waters include all coastal waters offshore from the mean high-water mark, including estuarine waters, lagoons, bays, brackish areas, wetlands, and other special aquatic sites, and other inland waters that are subject to tidal influence. Marine waters are further divided into three subcategories: Excellent (M-1), Good (M-2), and Fair (M-3).

The waters within Outer Apra Harbor—including the project area—are designated M-2 (good) quality marine water. According to the Guam Water Quality Standards, water in the M-2 category must be of sufficient quality to allow for the propagation and survival of marine organisms, particularly shellfish and other similarly harvested aquatic organisms, corals and other reef-related resources, and whole-body contact recreation. Other important and intended uses include mariculture activities, aesthetic enjoyment, and related activities. The Piti Channel empties into Outer Apra Harbor and is characterized as M-3 (fair) quality, which is defined as marine waters that are intended for general, commercial, and industrial use while allowing for protection of aquatic life, aesthetic enjoyment, and compatible recreation with limited body contact. Specified intended uses of M-3 waters include shipping, boating and berthing, industrial cooling water, and marinas. Saltwater acute, saltwater chronic, and human health standards are applicable to all toxic pollutants discharged in M-3 waters. Further, Apra Harbor, along with the nearby Gab Gab beach, are listed on Guam's 303(d) list of impaired waters for PCBs in fish tissue but are considered low priority for Total Maximum Daily Load development (Guam EPA 2020).

According to the National Wetlands Inventory map and classifications, the waters surrounding the Glass Breakwater are classified as "Estuarine and Marine Deepwater." Marine waters in Sumay Cove have a similar classification. The ocean side of the Glass Breakwater is an active environment where waves, wind, and tidal cycles affect and maintain the quality of the marine waters. On the inside (leeward) of the Glass Breakwater, the marine waters are more sheltered by the Glass Breakwater. Water depths near the breakwater in Outer Apra Harbor are substantial, measuring approximately 37 meters (120 feet). The marine waters in Sumay Cove are substantially shallower (approximately 5 meters [15 feet]) and are protected as an embayment on the southern shore of Outer Apra Harbor.

3.11.3.2 Wetlands

Although there are some wetlands in the immediate vicinity of the Sumay Cove project area, no wetlands have been identified in the proposed marina improvement area, Sumay Point, or the Glass Breakwater project area (see **Figure 3-7**) (DoN 2022a, USFWS 2024). The proposed Project laydown (including site for concrete casting yard), storage, and staging areas identified in **Figure 2-1** do not coincide with any wetlands; however, construction contractors would survey the final site selections and

immediate vicinity for the presence of any wetlands. If wetlands are found, certified wetlands scientists would delineate and flag the boundaries of these areas.

3.11.3.3 Floodplains

As shown in **Figure 3-8**, the Project locations in Sumay Cove, the landside entrance of the Glass Breakwater, and proposed primary and contingent concrete casting areas are located in the 100- and 500-year floodplains. The outer reach (Project repair area) of the Glass Breakwater is not located in a floodplain.

Figure 3-7. Wetlands within the Sumay Cove Project Area

Basemap: World Imagery; World_Ocean_Base
Source: USFWS 2024

Figure 3-8. Floodplains in and around the Project Area

Basemap: World Imagery; World Ocean Base

3.11.4 Environmental Consequences

In this EA, the analysis of water resources focuses on the potential impacts on Apra Harbor marine waters in the vicinity of the Glass Breakwater and Sumay Cove, floodplains in the project area, and the coastal zone.

3.11.4.1 No Action Alternative

Under the No Action Alternative, the critical repairs identified for the Proposed Action would not be completed, and the breakwater, at risk of imminent breach, would continue to degrade. There would continue to be long-term, adverse effects on marine waters, floodplains, and the coastal zone from the steady deterioration of the Glass Breakwater and marina infrastructure in Sumay Cove. Under the No Action Alternative, erosion would continue and would be exacerbated during major storm events, resulting in sediment plumes and suspended sediment in the marine waters of Outer Apra Harbor and an increase in flood risk on the shoreline and coastal zone. If the breakwater is breached, severe wave action and siltation of the Outer Apra Harbor would likely occur resulting in significant impacts on water resources, water quality, and the coastal zone.

3.11.4.2 Alternative 1

Glass Breakwater

Short-term, minor, localized adverse impacts on the marine waters surrounding the Glass Breakwater would be expected from site preparations for construction and repair activities, including construction of a concrete casting yard at one of the established laydown areas. Prior to commencing site preparation, vegetation clearing, and related work, the construction contractors would install silt fences or other fixed filter fabrics around the perimeter of the breakwater and the storage, staging, and concrete casting yard sites. The silt fencing would be maintained throughout the Project construction phase. Sediment, soil, rocks, and debris would be disturbed during both the removal and installation phases of the proposed breakwater repair area. Sediment and soil would also be disturbed during the preparation and use of the storage, staging, and concrete casting yard sites. The silt fencing would protect against the incidental and periodic episodes of sediment disturbance and sediment-laden stormwater runoff from being deposited in marine waters surrounding the Glass Breakwater and adjacent to the related construction support areas. An SWPPP would be prepared by the Construction Contractor and followed to minimize adverse effects from stormwater runoff during construction. As part of the SWPPP, an Erosion and Sedimentation Control Plan would be prepared and followed that outlines the means and methods to protect water resources from discharges of sediment-laden runoff from the construction sites. Additionally, sediment-laden runoff would not be expected to substantially increase PCB contamination in Apra Harbor, and potential further contamination and impairment would be minimized through use of standard construction BMPs listed in the SWPPP.

An SPCC Plan would also be prepared to guard against any water quality impacts from accidental spills from equipment and vehicles used in the construction process. As discussed in **Section 3.2.4.2**, BMPs would be implemented to monitor and control dust emissions from the various construction activities. Given the exposed location of the breakwater, wind-blown soil and dust particles from exposed and uncovered surfaces could readily travel out over the nearby marine waters of the Outer Apra Harbor and Philippine Sea. These dust emissions would cause suspended sediment in the receiving waters, degrading water quality and potentially harming living coral and other sensitive aquatic species. Any piles of graded materials would be covered, as would trucks carrying soil, rocks, and other debris. In addition, and as needed, any exposed disturbed surfaces would be periodically watered down to reduce

the chances of wind-blown dust. During periods of high winds and storm events, construction activities would be stopped so that dust and sediment would not be generated and dispersed.

In-water work would also disturb rocks, soil, and sediment, resulting in temporary impacts on marine water resources. The use of silt curtains would confine suspended sediment and minimize the creation of extended turbidity plumes, which is caused by sediment and soil discharges into the water column. Open water becomes cloudy, which would reduce the amount of light that reaches aquatic plants and other species at the sea and harbor floor. Turbidity can also distribute added sediment to the environment, causing damage to living coral and fish. On the leeward side of the breakwater, silt curtains installed to depth along the inner breakwater would be employed to enclose the construction work when and where feasible.

Due to exposure to substantial wind and wave conditions on the seaward side of the breakwater, silt curtains would not function properly and would generally not be used. Given the presence of live coral on the seaward side of the breakwater, however, efforts would be made during times of calm seas to install protective silt curtains to reduce the likelihood of construction-related suspended sediment from being deposited on the sea floor. Any sediment plumes on the seaward side of the breakwater would be temporary in nature and expected to dissipate quickly due to high wave and current energy.

The water is very deep in the Outer Apra Harbor near the Glass Breakwater and any lost discharges of sediment from temporary run-off and/or wind-blown dust during construction would likely dissipate and/or dissolve readily in the water column before reaching the substrata below. Containing the turbidity within the confines of the silt curtain would allow the suspended sediment time to settle out and reduce the chances of turbidity clouds or plumes transiting throughout the rest of Apra Harbor. The monitoring of measurements of turbidity with recording, corrective actions, and reporting would minimize adverse impacts. The Construction Contractor would monitor the effectiveness of containment by the silt curtains through visual inspections for any turbidity plumes forming outside the enclosure created by the silt curtains. A comprehensive list of BMPs during construction to avoid and minimize adverse impacts on marine waters is addressed in **Section 2.5** and listed in **Table 2-2** of this EA.

CAU used in the repair of the Glass Breakwater are constructed with specialized concrete mix design (Marine Concrete) that undergoes specific testing to verify long term durability and strength. This includes rigorous testing prior to acceptance of the mix. Marine Concrete is cured prior to placement, thus no leeching of CAU composites is anticipated.

The Glass Breakwater repairs would stay within the existing footprint of the in-water toe slope of the current breakwater. Thus, there would be no expansion of fill area in WOTUS. As depicted in the conceptual cross sections (see **Figures 2-2** and **2-3**) an estimated 11.4 acres of underwater area (below MHHW line) on the outer portion of the breakwater (Philippine Sea) would be excavated of old rock and replaced with new armor substrate and CAU. Up to 0.2 acres of underwater area below the MLLW line on the leeward (Apra Harbor) side of the Breakwater would be subject to excavation and replacement activities.

The Navy prepared and submitted a CCD to the Guam Bureau of Statistics and Plans (BSP) on March 27, 2025, which determined that the proposed Apra Harbor waterfront repairs would be consistent, to the maximum extent practicable, with mitigating any unintended effects on the Guam coastal zone per Guam EO 78-37 and 15 CFR 930.36(a). A concurrence letter from the Guam BSP on the Navy's coastal impacts determinations was received on May 23, 2025. Measures recommended by the Guam EPA and Department of Agriculture to avoid or minimize effects on coastal zone resources are included in **Table 2-2**. Copies of the CCD and the Guam BSP's concurrence letter are provided in **Appendix E**.

Therefore, implementation of Alternative 1 would result in less than significant impacts to water resources associated with the Glass Breakwater Project activities.

The long-term repairs to the Glass Breakwater would have substantial beneficial impacts on water quality and marine habitats surrounding it and throughout Apra Harbor. The ongoing erosion would be curtailed. The permanent replacement materials, including clean bedding and numerous (20,100) large (25 to 50 tons each) CAU, would stabilize the breakwater structure with new substantial surfaces. With new structured protection and corrected conditions that would reduce erosion potential, stormwater runoff over the long term would contain less sediment, oils, and debris compared to the current conditions.

Sumay Cove

Short-term, minor, localized adverse impacts on water resources in and around Sumay Cove would be expected from site preparations, pile driving, and implementation of construction and repair activities.

The Sumay Point revetment repairs would stay within the existing footprint of the in-water toe slope of the current revetment. Thus, there would be no expansion of fill area in WOTUS. There would be minimal to no disturbance to the bottom at the revetment. While there is no dredging planned, the excavation and installation of piles would disturb sediment from the mudline. The bottom sediment would be disturbed and move through the water column, creating re-suspended sediment and turbidity. Since Sumay Cove is a much more sheltered location than the Glass Breakwater, the installation and maintenance of silt curtains would be more feasible. To protect against any stormwater runoff entering marine waters during the removal and repair of the slope and Sumay Point revetment, turbidity curtains in-water and silt fences on land would be installed and maintained to the extent practicable during construction.

Any turbidity created in the short-term duration of construction would be contained, and dispersion of a plume of suspended sediment would be prohibited from moving outside of the confines of Sumay Cove into the larger Outer Apra Harbor. Re-suspended sediment would settle out within the enclosure created by the silt curtains to protect water quality and marine species, including coral and other protected species. Construction contractors would monitor the effectiveness of the installed silt curtains, and if there is visual evidence of a plume of sediment outside the enclosure created by the curtains, work would be stopped, and corrective action would be taken.

The Navy is coordinating permitting requirements with the USACE to obtain an Individual Permit for the proposed Glass breakwater, Sumay Cove revetment, and Sumay Marina infrastructure repair activities before the start of construction. All permit conditions, including those designed to avoid and minimize impacts on marine waters and floodplains, would be adhered to in executing the proposed Project. Additionally, no changes in the size of development within the floodplain or coastal zone would occur under the Proposed Action. Together with a CWA Section 401 WQC, construction contractors would adhere to all permit conditions to avoid and minimize adverse impacts of water resources in the project areas. Further, no changes in the size of development within the floodplain or coastal zone would occur under the Proposed Action. The USACE Honolulu District conducted a 30-day public interest review regarding the proposed project activities from April 24 through May 23, 2025. The Navy will continue to coordinate with USACE to obtain the appropriate permitting prior to the start of project activities; likely following completion of this EA.

Therefore, implementation of Alternative 1 would result in less than significant impacts to water resources associated with the Sumay Cove Project activities.

3.11.4.3 Cumulative Impacts

Past projects have been completed, and marine water quality has presumably returned to background levels. Ongoing MITT activities in Outer and Inner Apra Harbor have a limited potential area of impact (i.e., small zones immediately adjacent to the explosive charge), are generally widely dispersed in space and time, and were determined to result in changes to water quality below applicable standards, regulations, and guidelines (DoN 2020b).

The continued use of Outer Apra Harbor by commercial and military shipping, when combined with the short-term potential increase in turbidity near the Breakwater during the removal and installation of rocks and CAU, would cause minor, temporary adverse impacts to water quality. As the Outer Apra Harbor has deep water, any elevated levels of re-suspended sediment would be minor and less than significant.

If any of the relevant Marine Corps relocation projects were to occur concurrently with the Proposed Action, potential short-term, cumulative, adverse impacts on water quality could occur from increased turbidity and sedimentation during construction. Water quality impacts from construction activities associated with the Proposed Action and any other concurrent reasonably foreseeable actions would be avoided or minimized by the implementation of BMPs. Therefore, implementation of the Proposed Action combined with the past, present, and reasonably foreseeable future projects would not result in significant impacts within the proposed project area.

3.12 Summary of Potential Impacts to Resources and Impact Avoidance and Minimization

A summary of the potential impacts associated with each of the action alternatives and the No Action Alternative and impact avoidance and minimization measures is presented in **Table 3-19**. BMPs, as identified in **Section 2.5**, would be implemented to avoid or minimize impacts to the extent possible. Mitigation and conservation measures identified through consultations would also be implemented, as appropriate.

Table 3-19. Summary of Potential Impacts on Environmental Resources

Resource Area	No Action Alternative	Alternative 1
Air Quality	Less than significant to potentially significant beneficial No change to baseline air quality or air resources while the breakwater remains in its current condition. In the event of impending breakwater breach, port operations would be halted resulting in the reduction in vessel and equipment emissions.	Less than significant adverse Short-term, temporarily emitted air emissions (e.g., fugitive dust, combustion of fossil fuels) during construction relating to operation of construction vehicles, equipment, and vessels.
Biological Resources	Less than significant to significant adverse Continued erosion of rock along the slope of the breakwater would significantly damage native and protected species, as well as associated EFH, resulting in adverse impacts on biological resources. Without repair of the breakwater, even under normal wave action, sections of the crest and slope on the outer and leeward sides of the breakwater will continue to break away and fall into the water destroying protected species and habitats in the affected underwater areas. In these conditions, impacts would range from moderate to significant over time. A breach of the breakwater would result in substantial loss of corals, coral habitat, and EFH in the harbor, significantly and adversely affecting those resources.	Mitigated to less than significant adverse and beneficial A total of 37 (up to 47) colonies of *Acropora globiceps* would be translocated to avoid and minimize effects on the species. There could be a permanent loss of up to 83 colonies of the ESA-listed threatened hard coral, which would not affect the continued existence of the species. Impacts would be reduced through implementation of mitigation measures and conservation measures developed in consultation with NMFS and would be further minimized by avoiding in-water work during coral spawning periods to avoid sensitive spawning times and to maximize reproductive success. Short-term, minor, adverse impacts to all marine species from construction-associated noises, suspended sediments in the water, and reduced water quality during rock removal and CAU placement, pile driving, and vessel use associated with construction activities; to native fish, and ESA-listed endangered turtles and threatened scalloped hammerhead sharks during in- and out-of-water construction activities; and on EFH from construction and repair activities occurring directly within or around the EFH. Short-term, negligible, adverse impacts on marine species from potentially leaked pollutants and sediment plumes associated with construction activities; from vegetation clearing and earthwork around the project areas; and on MBTA-protected species that could be flying

		above or foraging near the project areas and could be disturbed by construction-associated noises. Short- and long-term, minor, adverse impacts on native corals and clams that are not ESA-listed, similar to those described for marine vegetation and non-coral benthic invertebrates. Short-term, negligible, adverse, and long-term, moderate, beneficial impacts on NMFS proposed green turtle (*Chelonia mydas*) critical habitat, if green turtle critical habitat is designated, would be anticipated from increased protections from the Apra Harbor repairs.
Cultural Resources	Less than significant adverse to significant adverse In the impending event of breakwater breach, significant adverse impacts on cultural resources would occur because failure to provide repairs would lead to further degradation and failure of the entire breakwater, which is an eligible historic property.	No adverse effects on cultural, historical, or archeological resources. The Guam SHPO concurred with the Navy's determination of no adverse effect on March 21, 2025. Beneficial impacts to the NRHP-eligible Glass Breakwater would result from restoration of its historic integrity. No appreciable impacts are expected on eligible terrestrial or submerged archaeological resources or TCPs.
Geological Resources (including Marine Sediments)	Less than significant to significant adverse There would be continued long-term adverse effects on adjacent substrates from the steady deterioration of the Glass Breakwater and marina infrastructure in Sumay Cove. In the event of impending breakwater breach, severe wave action and siltation/erosion of the Outer Apra Harbor would continue to occur, damaging and possibly destroying geological resources under water and on land.	Less than significant adverse and beneficial Minor to moderate temporary sedimentation impacts during deconstruction and reconstruction of the Glass Breakwater and piledriving and shoreline restoration activities at Sumay Cove. Long-term, moderate beneficial impacts from restored harbor protection and shoreline stabilization, supporting minimized erosion and sedimentation into nearby waters of Apra Harbor.
Hazardous Materials and Waste	Less than significant No change to baseline HAZMAT and HAZWASTE conditions.	Less than significant adverse Hazardous and petroleum wastes generated during construction would be negligible and construction methods would be established to properly handle any hazardous and petroleum wastes. No impacts on HAZMAT and HAZWASTE management would be anticipated following construction.

Infrastructure and Transportation	Less than significant to significant adverse There would be long-term, significant, adverse impacts on USCG, Navy Security and Emergency Response Forces, Port, and public infrastructure and transportation, which would be damaged or destroyed in the impending event of breakwater breach.	Less than significant adverse Short-term, negligible to minor, adverse impacts on potable water, wastewater, and energy utility demand would be expected due to the use of utilities during the construction period. Short-term, minor, adverse impacts on solid waste management may occur from the generation of construction and demolition waste. Short-term, minor, adverse impacts on maritime and road traffic would occur from the increased construction truck, equipment, and vessels operating in the area to transport repair/construction equipment and aggregate materials. These impacts would cease following the completion of construction.
Noise	Less than significant No change to the baseline noise environment would be anticipated as long as the breakwater remains in its current condition. In the impending event of breakwater breach, it is likely that port operations would be halted resulting in appreciably reduced in-air and in-water noise from reduced or stopped vessel traffic and related equipment operation to load/unload cargo vessels.	Less than significant adverse Short-term, minor, adverse effect on marina users and terrestrial wildlife from temporary construction noise. Pile driving at Sumay Cove might produce short-term, minor to moderate, adverse impact on marina users from temporary construction noise. Exposure to construction and vessel noise could cause aquatic species, including marine mammals, fish, and sea turtles, to avoid the area, producing a short-term, minor, adverse impact on these species. If used, an impact hammer would drive one pile per day, resulting in generated noise for approximately 10 minutes per day over an anticipated total of 72 days. Alternatively, if used, vibratory hammer noise would last for 8 hours per day for the approximately 72-day-period.
Health and Safety	Less than significant to significant adverse In the impending event of breakwater breach, harbor access and port operations would be severely affected, yielding devastating impacts on Port of Guam operations, including inability to import food, household goods, and medical supplies.	Less than significant adverse and beneficial Short-term, minor, adverse impacts on contractor, personnel, and marina user safety during breakwater and related waterfront repairs may include potential slips, falls, unfamiliar working environments, noise exposure, and specific hazards such as handling power tools and working with heavy equipment, trucks, and machinery, and exposure to increased roadway traffic. Long-term, beneficial impacts on safety would occur from the repairs safeguarding the shore facilities and infrastructure within the harbor

		from severe wave action during typhoons and other heavy weather events.
Socioeconomics	Less than significant to significant adverse In the impending event of breakwater breach, harbor access and port operations would be severely affected, yielding potentially devastating impacts on public services and shipment of goods to or from the island. Halting of Port of Guam operations would threaten the economic and community health stability of Guam and the broader Pacific region. Impacts from such an event would be potentially catastrophic.	Less than significant adverse and beneficial Although the anticipated 56 off-island workforce would add to housing demand. No appreciable shift or change in socioeconomic conditions, housing, population, or a notable effect on local industries would be expected. Construction-related socioeconomic impacts would be positive and temporary. Long-term, maintaining a safe, accessible port would ensure economic stability for Guam and the region. Short-term, adverse effects on local populations from increased construction-related traffic, potential for degraded roadway infrastructure, increased air emissions from construction vehicles, vessels, and equipment, and construction-related noise. Short-term, negligible, beneficial impacts on the local economy would be anticipated from construction-related and workforce spending in the local area, as well as the anticipated temporary jobs that would be required for the project.
Water Resources	Less than significant to potentially significant adverse Long-term, adverse effects on marine waters, floodplains, and the coastal zone from the steady deterioration of the Glass Breakwater and marina infrastructure in Sumay Cove. In the event of breakwater breach, harbor access and port operations would be severely affected, yielding potentially devastating impacts on water resources.	Less than significant adverse and beneficial Short-term, minor, localized adverse impacts on the marine waters surrounding the Glass Breakwater from site preparations for construction and repair activities. Long-term, beneficial impacts to water quality and surrounding marine habitats throughout Apra Harbor once repairs to the Glass Breakwater are complete.

Key: AAQS = ambient air quality standard; EFH = essential fish habitat; GHG = greenhouse gas; HAP = hazardous air pollutants; HAZMAT = hazardous materials; HAZWASTE = hazardous wastes; MBTA = Migratory Bird Treaty Act; MMPA = Marine Mammal Protection Act; MSA = Magnuson-Stevens Fishery Conservation and Management Act; NAAQS = National Ambient Air Quality Standards; NHPA = National Historic Preservation Act; NMFS = National Marine Fisheries Service; SHPO = State Historic Preservation Office.

4 Other Considerations Required by NEPA

4.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

Under NEPA, analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state, and local land use plans, policies, and controls. **Table 4-1** identifies the principal federal and state laws and regulations that are applicable to the Proposed Action and briefly describes how compliance with these laws and regulations would be accomplished.

Table 4-1. Principal Federal and State Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	Status of Compliance
National Environmental Policy Act (NEPA); 32 Code of Federal Regulations (CFR) 775, Navy procedures for Implementing NEPA	Complies; EA and FONSI anticipated.
Clean Air Act (CAA)	Exempt from General Conformity (see Record of Non-Applicability in **Appendix B**).
Clean Water Act (CWA)	Section 404 Standard Individual Permit and Section 401 Water Quality Certification would be obtained for in-water maintenance for long-term repairs of Glass Breakwater, Sumay Marina piles removal and new pile installation for docks and wave attenuation structure, and Sumay Point revetment repair in Sumay Cove. Correspondences and coordination for the Section 401 Water Quality Certification are provided in **Appendix A**. A National Pollutant Discharge Elimination System (NPDES) permit for construction activities would be obtained. Long-term stormwater management would be consistent with NBG's ongoing compliance programs. Runoff control measures and BMPs would be developed in addition to or in conjunction with MS4 and MSGP measures.
Rivers and Harbors Act	Section 10 Rivers and Harbors Act permit to be obtained for placement of temporary or permanent structures in the navigable waterway.
Coastal Zone Management Act (CZMA)	No significant effects on coastal zone resources. Coastal Consistency Determination concluded May 28, 2025 (see **Appendix E**).
National Historic Preservation Act (NHPA)	Section 106 consultation completed. The Guam SHPO concurred with the Navy's determination of no adverse effect on March 21, 2025 (see **Appendix D**).
Endangered Species Act (ESA)	Section 7 consultation concluded July 28, 2025. No significant effects on ESA protected species or habitats through implementation of best management practices, mitigation measures, and recommended conservation measures. See **Section 2.5** (**Table 2-2**) for the complete list of measures. See **Appendix C** for related consultation correspondences and documentation.
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act	Essential Fish Habitat consultation concluded. No significant effects on EFH through implementation of mitigation actions specified in **Section 2.5** (see **Table 2-2**). See **Appendix C** for related consultation correspondences and documentation.
Executive Order (EO) 12088, *Federal Compliance with Pollution Control Standards*	BMPs, avoidance, and minimization measures (see **Section 2.5, Table 2-2**) would address pollution control.

EO 12114, *Environmental Effects Abroad of Major Federal Actions,* and 32 CFR 287, Navy implementing regulation	No significant effects.
EO 13089, *Coral Reef Protection*	BMPs, avoidance, and minimization measures (see **Section 2.5, Table 2-2**) would address coral reef protection issues.

4.2 Irreversible or Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a Project are those that are used on a long-term or permanent basis. An irreversible or irretrievable commitment of resources refers to impacts on or losses to resources that cannot be reversed or recovered, even after an activity has ended. A commitment of resources is related to the use or destruction of nonrenewable resources and the impacts that loss will have on future generations. For example, if prime farmland is developed, a permanent loss of agricultural productivity would occur. This includes the use of non-renewable resources such as metal and fuel, and natural or cultural resources. These resources are irretrievable in that they would be used for this Project when they could have been used for other purposes. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

Implementation of the Proposed Action would include the irreversible and irretrievable commitment of biological resources, potable water, minerals, energy, labor, and landfill space. The impacts on these resources would be permanent. Implementing the Proposed Action would not result in significant irreversible or irretrievable commitment of resources. Furthermore, a combination of avoidance and minimization would offset the initial natural resource losses.

Biological Resources. Implementation of the Proposed Action could result in a permanent loss of coral habitat and take of up to 83 colonies of the ESA-listed threatened *A. globiceps* hard corals along the breakwater due to the relocation of existing rock, placement of core foundation aggregate and bedding rock, and placement of CAUs along the entire Outer Breakwater, head section, and select sites along the Inner Breakwater. However, upon completion, rock armor and CAU would create new hard substrate that could be colonized by corals and other encrusting marine invertebrates. Conservation measures being developed in consultation with NMFS could include in-kind and out-of-kind-mitigations to offset adverse impacts.

Potable Water. Concrete casting yard operations for construction of the casting of approximately 20,100 CAUs would require consumption of between approximately 20.1 and 40.2 million gallons of potable water over the 5-year duration of the Project. The water requirements represent between 0.2 and 0.3 percent of the average potable water production (8 MGD) at the Fena NWTP and would not be expected to exceed the NWTP's maximum capacity of 12 MGD. Additional water might be required for cleaning equipment and controlling dust, but the overall demand is anticipated to remain within the system's capacity.

Materials. Material resources, including HAZMAT used for the Proposed Action, would potentially include concrete, stones, soil, aggregate, steel, and various construction materials and supplies. The materials that would be consumed are not in short supply, would not limit other unrelated construction activities, and would not be considered significant. Additionally, their purchase would benefit local and regional construction material vendors.

Energy. Energy resources, including petroleum-based products (e.g., gasoline, diesel), used for the Proposed Action would be irretrievably lost. During construction, gasoline and diesel would be used for the operation of vehicles, vessel, and construction equipment. Consumption of these energy resources would not place a significant demand on their availability within the region.

Labor. Individuals hired by construction companies to support the Proposed Action would be part of a temporary and irretrievable loss of labor resources because the construction workers would temporarily be unable to support other projects or activities within the area. Increased construction work, provision of temporary jobs, and construction-related spending would be considered beneficial overall for the Guam economy.

Landfill Space. Generation of solid waste from construction, renovation, and demolition under the Proposed Action would reduce overall landfill space in the local area. Solid waste will be sent to the Layon Municipal Sanitary Landfill, which opened in 2011 with an initial capacity in excess of 15.8 million cy and an expected lifespan of 50 years. To the extent practicable, rock and CAUs would be reused, but general construction waste (e.g., broken concrete, packaging materials, general debris, etc.) would be generated and disposed of at Layon Landfill. A waste management plan will be developed and implemented to ensure appropriate handling and storage of waste and the appropriate handling, separation, recycling, salvaging, reuse, and return methods.

4.3 Unavoidable Adverse Impacts

Continued exposure to normal wave action, exacerbated by storms and typhoons, would increase the likelihood of and eventual breach and would increase the risk of potential environmental damage to underwater habitat and direct impacts to ESA-listed threatened *A. globiceps* hard coral species along the breakwater. Repairs to the breakwater would prevent potential adverse environmental impacts in the long term to biological resources, cultural resources, geological resources, infrastructure and transportation, health and safety, socioeconomics, and water resources.

This EA has determined that Action Alternative 1 would result in temporary, less than significant, adverse, and beneficial impacts on air quality, cultural resources, geological resources, HAZMAT and waste, infrastructure and transportation, noise, health and safety, socioeconomics, and water resources. The Proposed Action has the potential to have significant impacts on endangered species, but impacts would be mitigated to less than significant through the implementation of conservation measures and BMPs specified through consultation with NMFS. See the ESA and EFH consultation documentation and the list of measures to be implemented during construction for the Proposed Action as provided in **Appendix C**.

4.4 Relationship between Short-Term Use of the Environment and Long-Term Productivity

The NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

In the short term, effects on the human environment with the implementation of the Proposed Action would primarily relate to the construction activity itself. Air quality and noise would be impacted in the short term.

In the long term, the needed repairs to the Glass Breakwater would safeguard the facilities and infrastructure within the harbor from routine wave action as well as severe wave action during typhoons and other heavy weather events. Military and commercial vessels would be able to safely and effectively pass through the marine navigation channels, thus continuing to support and provide vital services to the island of Guam. Without the long-term repairs, there is a risk of breakwater breaching, which would have substantial impacts on Navy mission readiness and operational capabilities. The degraded condition of the breakwater, exacerbated by normal wave action, storms, and typhoons, heightens the likelihood of breach. Continued exposure to even normal wave action not only increases the risk of breach but also poses a risk of potential environmental damage to ESA-listed coral species located in the submerged areas of the structure.

The repair of the breakwater would not significantly impact the long-term natural resource productivity of the area. Because of the planned avoidance and minimization measures, conservation measures, BMPs, and in-kind and out-of-kind mitigations, the Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

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6 List of Preparers

This EA was prepared collaboratively by the Navy and the contractor team of MDPAC JV (HDR, Moffat & Nichol, and SCOUT Environmental):

HDR

Isha Alexander
Education: B.A. Psychology, M.A. Organizational Psychology, M.S. Biology
Years of Experience: 20
Responsible for: Biological Resources Analysis

Cathy Bacon
Education: B.S. Biology, M.S. Marine Resources Management
Years of Experience: 19
Responsible for: Biological Resources Analysis and QC Review (Technical and Formatting)

Michelle Bare
Education: B.S. General Studies
Years of Experience: 34
Responsible for Hazardous Materials and Waste

Chad Blackwell
Education: B.A. History, M.H.P. Historic Preservation
Years of Experience: 20
Responsible for: Cultural Resources

Brad Boykin
Education: B.S. Biomedical Science, M.S. Biotechnology
Years of Experience: 18
Responsible for: EA Deputy Project Manager, DOPAA, Noise, Technical and QC Reviews

Timothy Didlake
Education: B.S. Earth Sciences
Years of Experience: 17
Responsible for: Hazardous Materials and Waste, Technical Review

Carolyn Hein
Education: B.S. Environmental Science
Years of Experience: 6
Responsible for: Air Quality, and Infrastructure and Transportation

Travis Gahm
Education: B.S. Biology
Years of Experience: 15
Responsible for: Technical Reviews

Abbey Humphreys
Education: B.S. Geospatial Science, B.S. Environmental Biology, M.S. Biology
Years of Experience: 8
Responsible for: Health and Safety, Technical Reviews

Emily Moeller
Education: B.A. Biology, M.S. Natural Resources Law Studies
Years of Experience: 18
Responsible for: Environmental Justice, QC Review

Deborah Peer
Education: B.S. Wildlife Science and Management, B.S. Zoology, M.S. Environmental Science and Management
Years of Experience: 23
Responsible for: EA Project Manager, DOPAA, Environmental Justice, Technical and QC Reviews

Amberlyn Rodarte
Education: B.G.S. General Studies
Years of Experience: 4
Responsible for: Technical and Format Review

Patrick Solomon

Education: B.A. Geography, M.S. Geography
Years of Experience: 31
Responsible for: Technical and QC Reviews

Beniamino Volta
Education: B.A. Human Ecology, M.S. Anthropology
Years of Experience: 22
Responsible for: Cultural Resources

Moffatt & Nichol

Alan Alcorn, PE
Education: B.S. Civil Engineering, M.S. Coastal/Port Engineering
Years of Experience: 44
Responsible for: Contract PM; QC Review

Kim Garvey
Education: B.S. Mechanical Engineering, M.S. Astronautical Engineering, Graduate Certificate Coastal Engineering
Years of Experience: 21
Responsible for: QC Review

Rob Sloop, PE
Education: B.S. Mechanical Engineering, ME Coastal and Ocean Engineering
Years of Experience: 31
Responsible: Technical Review

SCOUT, Environmental

Rebecca Diaz
Education: B.A. Child Development, Certificate of Achievement in Environmental Studies and GIS
Years of Experience: 3
Responsible for: Socioeconomic Resources

John I. Ford
Education: B.S. Zoology/Marine Biology, M.S. Zoology/Tropical Insular Limnology
Years of Experience: 46
Responsible for: Geology and Water Resources

Melanie Hernandez, J.D.
Education: B.S. Political Science/Economics, J.D. Environmental Law
Years of Experience: 28
Responsible for: QC Review

Barry Snyder
Education: B.S. Marine Science, M.S. Marine Environmental Research
Years of Experience: 40
Responsible for: Geological Resources

Bob Wardwell, AICP
Education: M.S. Environmental Science, M.B.A. Business Administration, B.A. Economics/Physical Sciences
Years of Experience: 40
Responsible for: Water Resources

Appendix A: Agency Correspondence for USACE Permitting and Water Quality Certification

USACE-POH Individual Permit Public Notice

NOTE: For security purposes, email addresses and phone numbers are redacted from correspondences in the Appendices.

The USACE-POH Public Notice was posted on the USACE-POH website at:
https://www.poh.usace.army.mil/Missions/Regulatory/Public-Notices/

US Army Corps of Engineers®

PUBLIC NOTICE

Applicant:
Edward Moon
Naval Base Guam

Published: April 24, 2025 HST
Expires: May 23, 2025 HST

Honolulu District
Permit Application No. POH-2012-00114

TO WHOM IT MAY CONCERN: The Honolulu District of the U.S. Army Corps of Engineers (Corps) has received an application for a Department of the Army permit pursuant to Section 404 of the Clean Water Act (33 U.S.C. §1344) **and/or** Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. §403). The purpose of this public notice is to solicit comments from the public regarding the work described below:

APPLICANT: Edward Moon
Naval Base Guam (NBG)
PSC 455 Box 195
FPO AP 96540

AGENT: Jesse Cruz
Naval Base Guam (NBG)
PSC 455 Box 195
FPO AP 96540

WATERWAY AND LOCATION: The project would affect waters of the United States and navigable waters of the United States associated with the Philippine Sea. The project/review area is at the Glass Breakwater and in marine waters adjacent to Glass Breakwater at Apra Harbor, Guam (13.45845°, 144.62863°).

EXISTING CONDITIONS: The 2.8-mile long Glass Breakwater was originally built during the 1940's to protect Apra Harbor. The last major repair occurred in 2013. In May 2023, super typhoon Mawar caused severe damage, and subsequent smaller storm events exacerbated the damage. The Navy's engineering analysis determined there were failures along sections of the breakwater that were accelerating and at risk of catastrophic failure. An emergency repair was initiated on March 17, 2025, to stabilize the failing sections until a longer-term repair can be completed.

PROJECT PURPOSE:
Applicant's Project Purpose: Restore the typhoon damaged Glass Breakwater to Army Corps of Engineer breakwater standards, increase the breakwater effectiveness, and ensure long-term reliability and resiliency of the breakwater to continue protecting infrastructure in Apra Harbor and its shorelines.

Corps' Basic Project Purpose: vessel navigation, vessel mooring, and infrastructure

Corps' Overall Project Purpose: Reflect and dissipate wave energy to restore and maintain safe vessel access, vessel mooring, and shoreline and infrastructure protection within Apra Harbor.

PROPOSED WORK: NBG requests authorization to work and discharge fill material below the Mean Higher High Water to repair and the failing areas of the Glass Breakwater. Repairs would involve the phased placement of 25 to 50 ton concrete armor units (CAU) on the western 1.9 kilometers (1.2 miles) of deteriorated and/or failing areas of the breakwater. CAUs would be placed on the breakwater head section, along approximately 30 meters (100 linear feet) on the leeward (harbor) side, and along the entire ocean (Philippine Sea) side (1.9 kilometers), except for along the Luminao reef. The repair areas would extend from the breakwater crest up to approximately 49 meters (160 feet) seaward from the center of the crest road for the Outer Breakwater and up to 46 meters (150 feet) for the Inner Breakwater. Repair activities would potentially affect a maximum of up to 21.5 acres of underwater area (below the MLLW line) on the outer (Philippine Sea) side of the breakwater and head section. This includes the entire area from the waterline to the outer limit of the breakwater toe. Planned repairs would likely disturb up to 11.4 acres on the outer breakwater, and up to 0.2 acres of underwater area below the MLLW line on the leeward (harbor) side of the breakwater.

Site preparation:
Vegetation clearing and earthwork to create work and access areas on the breakwater crest to accommodate crane pads, construction equipment, and heavy truck traffic would be required prior to repair activities. Several construction laydown areas (including material loading and offloading, concrete casting, and material storage areas) would be utilized. The primary concrete casting yard would encompass the pre-cast yard, materials stockpile, and CAU storage. Contingent CAU and aggregate storage and an alternative concrete casting yard would be located at the old Cabras Quarry site, or the paved lot located across the street and approximately 700 feet southwest from the quarry entry along Highway 11.

The Hotel Wharf site along the inner side of the breakwater in the Outer Harbor would be the primary location for loading and unloading barges, personnel transports, supply boats, and push boats to shuttle workers, materials, equipment, and supplies to and from the breakwater work areas. Other wharves located in the Inner Harbor may also be used on a contingent basis for these purposes and to avoid forecasted typhoon conditions or tropical storms. On the leeward side of the breakwater, a spud/jack-up barge and temporary moorings (piles or anchors) would be used to position vessel for unloading CAUs and for other repair/construction support. The moorings would be supported by piles (up to 16 steel pipe piles). Any spuds or mooring piles installed would be placed only into soft sediment and would be removed following completion.

Temporary Removal of Existing Armor Layer and Toe Foundation:
To provide a stable foundation for placement of the CAUs, existing rock and CAUs along the slope, crest, and toe would be removed within the repair areas of the breakwater to be rebuilt. Removal would be down to the breakwater core for the slope and crest and approximately 6 meters (20 feet) deep along the toe section. The removed rock and CAUs would be used to rebuild the breakwater core, and some (up to 7,800 cubic yards (CY)) would be hauled off-site to be used for shoreline protection repairs within Apra Harbor, including at Sumay Point. Existing armor stone that has settled or fallen from the slope into the water, leaving voids along the breakwater, would be excavated and used to build a reinforcing base approximately halfway between the base of the slope and the outer limit of the existing toe.

The reinforcing base would be excavated to an elevation no deeper than 20 feet below the Mean Lower Low Water (MLLW) height to support the buildup of CAUs and/or CAUs and would serve to prevent settling or seaward movement of the CAUs, which would be placed from the reinforcing base up the slope to the crest. Repair and buildout of the breakwater could disturb approximately 11.4 acres of submerged area (below the MLLW line) inside the footprint of the existing toe on the outer (Philippine Sea) side and 0.2 acres of submerged area (below the MLLW line) within the footprint of the existing toe on the leeward (Apra Harbor) side of the breakwater.

Rebuilding the Core Foundation:
As necessary in each repair area, the breakwater's core would be graded and rebuilt to provide a stable foundation for placement of the CAUs. Imported, quarried aggregate material and stone that would be used for this work would be transported to Guam via barges.

Placement of Bedding Rock:
Up to 54,000 CY of bedding rock would be placed to create a stable underlayer for placement of the CAU. The bedding rock would be imported to the island via ship/barge and transported to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge.

Placement of Concrete Armor Units:
Approximately 20,100 large CAUs (25 to 50 tons each) would be placed along the toe, slope, and crest of the breakwater. The CAUs would be transported from the casting yard to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge. It is anticipated that 75 percent of the CAUs would be hauled to the breakwater repair site from the concrete casting yard via truck, and the remaining 25 percent would be hauled by barge to the Hotel Wharf site for transloading onto barge via crane. When fully laden, the barge would then transit to and moor against the pre-positioned spud barge leeward of the breakwater near the CAU-placing crane. CAUs would then be offloaded from the barge onto the breakwater by the CAU-placing crane.

Construction of Concrete Casting Yard:
It is anticipated that CAUs would be fabricated on the island at a concrete casting yard co-located with a construction laydown area. Concrete would be purchased from a local supplier's batching plant to the casting yard via mixer trucks and placed into armor unit molds.

Project figures enclosed.

AVOIDANCE AND MINIMIZATION, and COMPENSATORY MITIGATION: NBG provided the following information in support of efforts to avoid and/or minimize impacts to the aquatic environment:

Impacts to the waters of the U.S. would be avoided and minimized by the use of industry standard Best Management Practices (BMP) for all phases of construction. A list of BMPs are provided in the publicly available draft Environmental Assessment (EA) for the Apra Harbor Waterfront Repairs (https://pacific.navfac.navy.mil/About-Us/National-Environmental-Policy-Act-NEPA-Information/).

BMPs include numerous measures to specifically avoid and minimize effects on/from:

- ESA-listed sea turtles, sharks, and corals
- ESA-listed and EFH
- Water Pollution
- In-Water Sedimentation
- Vessel Transits to Guam
- Work on the Inner Breakwater
- Fugitive Dust
- Noise
- Moorhen

Proposed mitigation includes coral translocation and replanting of sea grasses to offset the impacts to Endangered Species Act and Essential Fish Habitat. Mitigation options, with detailed descriptions, are listed the draft EA, Appendix C.

Additional measures may be incorporated by Special Conditions into a Department of the Army permit.

CULTURAL RESOURCES: NBG is the lead federal agency for ensuring the project complies with Section 106 of the National Historic Preservation Act (NHPA). NBG established the area of potential effect (APE) and determined the proposed undertaking would have "no adverse effect" on historic properties. The Corps will review NBG's APE and consultation with the Guam State Historic Preservation Officer to determine if it is inclusive of the Corps' permit area.

The Corps final determination relative to historic resource impacts may be subject to additional coordination with the State Historic Preservation Officer and other interested parties.

ENDANGERED SPECIES: NBG is the lead federal agency for ensuring the project complies with Section 7 of the Endangered Species Act (ESA). NBG determined the project may affect, but is not likely to adversely affect federally listed or proposed terrestrial and aquatic species and habitat, with the exception of one species. NBG determined the project would have adverse effects to *Acropora globiceps* colonies. Pursuant to Section 7 of the ESA, NBG is consulting with the National Marine Fisheries Service (NMFS) Protected Resources office and US Fish and Wildlife Service (USFWS), as applicable, in accordance with 50 CFR part 402. The Corps will review NBG's Biological Assessment and ESA consultations to determine if they are inclusive of the Corps permit area.

The Corps final determination relative to endangered species impacts may be subject to additional coordination with the NMFS Protected Resources office and/or USFWS.

ESSENTIAL FISH HABITAT: NBG is the lead federal agency for ensuring the project complies with Section 305(b)(2) of the Magnuson Stevens Fishery Conservation and Management Act (MSA). NBG determined the proposed action would adversely affect Essential Fish Habitat (EFH). Pursuant to Section 305(b)(2) of the MSA, NBG is consulting with the National Marine Fisheries Service in accordance with 50 CFR part 600.920. The Corps will review NBG's EFH Assessment and consultation with NMFS Habitat Conservation office to determine if it is inclusive of the Corps' permit area.

The Corps final determination relative to EFH impacts may be subject to additional coordination with the NMFS Habitat Conservation office.

NAVIGATION: The proposed structure or activity is not located in the vicinity of a federal navigation channel.

SECTION 408: The applicant will not require permission under Section 14 of the Rivers and Harbors Act of 1899 (33 USC 408) because the activity, in whole or in part, would not alter, occupy, or use a Corps Civil Works project.

WATER QUALITY CERTIFICATION: Water Quality Certification may be required from the Guam Environmental Protection Agency (EPA). Pursuant to Section 401 of the Clean Water Act (Public Law 95-217), NBG will submit a water quality certification (WQC) request to the Guam EPA and the Corps. Once the WQC application has been reviewed and determined complete per 40 CFR 121.5(b), Guam EPA and the Corps will establish a reasonable period of time for granting (with or without conditions) or denying the WQC. The Section 401 WQC will be considered waived if the DEQ does not act on the certification request by end of the reasonable period of time.

COASTAL ZONE MANAGEMENT: The proposed activity may affect land, or water uses in the Coastal Zone. Under Section 307(c)(3) of the Coastal Zone Management Act of 1972, as amended by 16 U.S.C. 1456(c)(3), the Corps may not issue a permit for the described work until NBG obtains and provides to the Corps a Federal Consistency Concurrence from the Guam Coastal Management Program.

NOTE: This public notice is being issued based on information furnished by the applicant. This information has not been verified or evaluated to ensure compliance with laws and regulation governing the regulatory program. The geographic extent of aquatic resources within the proposed project area that either are, or are presumed to be, within the Corps jurisdiction has not been verified by Corps personnel.

EVALUATION: The decision whether to issue a permit will be based on an evaluation of the probable impact including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefits, which reasonably may be expected to accrue from the proposal, must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including cumulative impacts thereof; among these are conservation, economics, esthetics, general environmental concerns, wetlands, historical properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food, and fiber production, mineral needs, considerations of property ownership, and in general, the needs and welfare of the people. Evaluation of the impact of the activity on the public interest will also include application of the guidelines promulgated by the Administrator, EPA, under authority of Section 404(b) of the Clean Water Act or the criteria established under authority of Section 102(a) of the Marine Protection Research and Sanctuaries Act of 1972. A permit will be granted unless its issuance is found to be contrary to the public interest.

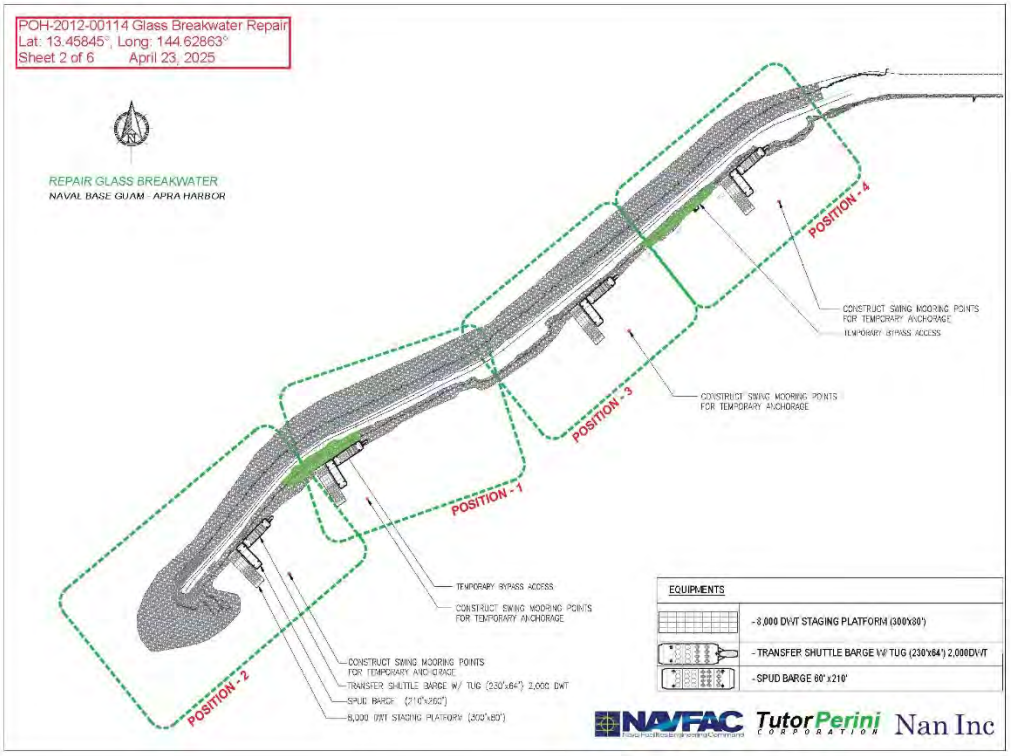
COMMENTS: The Corps is soliciting comments from the public; Federal, State, and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps to determine whether to issue, modify, condition, or deny a permit for this proposal. To make this determination, comments are used to assess impacts to endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment (EA) and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act (NEPA). Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

The Honolulu District will receive written comments on the proposed work, as outlined above, until May 23, 2025 HST. Comments should be submitted electronically via the Regulatory Request System (RRS) at https://rrs.usace.army.mil/rrs or to Jason Brewer at [redacted] Alternatively, you may submit comments in writing

to the Commander, U.S. Army Corps of Engineers, Honolulu District, Attention: Jason Brewer, PSC 455 Box 188, Santa Rita, Guam 96540. Please refer to the permit application number in your comments.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider the application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing. Requests for a public hearing will be granted, unless the District Engineer determines that the issues raised are insubstantial or there is otherwise no valid interest to be served by a hearing.

Map for Glass Breakwater repairs and associated construction areas, Apra Harbor, Guam.


POH-2012-00114 Glass Breakwater Repair
Lat: 13.45845°, Long: 144.62863°
Sheet 2 of 6 April 23, 2025
REPAIR GLASS BREAKWATER
NAVAL BASE GUAM - APRA HARBOR
POSITION - 1
POSITION - 2
POSITION - 3
POSITION - 4
CONSTRUCT SWING MOORING POINTS FOR TEMPORARY ANCHORAGE
TEMPORARY BYPASS ACCESS
CONSTRUCT SWING MOORING POINTS FOR TEMPORARY ANCHORAGE
TEMPORARY BYPASS ACCESS
CONSTRUCT SWING MOORING POINTS FOR TEMPORARY ANCHORAGE
TRANSFER SHUTTLE BARGE W/ TUG (230'x64') 2,000 DWT
SPUD BARGE (210'x260')
8,000 DWT STAGING PLATFORM (300'x80')
EQUIPMENTS
- 8,000 DWT STAGING PLATFORM (300'X80')
- TRANSFER SHUTTLE BARGE W/ TUG (230'x64') 2,000DWT
- SPUD BARGE 80' x 210'
NAVFAC
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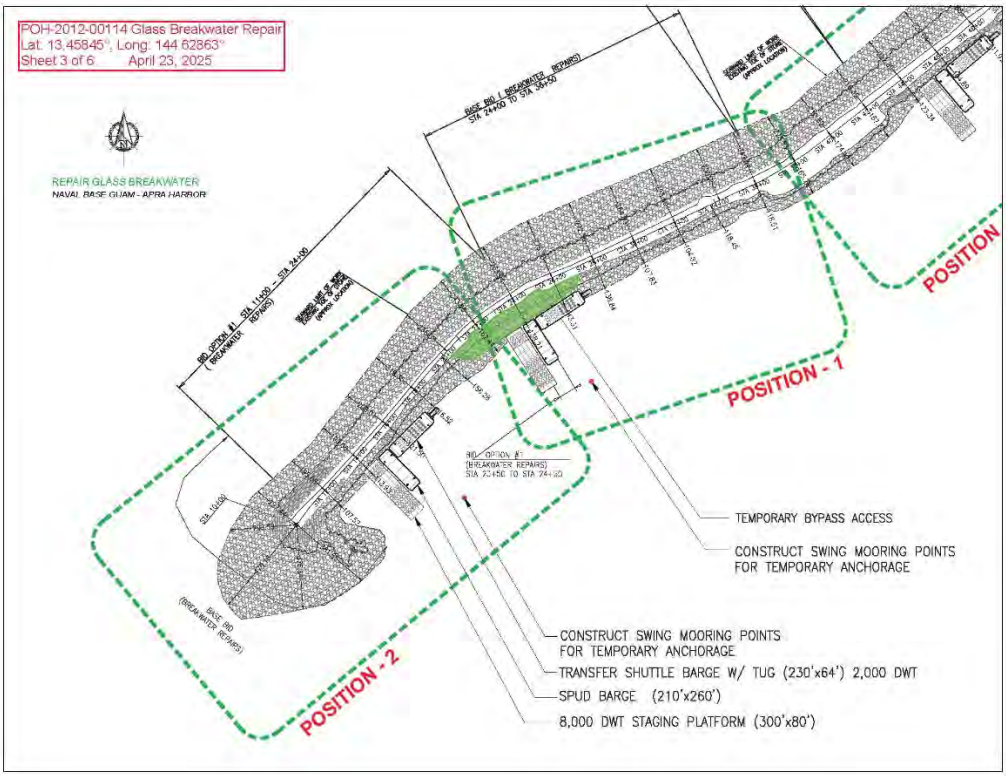
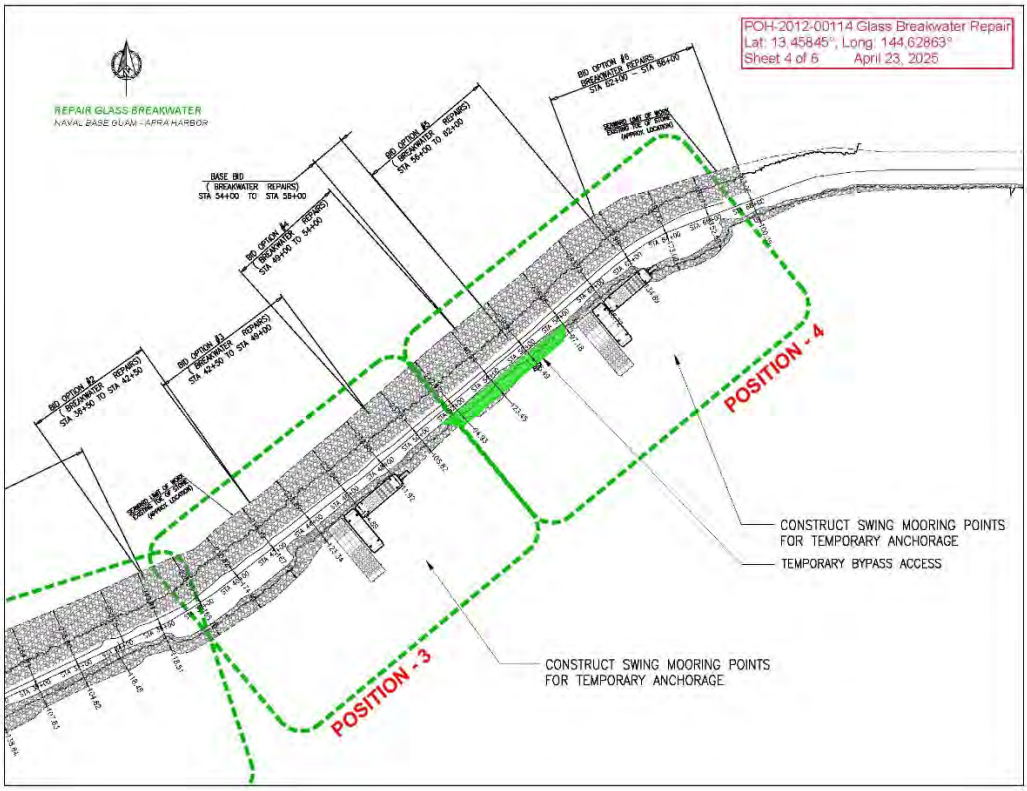
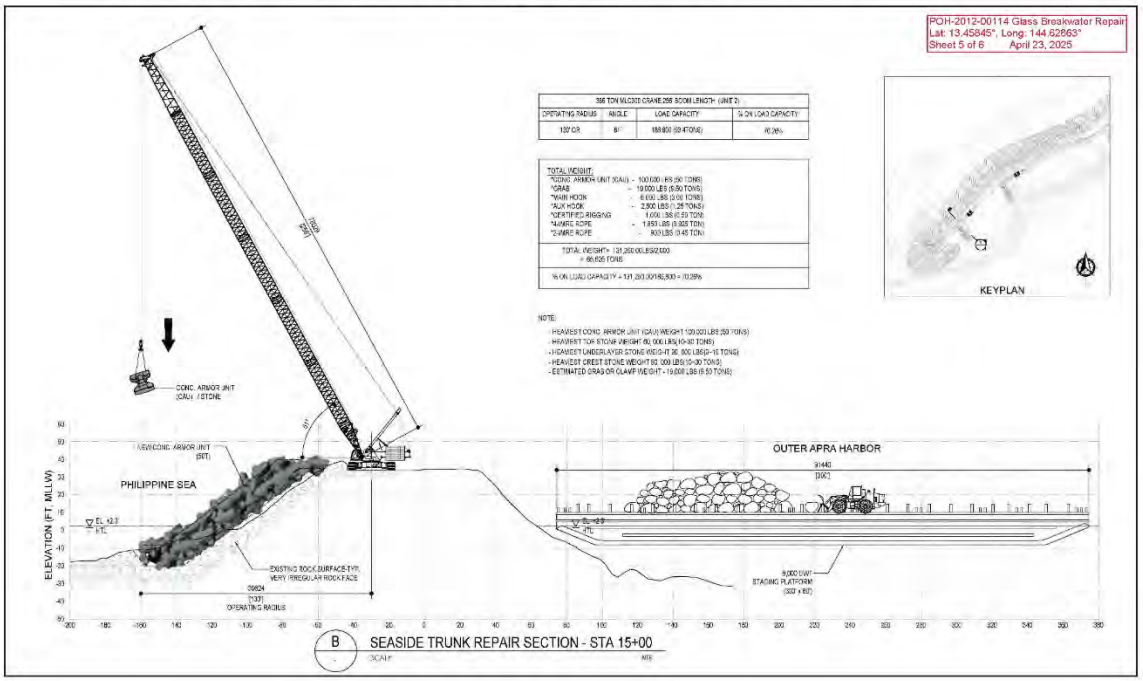
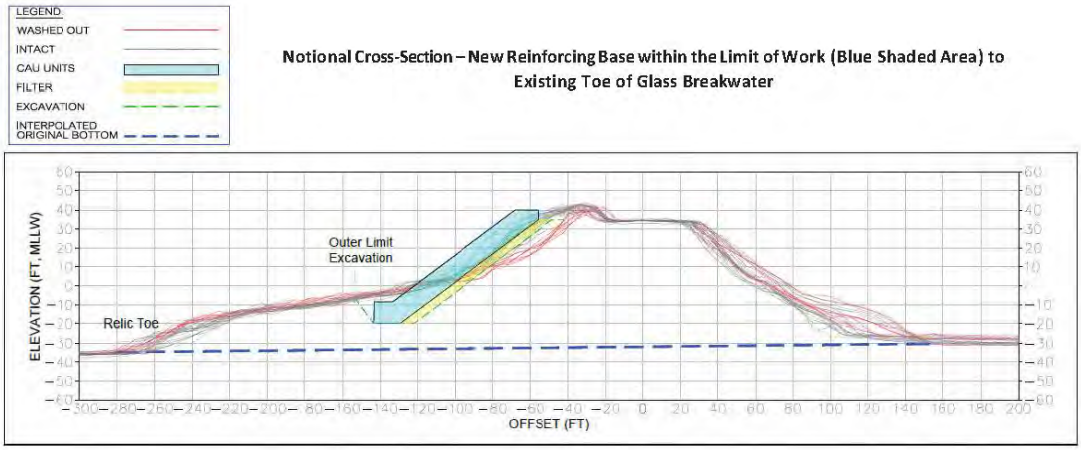

POH-2012-00114 Glass Breakwater Repair
Lat: 13.45845°, Long: 144.62863°
Sheet 3 of 6 April 23, 2025
REPAIR GLASS BREAKWATER
NAVAL BASE GUAM - APRA HARBOR
POSITION - 1
POSITION - 2
TEMPORARY BYPASS ACCESS
CONSTRUCT SWING MOORING POINTS FOR TEMPORARY ANCHORAGE
CONSTRUCT SWING MOORING POINTS FOR TEMPORARY ANCHORAGE
TRANSFER SHUTTLE BARGE W/ TUG (230'x64') 2,000 DWT
SPUD BARGE (210'x260')
8,000 DWT STAGING PLATFORM (300'x80')



Notional Cross-Section of Stone and CAU Transport and Placement for Glass Breakwater Repair



POH-2012-00114 Glass Breakwater Repair
Lat: 13.45845°, Long: 144.62863°
Sheet 6 of 6 April 23, 2025



Notional Cross-Section – New Reinforcing Base within the Limit of Work (Blue Shaded Area) to Existing Toe of Glass Breakwater

Navy CWA Section 401 WQC Application Package

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/046
March 28, 2025

Ms. Michelle C. R. Lastimoza
Administrator
Guam Environmental Protection Agency
P.O. Box 22439 GMF
Barrigada, Guam 96921

Guam Environmental Protection Agency
03-28-2025 RA 332 pm
RECEIVED

Dear Ms. Lastimoza,

SUBJECT: SECTION 401 WATER QUALITY CERTIFICATION FOR PROJECT: APRA HARBOR WATERFRONT REPAIRS, APRA HARBOR, NAVAL BASE GUAM

In accordance with Section 401 of the Clean Water Act (CWA), Naval Base Guam (NBG) hereby submits this permit application package supporting a Water Quality Certification (WQC) for the proposed subject project. The application package is attached and consists of the listed Enclosures (1) and (2). The signed certification statement is on the last page of Enclosure (2).

Naval Base Guam proposes to conduct long-term repairs on the Admiral Glass Breakwater (GBW) and at Sumay Cove in Apra Harbor, Guam. The long-term breakwater repairs, repairs to the Sumay Marina docks and wave attenuator, and repairs to the Sumay Point revetment are needed due to extensive damage that occurred during Typhoon Mawar in May 2023. The project work on the breakwater will include excavation and replacement of the existing toe, slope, and crest rock protection; rebuild of the damaged core and toe sections; placement of a bedding stone underlayer; and installation of concrete armor units along the toe, slope, and crest. The long-term repairs of GBW would restore the breakwater to Army Corps of Engineer breakwater standards, increase the effectiveness, and ensure long-term reliability and resiliency of the breakwater in order to continue protecting Apra Harbor and its shorelines. Thus, allowing for continued safe use of the area by the public, civil, and federal individuals and organizations.

Project work at Sumay Cove would include driving piles to provide additional anchoring and/or support for the floating docks and to replace deteriorated piles. A pile-supported fixed wave attenuator would also be constructed within Sumay Marina to replace the failed floating wave attenuator. The existing engineered revetment along Sumay Point would be repaired by removing a deteriorated steel structure and restoring the rock revetment protection. A detailed project description is provided in Enclosure 1.

SUBJECT SECTION 401 WATER QUALITY CERTIFICATION FOR PROJECT: APRA HARBOR WATERFRONT REPAIRS, APRA HARBOR, NAVAL BASE GUAM

The Navy has prepared a Draft Environmental Assessment (EA), which includes all required regulatory consultations (i.e., Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Coastal Zone Management Act and the National Historic Preservation Act). The notice of availability of the EA for public review has been published in both print and online media. The draft EA is available on the following website https://pacific.navfac.navy.mil/About-Us/National-Environmental-Policy-Act-NEPA-Information. Hard copies of the draft EA are available for public review at Nieves M. Flores Memorial Library, in Hagåtña.

Best Management Practices will be implemented to ensure that debris and surface runoff do not enter Guam's coastal waters. A Water Quality Monitoring Plan will be developed and submitted once it is completed and finalized. The construction project has a tentative start date of September 2025, with an estimated projected duration of up to sixty (60) months.

Should you have any questions, or require additional information, please contact Mr. Jesse T. Cruz at [redacted]

Sincerely,

Edward Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosure: 1. Apra Harbor Waterfront Repairs Project Description
2. GEPA Section 401 WQC Application

2

ENCLOSURE 1

Guam EPA CWA Section 401 WQC
Project Description: Apra Harbor Waterfront Repairs

The United States (U.S.) Navy Naval Facilities Engineering Command Marianas (NAVFAC Marianas) (hereafter, jointly referred to as the Navy) commissioned the Special Project Typhoon Mawar Apra Harbor Waterfront Repairs. The Navy proposes to conduct repairs of waterfront infrastructure along the Admiral Glass Breakwater (Glass Breakwater) and Sumay Cove in Apra Harbor, Guam. Breakwater repairs are needed due to extensive damage that occurred during Super Typhoon Mawar in May 2023. During subsequent engineering analysis, the Navy has determined failure of sections of the breakwater is accelerating, and multiple sections are at risk of catastrophic failure (i.e., a full breach of the breakwater). In 2024, the Navy prepared an Environmental Assessment (EA) to address emergency repairs that would temporarily secure the breakwater until long-term repairs could be made. This EA addresses the Navy's plan for the subsequent completion of long-term repairs of the breakwater and other vital infrastructure in the harbor.

The Proposed Action would repair and rebuild the failing areas of the Glass Breakwater, Sumay Marina docks and wave attenuator, and Sumay Point shoreline protection to provide long-term stability and protection for vessel traffic and Naval Base Guam infrastructure in Apra Harbor.

Construction is anticipated to begin in September 2025 with mobilization of equipment, labor, and some above-water site preparation. Concrete Armor Units (CAU) fabrication may begin by the end of 2025 and will continue throughout the armor placement period. Initial armor placement is anticipated to begin in early 2026 and to continue through the middle of 2029. In-water work is anticipated to continue intermittently for the duration of the Project. Nighttime in-water work is not anticipated; however, above-water nighttime work to prepare the site for placement and delivery of armor units may occur. The timing of in-water work will avoid coral spawning periods; spawning typically occurs between May and August. Coral spawning periods will be verified with the UOG Marine Lab annually. During the spawning periods, construction may continue above the water line.

GLASS BREAKWATER REPAIRS

This approach involves phased placement of CAUs on the western 1.9 kilometers (1.2 miles) of deteriorated and/or failing areas of the breakwater (Figure 1 and Figure 2). CAUs will be placed on the breakwater head section, along approximately 30 meters (100 linear feet) on the leeward (harbor) side, and along the entire ocean (Philippine Sea) side (1.9 kilometers), except for along the Luminao reef. The repair areas would extend from the breakwater crest up to approximately 49 meters [160 feet] seaward from the center of the crest road for the Outer Breakwater and up to 46 meters [150 feet] for the Inner Breakwater. Repair activities would potentially affect a maximum of up to 21.5 acres of underwater area (below the MLLW line) on the outer (Philippine Sea) side of the breakwater and head section. This includes the entire area from the waterline to the outer limit of the breakwater toe. Planned repairs would only likely disturb up to

11.4 acres on the outer breakwater, and up to 0.2 acres of underwater area below the MLLW line on the leeward (harbor) side of the breakwater.

Additionally, this work would require temporary relocation of the existing federal Aid to Navigation (ATON) situated at the breakwater head section. The temporary site for relocation would be within 200 feet of ATON's charted location. Relocation would be coordinated and approved through the U.S. Coast Guard (USCG), and a notice to mariners would be issued through the USCG, the National Geospatial-Intelligence Agency (NGA), and/or the National Ocean Service (NOS), about the temporary change. The ATON would be placed back on the head section when construction is complete.

Repair activities would include the following work elements:

1. Site preparation:

Vegetation clearing and earthwork to create work and access areas on the breakwater crest to accommodate crane pads, construction equipment, and heavy truck traffic would be required prior to repair activities. Several construction laydown areas (including material loading and offloading, concrete casting, and material storage areas) have been identified, as shown in Figure 1. The primary concrete casting yard would encompass the pre-cast yard, materials stockpile, and CAU storage. Contingent CAU and aggregate storage and an alternative concrete casting yard would be located at the old Cabras Quarry site or the paved lot located across the street and approximately 700 feet southwest from the quarry entry along Highway 11.

The Hotel Wharf site along the inner side of the breakwater in the Outer Harbor would be the primary location for loading and unloading barges, personnel transports, supply boats, and push boats to shuttle workers, materials, equipment, and supplies to and from the breakwater work areas. Other wharves located in the Inner Harbor (e.g., Oscar-Papa-Quebec) may also be used on a contingent basis for these purposes and to avoid forecasted typhoon conditions or tropical storms. On the leeward side of the breakwater, a spud/jack-up barge and temporary moorings (piles or anchors) would be used to position vessel for unloading CAUs and for other repair/construction support (Figure 2). The moorings would be supported by piles (up to 16 steel pipe piles). Any spuds or mooring piles installed would be placed only into soft sediment and would be removed following completion. Figure 3 provides a schematic of the process for stone and CAU transport via barge, lifted by crane, and placement along the breakwater.

2. Temporary Removal of Existing Armor Layer and Toe Foundation:

To provide a stable foundation for placement of the CAUs, existing rock and CAUs along the slope, crest, and toe would be removed within the repair areas of the breakwater to be rebuilt. Removal would be down to the breakwater core for the slope and crest and approximately 6 meters (20 feet) deep along the toe section. Figure 4 provides a notional cross schematic of the existing breakwater design and shows the limits of work to the toe of the existing breakwater. The removed rock and CAUs would be used to rebuild the breakwater core, and some (up to 7,800 cubic yards [CY]) would be hauled off-site to be used for shoreline protection repairs within Apra Harbor, including at Sumay Point. Predominantly, existing armor stone that has

settled or fallen from the slope into the water, leaving voids along the breakwater, would be excavated and used to build a reinforcing base approximately halfway between the base of the slope and the outer limit of the existing toe. The reinforcing base would be excavated to an elevation no deeper than 20 feet below the Mean Lower Low Water (MLLW) height to support the buildup of CAUs and/or CAUs and would serve to prevent settling or seaward movement of the CAUs, which would be placed from the reinforcing base up the slope to the crest. Using this approach, repair and buildout of the breakwater could disturb a maximum area of up to approximately 21.5 acres (which conservatively includes the entire the entire area from the breakwater crest to the outer limit of breakwater toe). However, it is likely that the required work would only disturb approximately 11.4 acres of submerged area (below the MLLW line) inside the footprint of the existing toe on the outer (Philippine Sea) side and 0.2 acres of submerged area (below the MLLW line) within the footprint of the existing toe on the leeward (Apra Harbor) side of the breakwater.

3. Rebuilding the Core Foundation:

As necessary in each repair area, the breakwater's core would be graded and rebuilt to provide a stable foundation for placement of the CAUs. Imported, quarried aggregate material and stone that would be used for this work would be transported to Guam via barges.

4. Placement of Bedding Rock:

Up to 54,000 CY of bedding rock would be placed to create a stable underlayer for placement of the CAU. The bedding rock would be imported to the island via ship/barge and transported to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge.

5. Placement of Concrete Armor Units:

Approximately 20,100 large CAUs (25 to 50 tons each) would be placed along the toe, slope, and crest of the breakwater. The CAUs would be transported from the casting yard to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge. It is anticipated that 75 percent of the CAUs would be hauled to the breakwater repair site from the concrete casting yard via truck, and the remaining 25 percent would be hauled by barge to the Hotel Wharf site for transloading onto barge via crane. When fully laden, the barge would then transit to and moor against the pre-positioned spud barge leeward of the breakwater near the CAU-placing crane. CAUs would then be offloaded from the barge onto the breakwater by the CAU-placing crane.

6. Construction of Concrete Casting Yard.

It is anticipated that CAUs would be fabricated on the island at a concrete casting yard co-located with a construction laydown area (Figure 1). Concrete would be purchased from a local supplier's batching plant to the casting yard via mixer trucks and placed into armor unit molds.

Figure 1. Location Map for Glass Breakwater and Sumay Cove Repairs, Apra Harbor.

Figure 2. Overview of the Glass Breakwater Repair Effort

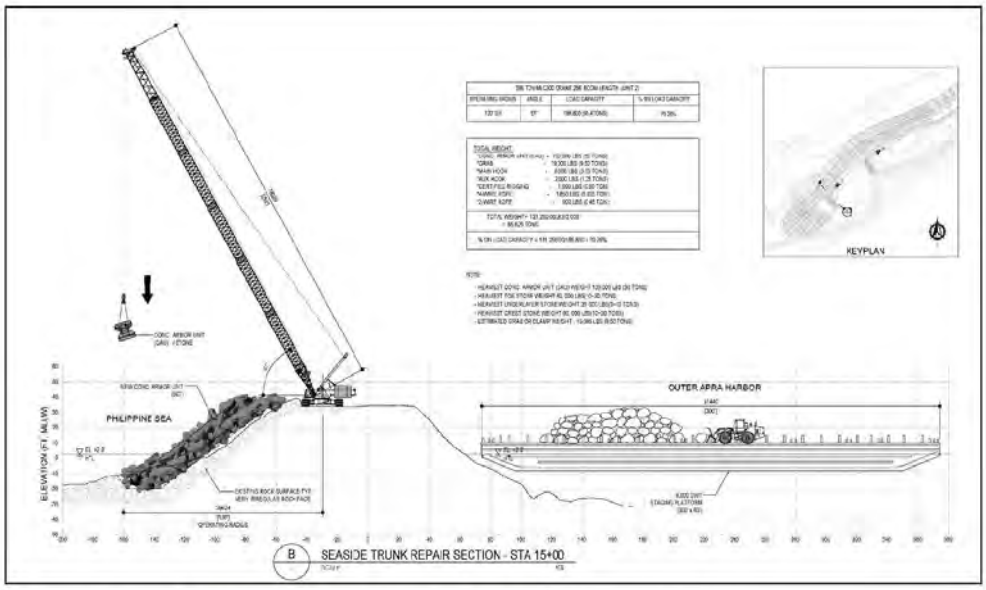


Figure 3. Proposed construction methodology for GBW repairs.

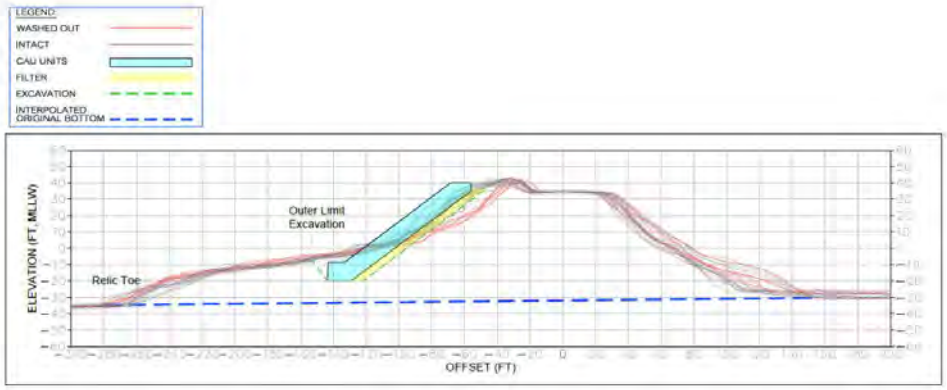


Figure 4. Notional Cross Section – Limit of Work (Blue Shaded Area) to Existing Toe of Breakwater.

SUMAY COVE REPAIRS

Proposed Action activities in Sumay Cove (Figure 5) would include the following component actions:

1. Sumay Marina Floating Dock Repairs. Repairs would drive up to 12 (20-inch diameter) octagonal concrete piles to provide lateral support and replacement of existing deteriorated piles for the floating docks supporting the USCG, Port Operations, and Navy Security Forces vessels and up to 12 (16-inch diameter) octagonal piles to replace damaged/deteriorating main dock guide piles (Figure 6). In the marina area, the ocean bottom is at a depth of approximately 5.5 meters (18 feet) and is comprised of silt. Sites where piles would be driven would be pre-drilled, and then each pile would be hammered to a depth of approximately 20 feet below the mud line. Finger and main dock pile installation for the proposed Sumay Dock repairs and wave attenuator would be conducted in a similar manner as described in the 2011 BiOp for Sumay Cove Marina Repairs and the 2020 LMN Wharf Repair EA and with the same pile driving requirements as assessed in the NMFS 2022 consultation response on similar Navy project work elsewhere in the Pacific Island Region (i.e., PIRO-2020-03728). It is anticipated that on average, one pile would be driven per day over a two-month period for all proposed projects in Sumay Cove.

Following pre-drilling if necessary, the process for impact driving the concrete piles begins by placing a choker cable around a pile and lifting the pile into a vertical position with a crane. The in-water pile is then lowered into position inside the template and set in place at the mudline, vibrated into place, and driven to design elevation using impact hammers. As needed, jetting would be used to assist in pile installation. Impact hammers have guides that hold the hammer in alignment with the pile while a heavy piston moves up and down, striking the top of the pile, driving the pile into the substrate from the downward force of the hammer. Assuming a similar number of strikes as described in the NMFS (2020b and 2022) consultation responses for similar pile driving activities, it is anticipated that driving a concrete pile would require an average of 200 hammer strikes per pile to reach the 20-foot depth below the mudline. This number will vary depending on factors such as soil condition, tip elevation, size of hammer, and final dimensions of the piles.

To support construction of the marina docks and wave attenuator, a temporary trestle may be constructed within Sumay Cove. The trestle would require installation of up to 10 (36-inch) steel pipe piles, which would be set in place via vibratory pile driving. Upon completion of construction, the trestle structure would be removed and the trestle piles would be pulled or cut off at the mudline.

2. Sumay Marina Wave Attenuator. Up to 32 octagonal concrete piles (20-inch diameter) or tubular steel piles (36-inch diameter) would be driven into pre-drilled sites to a depth of approximately 20 feet below the mud line to support the fixed wave attenuator. The pile installation method would be similar as described above for the Sumay Marina dock piles. Storm waves from the harbor can propagate along the Sumay Channel and impact the outer marina docks. A fixed (pile-supported) wave attenuator is proposed to reduce these waves to increase the survivability of the floating docks and to maintain safe vessel operation within the basin

(Figure 7). The face of the attenuator would be constructed of steel or concrete panels that are attached above the water and extend below the water with a gap at the bottom to allow for water flow. The wave attenuator is intended to block wave energy that would adversely affect the Sumay Marina docks while allowing for water flow around and under it to maintain circulation within Sumay Cove. A concrete cap would be constructed on the piles and navigation lights installed on the cap. The adjacent bulkhead contains corals; however, the wave attenuator would not be attached to the bulkhead; it would be its own free-standing structure in the approximate location of the previous attenuator. Figure 8 provides a diagram of the proposed wave attenuator.

Figure 5. Sumay Point Action Areas in outer Apra Harbor, inset to show project areas (pink lines).

Figure 6. Sumay Marina and the overall project layout.

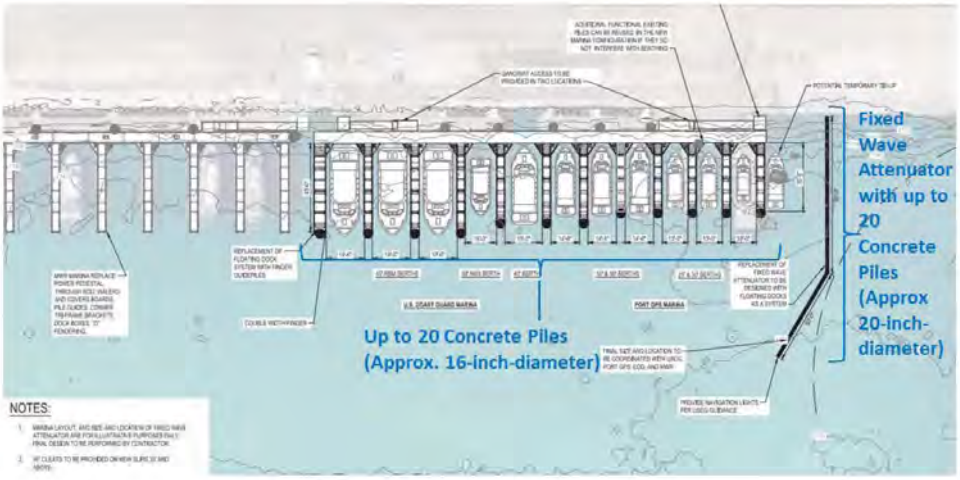


Figure 7. Schematic of Proposed Repair Activities at Sumay Marina.

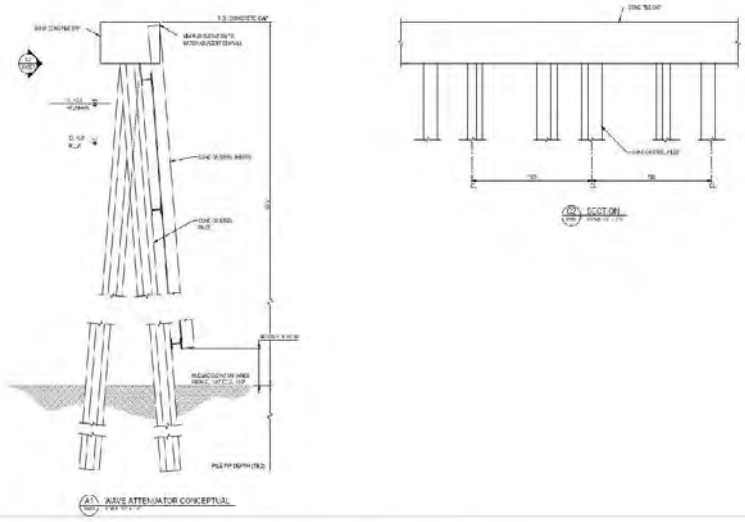


Figure 8. Conceptual Diagram of Wave Attenuator

Sumay Point Revetment Restoration. At Sumay Point (shown in Figure 9), an existing deteriorated steel structure would be demolished and removed (demonstrated in Figure 10). The underlying slope would be backfilled and compacted, likely requiring the import of soil/bedding material, and then imported rock or rock salvaged from the breakwater (approximately 900 CY) would be placed above and in water to restore the previously constructed rock revetment. The new rock would be placed within the existing revetment footprint and such that it ties into the existing rock in the water and at both ends. The rock would be brought to the Sumay Point site via truck from the breakwater (salvaged existing armor and core layer rock from breakwater repair) or from the Port of Guam (imported from off-island via ship/barge). At a haul capacity of approximately 10 CY per truckload, this work would require 90 truck trips. All construction work would likely occur from the landside.

Figure 9. Location for the actions at Sumay Point for the revetment

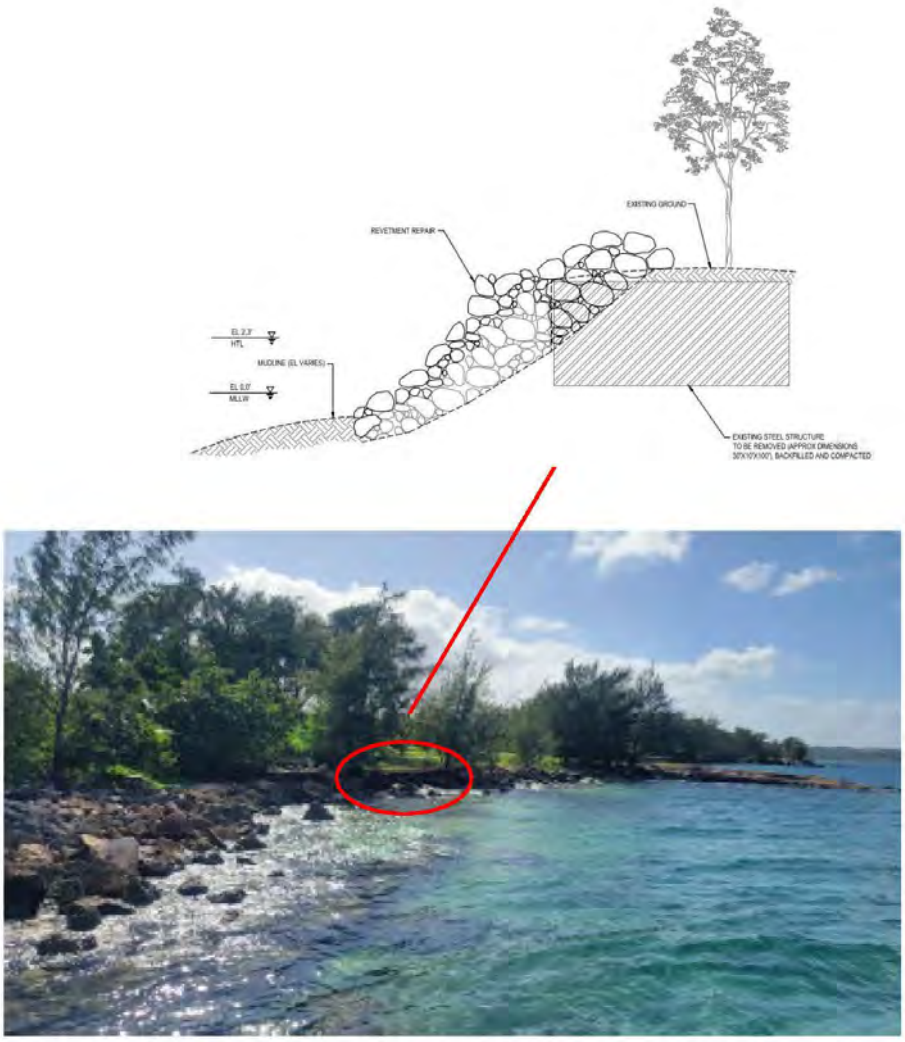


Figure 10. Sumay Point revetment plan (above) and the location of the sheet wall to be removed

References

Department of the Navy (DoN). (2020). Environmental Assessment for the Lima, Mike, Navy Wharf Repair and Modernization at Naval Base Guam, Apra Harbor, Guam. July 2020. Available online: <https://pacific.navfac.navy.mil/About-Us/National-Environmental-Policy-Act-NEPA-Information/>. Accessed 27 September 2024.

National Marine Fisheries Service (NMFS). (2011). Endangered Species Action- Section 7 Consultation Biological Opinion for Sumay Cove Repair and Modernization Naval Base Guam. Consultation number: I-PI-10-856-LVA. Pacific Islands Regional Office, NOAA National Marine Fisheries Service, Honolulu, Hawaii.

NMFS. (2020). Endangered Species Act, Section 7 - Informal Consultation Response Letter to Naval Base Guam [I-PI-20-1815-1G, PIR-2020-00424]. April 8, 2020.

NMFS. (2022). Endangered Species Act Section 7(a)(2) Biological Opinion 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 number: PIRO-2020-03728. Pacific Islands Regional Office, NOAA National Marine Fisheries Service, Honolulu, Hawaii.

ENCLOSURE 2

SEC 401 WQC APPLICATION

GUAM ENVIRONMENTAL PROTECTION AGENCY
SECTION 401 WATER QUALITY CERTIFICATION
APPLICATION (401A)

Revised 7/98

FOR OFFICIAL USE ONLY
Application No. _____
Date Received: _____

Prepared by: Naval Base Guam
Title: IEPD
Date Prepared: March 28, 2025

DISCHARGES FROM OCEAN OUTFALLS AND FOR NEAR-SHORE DISCHARGES.

Instructions

1. Activities covered by this application request form include outfalls for sewage treatment plants, stormwater, aquariums, thermal effluent from power plants, and industrial/other facility waste waters.

2 When addressing the following items, be sure to answer all questions. If the item is not applicable or the response is none, indicate as much and provide a brief explanation why. If there are incomplete items the application will be returned.

3. When references are made to supporting documents, studies, previous permit actions or other information, they must be identified by document name and date. All pertinent references used to support this application request must be provided.

4. The applicant should use this form; however, a similar format may be used and must include each question (item) found in this form.

5. If additional space is required, use extra sheets or the backside of this form. This form is available on diskette.

Applicant Information

1.a. Applicant and Address: **Mr. Edward E. Moon**
Installation Environmental Program Director
Public Works Department
U.S. Naval Base Guam
PSC 455, BOX 152
FPO AP 96540-1000

b. Agent/Representative and address: **Mr. Jesse T. Cruz**
Environmental Compliance Supervisor
Public Works Department
U.S. Naval Base Guam
PSC 455, BOX 152
FPO AP 96540-1000

2. Project Name: **Apra Harbor Waterfront Repairs Project**
Location: **Apra Harbor, Guam**

2

3. Associated Federal Permit or File No.
USACE Pre-Construction Notice – Submitted March 28, 2025
CZMA Federal Consistency Determination – Submitted March 27, 2025

Project Description and Potential Effects

4. *Describe the facility and/or activity, and any resultant discharge into Guam Waters or coastal wetlands including, but not limited to, the construction or operation of the facility or activity. Include an accurate description of the physical, biological, chemical, thermal, and any other characteristics of the discharge, and the location or locations at which such discharge may enter Guam Waters.*

Refer to Enclosure 1 for a detailed project description.

a. *Description of facility or activity:*

The Proposed Action would repair and rebuild the failing areas of the Glass Breakwater (GBW), Sumay Cove (i.e., marina docks, wave attenuator, and shoreline) to provide long-term stability and protection for vessel traffic and Naval Base Guam infrastructure in Apra Harbor.

b. *Description of construction actions, methodology, and operation of facility or activity:*

Refer to Enclosure 1 for a detailed project description.

c. *Description of physical, biological, chemical, thermal, quantity and other characteristics of discharge:*

GLASS BREAKWATER REPAIRS
Discharge will be prevented from entering Guam Waters to the maximum practicable extent. Discharge, if it should occur, is expected to be minimal and be restricted to existing sediment that composes the core of the GBW as it is exposed during the repair. The expected duration is the projected project period of 60 months. Silt curtains will only be deployed for sections along the Apra Harbor side of the GBW due to heavy wave energy on the Philippine side.

SUMAY COVE REPAIRS
Discharge will be prevented from entering Guam Waters to the maximum practicable extent. Resuspension of the soft bottom sediments of the marina during the pile driving operation is the only anticipated discharge but it will be contained by silt curtains deployed around the pile driving equipment during project duration.

No biological, chemical or thermal discharges are expected as a result of the proposed action.

d. Location(s) at which the discharge will enter Guam Waters:

GLASS BREAKWATER REPAIRS
Discharge will be prevented from entering Guam Waters to the maximum practicable extent. If discharges should occur, they will be limited to the Philippine Ocean side of the GBW as sections of the core are exposed during the repair and be temporary in nature, due to the high wave energy of the area.

SUMAY COVE REPAIRS
Discharge will be prevented from entering Guam Waters to the maximum practicable extent. If discharges should occur, they will be limited to the immediate area of pile driving and contained by the deployed silt curtains.

5. Provide information and an analysis, which describes the effect(s) of the discharge, which preclude or necessitate a "zone of mixing".

GLASS BREAKWATER REPAIRS
Discharge will be prevented from entering Guam Waters to the maximum practicable extent. No "Zone of Mixing" will be required. If discharges should occur, they will be limited to sedimentation and potential impacts of sessile marine organisms along the Philippine Ocean side of the GBW, that are outside of the immediate project area. This effect would be temporary due to the high wave energy of the area washing and/or removing the sediment. A coral translocation program is also being developed as a minimization option to reduce the impacts to corals within the area.

SUMAY COVE REPAIRS
Discharge will be prevented from entering Guam Waters to the maximum practicable extent. No "Zone of Mixing" will be required. If discharges occur, they will be short term in nature and limited to the area immediately within the silt curtain containing the pile driving equipment.

6. Provide information about the baseline environmental conditions of the receiving waters such as wildlife habitat and biological resources (e.g. coral, sea grass beds, mangroves, etc.). Attach baseline survey if completed.

ESA-listed marine species, specifically, the green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), the Scalloped hammerhead shark (*Sphyrna lewini*), and the coral *Acropora globiceps* have been observed within and around Apra Harbor and vicinity. Regulatory consultations with National Oceanic Atmospheric Administration are currently underway for the Essential Fish Habitat (EFH) and Endangered Species Act (ESA) listed species. The Navy has developed a draft Environmental Assessment that is currently available for public review that summarizes the affected environment and contains all final regulatory consultations.

7. *Describe any alternative(s) considered for the project and the reasons for not selecting those alternatives. Would any of the alternatives pose fewer or less intense environmental impact(s) or consequences?*

The alternatives considered for the proposed project are as follows:

GLASS BREAKWATER REPAIRS

a. No-Action Alternative: The critical repairs would not be completed and the breakwater would continue to degrade. Failure to execute this project would continue to expose the breakwater to more serious damage including partial collapse of the breakwater head and breach of the breakwater trunk.

b. Other Alternative: There are no other alternatives, besides the possibility of constructing a new breakwater at other locations. This alternative was not considered due to the potential for greater environmental and safety impacts.

c. Preferred Alternative: The preferred alternative is this proposed GBW repair project.

SUMAY COVE REPAIRS

a. No-Action Alternative: The critical repairs would not be completed and the Sumay Cove infrastructure would continue to degrade. The marina would not be available for various mission critical and recreational uses. Failure to execute this project would continue to jeopardize the Navy's mission by not having the necessary resources readily available.

b. Other Alternative: There are no other alternatives, besides the possibility of constructing new marina at other locations. This alternative was not considered due to the potential for greater environmental and safety impacts.

c. Preferred Alternative: The preferred alternative is this repair project.

Water Quality Maintenance and Treatment

8. *Provide a description of the function(s) and operation of all equipment, measures, or activities employed to treat wastes or effluent, which may be discharged, including specification of the degree of treatment expected to be attained.*

a. *Describe the function(s) of equipment or protection measures to treat wastes or effluent:*

Discharge will be prevented from entering Guam Waters to the maximum

practicable extent. No effluent or waste is anticipated to be discharged by the proposed activity on either the GBW or within Sumay Cove. Potential leaks of petroleum or hydraulic fluid from the heavy machinery will be prevented by Best Management Practices.

b. *Specify the degree of treatment or protection to be obtained:*

The in-water silt curtains are expected to maintain the water quality to normal (i.e., baseline) conditions and will prevent any further degradation in overall water quality. Petroleum products, such as oil and hydraulic fluid, may potentially leak from the heavy machinery. Absorbent pads, spill kits, and floating containment booms will be available on site. Before the commencement of each day's activity, all the machinery will be inspected for corrosion and damage. Fuel will not be stored on-site and all re-fueling of the heavy machinery will be done off-site, away from the shoreline, on an impervious surface. In situations of accidental petroleum spills on land, the absorbent materials will be used. For spills occurring in the water, floating containment booms will be immediately deployed. The effectiveness of the containment boom will be continuously monitored and adjusted as needed to confine the spill. Proper regulatory authorities will be contacted in the event of any spill of petroleum products in any quantity.

9. *Provide the date(s) on which the activity and/or discharge will begin and end. Approximate if necessary.*

a. *Date(s) on which the activity will begin and end:*

Naval Base Guam is expecting the project to start September 2025 and last approximately 60 months.

b. *Date(s) on which discharges will take place:*

Not Applicable (N/A). No discharge is anticipated for either the GBW or the Sumay Cove portions of the project. New and existing armor stones are free of loose sediment and will be placed individually and systematically. Appropriate industry standard BMPs will be utilized for the entire project period to contain and limit any potential discharge.

Water Quality Monitoring

10. *Provide a description and location(s) (plan) of the measures being used or proposed to monitor water quality and characteristics of the discharge and the operation of equipment or facilities employed in the treatment, protection or/and control of wastes or effluent.*

a. *Describe the methods to be used to monitor water quality:*

During in-water construction and pile driving activities, the contractor will monitor

turbidity levels at the project area to insure employed BMPs effectively control turbidity and protect marine resources. Turbidity will be monitored during construction and pile driving activities using two test stations and two control stations, at a minimum. Should monitoring indicate that Guam Water Quality Standards are exceeded, shut down procedures will be followed and additional BMPs will be implemented, as required.

c. *Describe the operation of equipment used:*

Heavy equipment such as crane or backhoe will be used to perform the relocation and placement of the existing armor stones along the GBW. Industry standard pile driving equipment and barge is anticipated to be used for the installation of new piles and docks within Sumay Cove. Refer to Enclosure 1 for more details.

d. *Identify the individual(s) responsible for developing, implementing and reporting the Water Quality Monitoring Plan and monitoring results:*

The Contractor for this project will be responsible for the monitoring plan development and will be responsible for the implementation and execution of the water quality monitoring plan. The plan will be submitted when the contractor submits its GEPA general construction permit application.

11. *Describe the classification of the Guam's Waters and the associated recreational uses, if any, at the discharge location(s) and state whether the basic water quality criteria and the applicable water quality standards will be met.*

a. *Describe the classification and recreational uses of Guam's Water at the discharge:*

The waters of the Apra Harbor are classified as M-2 (Good), according to the 2001 Guam Water Quality Standards (Guam EPA, 2001). Water in this category is of sufficient quality to allow for the propagation and survival of marine organisms, particularly shellfish and other similarly harvested aquatic organisms, corals, and other reef-related resources, and whole body contact recreation. Recreational activities within Apra Harbor are primary and secondary contact.

b. *State whether the basic water quality criteria and applicable water quality standards will or are expected to be met and provide a signed assurance statement by the applicant that, "There is reasonable assurance that the activity will be conducted in such a manner which will not violate applicable water quality standards."*

The Guam Water Quality Standards (Guam EPA 2001 Revision) have been reviewed and the basic water quality criteria and applicable water quality standards are expected to be met throughout the duration of the proposed project.

Since there are no anticipated discharges, there is reasonable assurance that the proposed activities will be conducted in such a manner which will not violate applicable water quality standards.

MOON.EDWARD.E.1272181507 Digitally signed by MOON.EDWARD.E.1272181507 Date: 2025.04.01 17:56:32 +10'00'

April 1, 2025

Edward E. Moon **Date**
By Direction of the Commanding Officer

Supporting Documentation

12. *Check and submit all applicable supporting plans and documents as identified below.* ***The Agency may require additional documentation prior to Section 401 issuance or as a condition of issuance which may include any of the following.***

a. X Construction Drawing/Plans
b. ___ Wetland Delineation Map
c. X Specifications
d. ___ Environmental Baseline Survey (marine, freshwater aquatic, or adjacent upland)
e. ___ Environmental Protection Plan (EPP)
f. ___ Water Quality Monitoring Plan (WQMP)
g. ___ Environmental Impact Assessment/Statement (EIA/EIS)

13. Explain any irregularities, recent disturbances (natural or man caused), unique features, and/or expected cumulative effects that may influence water quality conditions adjacent to or within the project site.

Typhoon Mawar, with sustained winds of 140 mph and recorded significant wave heights just under 30 feet, made land fall on Guam Wednesday. May 24, 2023. This typhoon severely damaged the Admiral Glass Breakwater and exposed the core in certain areas. The typhoon also severely damaged the dock infrastructure within the Sumay Cove. This repair project will return these structures to operational capabilities and will help to decrease the number and severity of sedimentation events.

8

Appendix B: Air Quality and Greenhouse Gas Analysis Supporting Documentation: Record of Non-Applicability for Clean Air Act Conformity and Air Emission Calculations

Record of Non-Applicability for Clean Air Act Conformity

Apra Harbor Waterfront Repairs
Naval Base Guam, Apra Harbor, Guam

The Proposed Action falls under the Record of Non-Applicability (RONA) category and is documented with this RONA.

Proposed Action

Action Proponent: Naval Base Guam

Location: Naval Base Guam, Apra Harbor, Guam

Proposed Action Name: Apra Harbor Waterfront Repairs

Proposed Action and Emission Summary:

The Proposed Action is to make necessary long-term repairs to the Admiral Glass Breakwater (Glass Breakwater), Sumay Marina U.S. Coast Guard (USCG)/Port Operations/Navy Security docks and wave attenuator, and Sumay Point shoreline protection. Work on the breakwater includes excavation and replacement of the existing tow (the outermost and deepest submerged base of the breakwater), slope, and crest rock protection; restoration of the damaged core and tow sections; placement of a bedding stone underlayer; and installation of concrete armor units (CAU) along the toe, slope, and crest. Site preparations include earthwork, placement of gravel, and vegetation clearing to provide work areas to accommodate crane pads and heavy truck traffic on the breakwater crest roadway. Other site work includes construction of a concrete casting yard at one of the nearby construction laydown areas to fabricate the CAUs and temporary relocation of the existing USCG aid to navigation (ATON) tower on the breakwater head section during construction. The ATON will be placed back on the head section when construction is complete.

The purpose of and need for the Proposed Action is to complete necessary long-term repairs and modernization to the Glass Breakwater and Sumay Cove infrastructure with the goal of improving safety, accessibility, usability, and functionality of the area for the Navy, USCG, Port Operations, Military Sealift Command, Morale, Welfare, and Recreation users as well as for all citizens of Guam.

The Proposed Action is needed to prevent imminent breach of the breakwater, thereby safeguarding the harbor, shoreline, and vital Navy and Port of Guam infrastructure that is essential to sustain critical military missions and civilian activities on Guam. There remains a risk of breaching the Glass Breakwater, which would have significant impacts on Navy mission readiness and operational capabilities. The degraded condition of the breakwater, exacerbated by ongoing normal wave action, storms, and typhoons, heightens the likelihood of breach. Continued exposure to even normal wave action not only increases the risk of breach but also poses a risk of potential environmental damage to the underwater habitat areas of Endangered Species Act (ESA)-listed threatened hard coral species (*Acropora globiceps*) and ESA-candidate giant clam species (*Tridacna spp*.).

The proposed repairs in Sumay Cove are needed to improve safety, accessibility, usability, and functionality of the area for the USCG, Port Ops, and Navy Security Forces users. The Proposed Action seeks to improve safety while minimizing environmental impacts on natural and cultural resources.

Table 1. Estimated Emissions for the Proposed Action

Project Year	Sulfur Dioxide (tons per year)
2025	0.106
2026	0.140
2027	0.143
2028	0.143
2029	0.029
2030	0.000

Affected Air Basin: Piti-Cabras, Air Quality Control Region 246, Guam

Date RONA Prepared: March 12, 2025

RONA Prepared By: HDR

Proposed Action Exemption

The Proposed Action is exempt from the Clean Air Act General Conformity Rule because the Proposed Action's projected emissions are below the applicable *de minimis* threshold.

Attainment Area Status and Emissions Evaluations Conclusions

The project area at Naval Base Guam Apra Harbor is located within the Guam Piti-Cabras area, which has been designated nonattainment for sulfur dioxide, unclassified for particles with an aerodynamic diameter less than or equal to a nominal 10 micrometers, and unclassifiable/attainment for carbon monoxide, ozone, nitrogen dioxide, lead, and particles with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

RONA Approval:

Signature: _____

Name/Rank/Date: _____

Position: _____

RONA: Equipment List Used for Air Emissions Calculations

Equipment	Fuel Type	Power (hp)	Load Factor	Operating Hours (normal operations)					Onsite Idling (hours)					Total Hours					Avg. Speed (mph)	Vehicle Miles Traveled (mi)				
				2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029		2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS																								
Government Fleet Vehicles																								
Passenger truck	Gasoline	200		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	25	12000	12000	12000	12000	12000
Passenger car	Gasoline	170		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	25	12000	12000	12000	12000	12000
Contractor Breakwater Fleet Vehicles																								
Passenger Trucks (3), 3 Eng. Home Office	Gasoline	240		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	25	24000	36000	36000	36000	18000
Passenger Trucks (18), Multiple Staff (18)	Gasoline	240		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0	N/A	N/A	N/A	N/A	N/A	25	216000	324000	324000	324000	162000
Coral Translocation																								
Excavator	Diesel	225	0.59	800	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	800	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Flat Bed Truck	Diesel	150		800	N/A	N/A	N/A	N/A	0	0	0	0	0	800	0	0	0	0	20	16000	0	0	0	0
Tugboat (Primary Engine)	Diesel	3600		320	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	320	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Tugboat (Bow Thrusters)	Diesel	3600		320	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	320	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Tugboat (Generator)	Diesel	300		320	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	320	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Twin Engine Large Dive Boat (2 engines, total hp)	Diesel	630		320	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	320	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Twin Engine Small Dive Boat (2 engines, total hp)	Diesel	300		320	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	320	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
Contractor Casting Yard Fleet Vehicles and Equipment																								
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	Gasoline	240		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0						25	40000	60000	60000	60000	30000
6T All Terrain Forklift 1	Diesel	85	0.59	1310	1560	1560	1560	1320	N/A	N/A	N/A	N/A	N/A	1310	1560	1560	1560	0	N/A	N/A	N/A	N/A	N/A	N/A
6T All Terrain Forklift 2	Diesel	85	0.59	780	1560	1560	1560	1170	N/A	N/A	N/A	N/A	N/A	780	1560	1560	1560	0	N/A	N/A	N/A	N/A	N/A	N/A
Boom Truck	Diesel	150		624	1248	1248	1248	936	0	0	0	0	0						20	12480	24960	24960	24960	18720
Vacuum Truck/Sweeper	Diesel	210		520	1040	1040	1040	780	0	0	0	0	0						20	10400	20800	20800	20800	15600
Cement Train Tractor 1	Diesel	400	0.21	780	1560	1560	1560	1170	N/A	N/A	N/A	N/A	N/A	780	1560	1560	1560	0	N/A	N/A	N/A	N/A	N/A	N/A
Cement Train Tractor 2	Diesel	400	0.21	780	1560	1560	1560	1170	N/A	N/A	N/A	N/A	N/A	780	1560	1560	1560	0	N/A	N/A	N/A	N/A	N/A	N/A
100T Gantry Crane 1	Diesel	300	0.43	1248	2496	2496	2496	1872	312	624	624	624	468	1560	3120	3120	3120	0	N/A	N/A	N/A	N/A	N/A	N/A
100T Gantry Crane 2	Diesel	300	0.43	1248	2496	2496	2496	1872	312	624	624	624	468	1560	3120	3120	3120	0	N/A	N/A	N/A	N/A	N/A	N/A
Truck Tractor 1	Diesel	400		936	1872	1872	1872	1404	960	960	960	960	960						20	18720	37440	37440	37440	28080
Truck Tractor 2	Diesel	400		936	1872	1872	1872	1404	960	960	960	960	960						20	18720	37440	37440	37440	28080
Skid Steer 1	Diesel	55	0.21	1248	2496	2496	2496	1872	N/A	N/A	N/A	N/A	N/A	1248	2496	2496	2496	0	N/A	N/A	N/A	N/A	N/A	N/A
Skid Steer 2	Diesel	55	0.21	1248	2496	2496	2496	1872	N/A	N/A	N/A	N/A	N/A	1248	2496	2496	2496	0	N/A	N/A	N/A	N/A	N/A	N/A
4000 Gal Water Truck	Diesel	275		1248	2496	2496	2496	1872	0	0	0	0	0						24960	24960	49920	49920	49920	37440
Cat 966 Loader 1	Diesel	240	0.59	1248	2496	2496	2496	1872	N/A	N/A	N/A	N/A	N/A	1248	2496	2496	2496	0	N/A	N/A	N/A	N/A	N/A	N/A
Cat 966 Loader 2	Diesel	240	0.59	1248	2496	2496	2496	1872	N/A	N/A	N/A	N/A	N/A	1248	2496	2496	2496	0	N/A	N/A	N/A	N/A	N/A	N/A
36 Meter Concrete Pump Truck	Diesel	400		936	1872	1872	1872	1404	0	0	0	0	0						20	18720	37440	37440	37440	28080
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller	Electricity	N/A		936	1872	1872	1872	1404	N/A	N/A	N/A	N/A	N/A						N/A	N/A	N/A	N/A	N/A	N/A	N/A
100 KW Generators Backup Power (2)	Diesel	268	0.59	200	200	200	200	200	N/A	N/A	N/A	N/A	N/A	200	200	200	200		N/A	N/A	N/A	N/A	N/A	N/A
Ready Mix Concrete Truck 1	Diesel	400		936	1872	1872	1872	1404	960	960	960	960	960						20	18720	37440	37440	37440	28080
Ready Mix Concrete Truck 2	Diesel	400		936	1872	1872	1872	1404	960	960	960	960	960						20	18720	37440	37440	37440	28080
Ready Mix Concrete Truck 3	Diesel	400		936	1872	1872	1872	1404	960	960	960	960	960						20	18720	37440	37440	37440	28080
Ready Mix Concrete Truck 4 (reserve)	Diesel	400		100	200	200	200	150	96	96	96	96	96						20	1872	3744	3744	3744	2808
60' Manlift for Maintenance	Diesel	125	0.21	416	832	832	832	624	N/A	N/A	N/A	N/A	N/A	416	832	832	832		N/A	N/A	N/A	N/A	N/A	N/A
Dump Trucks (4)	Diesel	400		4992	9984	9984	9984	8608	960	960	960	960	960						20	99840	199680	199680	199680	172160
Truck Tractor for Roll Off Trash Bins	Diesel	400		416	832	832	832	624	960	960	960	960	960						20	8320	16640	16640	16640	12480
Fuel Truck	Diesel	250		520	1040	1040	1040	780	960	960	960	960	960						20	10400	20800	20800	20800	15600
CAT D8 Dozer	Diesel	300	0.59	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	120	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
CAT 950 Loader	Diesel	190	0.59	120	N/A	N/A	N/A	120	N/A	N/A	N/A	N/A	N/A	120	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
CAT 14H Grader	Diesel	150	0.59	404	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	404	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
25T Vibratory Compactor	Diesel	150	0.59	260	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	260	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
CAT 345 Excavator	Diesel	225	0.59	N/A	N/A	N/A	N/A	170	N/A	N/A	N/A	N/A	N/A	0	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
100T Crawler Crane	Diesel	275	0.43	200	N/A	N/A	N/A	150	N/A	N/A	N/A	N/A	N/A	200	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A

175T Crawler Crane	Diesel	350	0.43	480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	480	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
185 CFM Compressor	Diesel	75	0.43	480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	480	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
Miller Welder 400Amps	Diesel	95	0.21	480	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	480	0	0	0		N/A	N/A	N/A	N/A	N/A	N/A
Construction																								
Liebherr LR1300 Crawler Crane Hotel Wharf	Diesel	336	0.43	624	2496	2496	2496	624	N/A	624	624	624	N/A	624	3120	3120	3120	624	N/A	N/A	N/A	N/A	N/A	N/A
Manitowoc MLC 300 Crawler Crane Breakwater	Diesel	336	0.43	624	2496	2496	2496	624	N/A	624	624	624	N/A	624	3120	3120	3120	624	N/A	N/A	N/A	N/A	N/A	N/A
Manitowoc MLC 300 Crawler Crane Breakwater	Diesel	336	0.43	624	2496	2496	2496	624	N/A	624	624	624	N/A	624	3120	3120	3120	624	N/A	N/A	N/A	N/A	N/A	N/A
Manitowoc 999 Crawler Crane Breakwater	Diesel	298	0.43	624	2496	2496	2496	624	N/A	624	624	624	N/A	624	3120	3120	3120	624	N/A	N/A	N/A	N/A	N/A	N/A
Kobelco 275 Ton Crawler	Diesel	400	0.59	624	2496	2496	2496	624	N/A	624	624	624	N/A	624	3120	3120	3120	624	N/A	N/A	N/A	N/A	N/A	N/A
60T Hydraulic Crane Assembly Crane	Diesel	336	0.43	384	384	384	384	384	N/A	N/A	N/A	N/A	N/A	384	384	384	384	384	N/A	N/A	N/A	N/A	N/A	N/A
Cat 988 Loader 1	Diesel	439	0.59	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	N/A
Cat 988 Loader 2	Diesel	439	0.59	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	N/A
Cat 988 Loader 3	Diesel	439	0.59	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	N/A
100T Hydraulic Excavator 1	Diesel	404	0.59	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	N/A
100T Hydraulic Excavator 2	Diesel	404	0.59	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	N/A
CAT 745 Rock Truck 1	Diesel	348	0.59	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	N/A
CAT 745 Rock Truck 2	Diesel	348	0.59	312	1248	1248	1248	312	N/A	N/A	N/A	N/A	N/A	312	1248	1248	1248	312	N/A	N/A	N/A	N/A	N/A	N/A
8000 DWT Staging Platform	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2000 DWT Transfer Shuttle Barge	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Spud Barge	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16000 DWT Barge for Armor Stone Transport	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inner Harbor Tug 1 Engine	Diesel	3600	50	312	1248	1248	1248	312	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inner Harbor Tug 1 Generator	Diesel	300	43	2190	8760	8760	8760	2190	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inner Harbor Tug 2 Engine	Diesel	3600	50	312	1248	1248	1248	312	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Inner Harbor Tug 2 Generator	Diesel	300	43	2190	8760	8760	8760	2190	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ocean Going Tug for Armor Stone Transport Engine	Diesel	4200	50	2190	4380	4380	4380	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ocean Going Tug for Armor Stone Transport Generator	Diesel	350	43	4380	8760	8760	8760	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
20' Aluminum Crew Boat	Gasoline	130	0.21	260	1040	1040	1040	260	N/A	N/A	N/A	N/A	N/A						N/A	N/A	N/A	N/A	N/A	N/A
10' Safety Boat 1	Gasoline	65	0.21	52	208	208	208	52	N/A	N/A	N/A	N/A	N/A						N/A	N/A	N/A	N/A	N/A	N/A
10' Safety Boat 2	Gasoline	65	0.21	52	208	208	208	52	N/A	N/A	N/A	N/A	N/A						N/A	N/A	N/A	N/A	N/A	N/A
Fuel Truck	Diesel	250		260	1040	1040	1040	260	0	0	0	0	0						20	5200	20800	20800	20800	5200
Mechanic Truck 1	Diesel	250		1040	2080	2080	2080	1040	960	960	960	960	960						20	20800	41600	41600	41600	20800
Mechanic Truck 2	Diesel	250		1040	2080	2080	2080	1040	960	960	960	960	960						20	20800	41600	41600	41600	20800
Welding Truck	Diesel	301	0.21	260	1040	1040	1040	260	N/A	N/A	N/A	N/A	N/A	260	1040	1040	1040	260	N/A	N/A	N/A	N/A	N/A	N/A
Compressor	Diesel	75	0.43	260	1040	1040	1040	260	N/A	N/A	N/A	N/A	N/A	260	1040	1040	1040	260	N/A	N/A	N/A	N/A	N/A	N/A
Boom Truck	Diesel	250		312	1248	1248	1248	312	0	0	0	0	0						20	6240	24960	24960	24960	6240
Water Truck	Diesel	400		624	2496	2496	2496	624	0	0	0	0	0						20	12480	49920	49920	49920	12480
Truck Tractor for Roll Off Trash Bins Stage at Hotel	Diesel	400		312	1248	1248	1248	312	960	960	960	960	960						20	6240	24960	24960	24960	6240
Truck Tractor for Mob/Demob/Various	Diesel	400		312	1248	1248	1248	312	0	0	0	0	0						20	6240	24960	24960	24960	6240
6T All Terrain Forklift	Diesel	85	0.59	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	624	2496	2496	2496	624	N/A	N/A	N/A	N/A	N/A	N/A
D8 Dozer	Diesel	275	0.59	500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	500	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
CAT 330 Excavator	Diesel	225	0.59	500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	500	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
CAT 14H Grader	Diesel	275	0.59	500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	500	0	0	0	0	N/A	N/A	N/A	N/A	N/A	N/A
230T Crawler Crane	Diesel	246	0.43	N/A	N/A	86	86	N/A	N/A	N/A	17	17	N/A	0	0	103	103	0	N/A	N/A	N/A	N/A	N/A	N/A
Kincho Vibro Hammer/Gen	Diesel	275	0.43	N/A	N/A	17	17	N/A	N/A	N/A	N/A	N/A	N/A	0	0	17	17	0	N/A	N/A	N/A	N/A	N/A	N/A
HPSI 260Hammer w/400HP Powerpack	Diesel	400	0.43	N/A	N/A	11	11	N/A	N/A	N/A	N/A	N/A	N/A	0	0	11	11	0	N/A	N/A	N/A	N/A	N/A	N/A
Delmag 30-32 Hammer	Diesel	285	0.43	N/A	N/A	29	29	N/A	N/A	N/A	N/A	N/A	N/A	0	0	29	29	0	N/A	N/A	N/A	N/A	N/A	N/A
65T Rough Terrain Crane	Diesel	194	0.43	N/A	N/A	4	4	N/A	N/A	N/A	N/A	N/A	N/A	0	0	4	4	0	N/A	N/A	N/A	N/A	N/A	N/A
SUMAY COVE REPAIRS																								
Government Fleet Vehicles																								
Passenger truck	Gasoline	200		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0						25	0	0	3600	3600	0
Passenger car	Gasoline	170		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0						25	0	0	3600	3600	0
Contractor Sumay Cove Vehicles																								
Passenger trucks (5), Multiple Staff (5)	Gasoline	240		N/A	N/A	N/A	N/A	N/A	0	0	0	0	0						25	N/A	N/A	N/A	N/A	N/A
185 CFM Compressor	Diesel	75	0.43	N/A	N/A	930	930	N/A	N/A	N/A	N/A	N/A	N/A	0	0	930	930	0	N/A	N/A	N/A	930	930	N/A
Miller Welder	Diesel	75	0.21	N/A	N/A	400	400	N/A	N/A	N/A	N/A	N/A	N/A	0	0	400	400	0	N/A	N/A	N/A	400	400	N/A

90T Rough Terrain Crane	Diesel	205	0.43	N/A	N/A	55	55	N/A	N/A	N/A	N/A	N/A	N/A	0	0	55	55	0	N/A	N/A	N/A	55	55	N/A
175T Crawler Crane	Diesel	225	0.43	N/A	N/A	360	360	N/A	N/A	N/A	72	72	N/A	0	0	432	432	0	N/A	N/A	N/A	360	360	N/A
6T Forklift	Diesel	85	0.59	N/A	N/A	360	360	N/A	N/A	N/A	72	72	N/A	0	0	432	432	0	N/A	N/A	N/A	360	360	N/A
20' Aluminum Crew Boat	Diesel	130	45	N/A	N/A	312	312	N/A	N/A	N/A	N/A	N/A	N/A	0	0	312	312	0	N/A	N/A	N/A	312	312	N/A
10' Safety Boat	Diesel	65	45	N/A	N/A	20	20	N/A	N/A	N/A	N/A	N/A	N/A	0	0	20	20	0	N/A	N/A	N/A	20	20	N/A
230T Crawler Crane	Diesel	246	0.43	N/A	N/A	354	354	N/A	N/A	N/A	71	71	N/A	0	0	425	425	0	N/A	N/A	N/A	354	354	N/A
Kincho Vibro Hammer/Gen	Diesel	275	0.43	N/A	N/A	71	71	N/A	N/A	N/A	N/A	N/A	N/A	0	0	71	71	0	N/A	N/A	N/A	71	71	N/A
HPSI 260Hammer w/400HP Powerpack	Diesel	400	0.43	N/A	N/A	47	47	N/A	N/A	N/A	N/A	N/A	N/A	0	0	47	47	0	N/A	N/A	N/A	47	47	N/A
Delmag 30-32 Hammer	Diesel	285	0.43	N/A	N/A	118	118	N/A	N/A	N/A	N/A	N/A	N/A	0	0	118	118	0	N/A	N/A	N/A	118	118	N/A
65T Rough Terrain Crane	Diesel	194	0.43	N/A	N/A	18	18	N/A	N/A	N/A	N/A	N/A	N/A	0	0	18	18	0	N/A	N/A	N/A	18	18	N/A
Truck Tractor	Diesel	400		N/A	N/A	15	15	N/A	0	0	0	0	0						20	N/A	N/A	15	15	N/A
Spud Barge	N/A	N/A		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A						N/A	N/A	N/A	N/A	N/A	N/A
Inner Harbor Tug Engine	Diesel	3600	50	N/A	N/A	60	60	N/A	N/A	N/A	N/A	N/A	N/A						N/A	N/A	N/A	60	60	N/A
Inner Harbor Tug Generator	Diesel	300	43	N/A	N/A	168	168	N/A	N/A	N/A	N/A	N/A	N/A						N/A	N/A	N/A	168	168	N/A
Concrete Pump	Diesel	400	0.43	N/A	N/A	15	15	N/A	N/A	N/A	N/A	N/A	N/A	0	0	15	15	0	N/A	N/A	N/A	15	15	N/A
100T Crawler Crane	Diesel	225	0.43	N/A	N/A	100	100	N/A	N/A	N/A	20	20	N/A	0	0	120	120	0	N/A	N/A	N/A	100	100	N/A
CAT 345 Excavator	Diesel	225	0.59	N/A	N/A	380	380	N/A	N/A	N/A	N/A	N/A	N/A	0	0	380	380	0	N/A	N/A	N/A	380	380	N/A
CAT 330 Excavator	Diesel	200	0.59	N/A	N/A	105	105	N/A	N/A	N/A	N/A	N/A	N/A	0	0	105	105	0	N/A	N/A	N/A	105	105	N/A
CAT 966 Loader	Diesel	240	0.21	N/A	N/A	345	345	N/A	N/A	N/A	N/A	N/A	N/A	0	0	345	345	0	N/A	N/A	N/A	345	345	N/A
CAT 950 Loader	Diesel	200	0.21	N/A	N/A	185	185	N/A	N/A	N/A	N/A	N/A	N/A	0	0	185	185	0	N/A	N/A	N/A	185	185	N/A

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.

RONA: Shipping List for Ocean Going Vessels Used for Air Emissions Calculations

Product Shipped	Quantity Needed	Quantity Units	Vessel Size (DWT)	Round Trip Distance between 3 nm seaward from Apra Harbor Port and 0.25 nm from Port (miles)	Round Trip Distance between 0.25 nm seaward from Apra Harbor Port and Port dockside (miles)	Number of Vessel Round Trips	3 nm - Hours per Round Trip (hr)	0.25 nm - Hours per Round Trip (hr)	Main Engine Rated Power (kW)	Cruising Load Factor (% of Main Engine Rated Power)	Porting Load Factor (% of Main Engine Rated Power)	Auxiliary Engine Rated Power (kW)	Cruising Load Factor (% of Aux. Engine Rated Power)	SO_2 Low Load Adjustment Factor (Porting)
ADVA 140 m 58oz/CY (Concrete Additive)	67,721	gallons	20,000	12.89	0.58	1	1.02	0.17	5,920	55.8	1.1	1,725	30	1.00
DARREX1 1AEA 63oz/CY (Concrete Additive)	73,551	gallons												
WRDA-HA 43 oz/CY (Concrete Additive)	49,273	gallons												
Concrete Sand C-33	112,800	short tons	20,000	12.89	0.58	6	1.02	0.17	5,920	55.8	1.1	1,725	30	1.00
Coarse Concrete Aggregate	169,200	short tons	20,000	12.89	0.58	9	1.02	0.17	5,920	55.8	1.1	1,725	30	1.00
Cement 504#/CY (4)	39,467	short tons	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fly Ash 215 lb/CY	16,836	short tons	20,000	12.89	0.58	1	1.02	0.17	5,920	55.8	1.1	1,725	30	1.00
Armor Stone Bedding	235,000	short tons	16,000	12.89	0.58	15	1.02	0.17	14,914	55.8	1.1	500	30	1.00

Data Source: USEPA Ports Emissions Inventory Guidance: Methodologies for Estimating Port-Related and Goods Movement Mobile Source Emissions (EPA-420-B-22-011, April 2022). Accessed online: <https://nepis.epa.gov/Exe/ZyPDF.cgi?Dockey=P1014J1S.pdf> accessed on December 15, 2024.
(1) Assume liquid admixtures for concrete and other concrete materials are shipped by ocean going vessels (Bulk Carriers) moving under their own power using vessel with same characteristics of Delta Marine Co. 20,000 DWT Buk Carrier. 1 main engine at 5920 kW, three diesel generators at 575 kW each, and one backup generator at 150 kW. Assume backup generators are not used within 3 nm of the port or at the port. Assume all three liquid admixtures are transported in one 20,000 DWT vessel for one trip; total of approximately 830 tons. Assume all concrete material components are shipped separately.
(2) Round trip distance was calculated based on 3 nautical miles (nm) from the breakwater structure plus extra 3 miles (2.6 nm) to go around breakwater structure and travel through Apra Harbor to 0.25 nm from the port.
(3) Number of vessel round trips based on total quantity of material divided by the vessel capacities.
(4) Hours per round trip from 3 nm to 0.25 nm from port calculated assuming vessel cruising speed of 11 kn and distance from item (2).
(5) Hours per round trip from 0.25 nm from port to the port calculated assuming speed of 3 kn and distance of 0.25 nm.
(6) Assume tug for ocean going barge carrying armor stone bedding has total of 20,000 hp engines and one 500 kW diesel generator for electrical needs. Assume tug main engine is a C3 category engine with the same emission factors as main engine for 20,000 DWT bulk carrier.
(7) Cruising load factor of main engine (operating at 11 kn) calculated assuming max speed of vessel is 14 kn, the sea margin factor is 1.15 for at-sea operations, and Equation 3.13 within USEPA Ports Emissions Inventory Guidance document (EPA-420-B-22-011, April 2022) for main engine operating power: Operating Power = Total Installed Power x (Avg. Speed/Max Speed)2 x Sea Margin.
(8) Porting load factor of main engine (operating at 3 kn) calculated assuming max speed of vessel is 14 kn, the sea margin factor is 1.15 for at-sea operations, and Equation 3.13 within the same USEPA Ports Emissions Inventory Guidance document (EPA-m420-B-22-011, April 2022).
(9) Assume all vessel auxiliary engines are C2 category engines and utilize emission factors from Appendix H of the 2022 EPA Port Emission Inventory guidance document for C2, Tier 2 engines using 500 ppm sulfur fuel with cylinder displacement between 5 and 30 liters.
(10) Cruising Load Factor % for Auxiliary Engines assumed to be 30 %.
(11) Low load adjustment factors applied to emissions calculations for main engines to account for higher rate of emissions at low power levels. Factors obtained from Table 3-10 and Appendix F (for SO2) in the USEPA Ports Emissions Inventory Guidance document.
(12) Emission factors for vessel main engines and auxiliary engines obtained from Section 3 within the USEPA Ports Emissions Inventory Guidance document.

RONA: SO_2 Emissions Summary

Equipment	SO_2 Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					SO_2 Idling Emission Factor (g/hr for on-road only)					SO_2 Emissions (lb/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.002185	0.002144	0.00211	0.00208	0.002056	0.017	0.016213	0.015749	0.015275	0.014785	0.058	0.057	0.056	0.055	0.054
Passenger car	0.001726	0.001703	0.001675	0.001652	0.001633	0.013	0.013104	0.01267	0.012256	0.011853	0.046	0.045	0.044	0.044	0.043
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.002185	0.002144	0.00211	0.00208	0.002056	0.017	0.016213	0.015749	0.015275	0.014785	0.116	0.170	0.167	0.165	0.082
Passenger Trucks (18), Multiple Staff (18)	0.002185	0.002144	0.00211	0.00208	0.002056	0.017	0.016213	0.015749	0.015275	0.014785	1.040	1.532	1.507	1.486	0.734
Coral Translocation															
Excavator	0.00487	0.00487	0.00487	0.00487	0.00487						1.140	0	0	0	0
Flat Bed Truck	0.002339	0.002274	0.002241	0.002186	0.00217	0.001	0.000839	0.000819	0.000768	0.000761	0.083	0	0	0	0
Tugboat (Primary Engine)	0.006246	0.006246	0.006246	0.006246	0.006246						5.914	0	0	0	0
Tugboat (Bow Thrusters)	0.006246	0.006246	0.006246	0.006246	0.006246						5.914	0	0	0	0
Tugboat (Generator)	0.006246	0.006246	0.006246	0.006246	0.006246						0.424	0	0	0	0
Twin Engine Large Dive Boat (2 engines, total hp)	0.006246	0.006246	0.006246	0.006246	0.006246						0.869	0	0	0	0
Twin Engine Small Dive Boat (2 engines, total hp)	0.006246	0.006246	0.006246	0.006246	0.006246						0.414	0	0	0	0
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.002185	0.002144	0.00211	0.00208	0.002056	0.017	0.016213	0.015749	0.015275	0.014785	0.193	0.284	0.279	0.275	0.136
6T All Terrain Forklift 1	0.005415	0.005415	0.005415	0.005415	0.005415						0.784	0.934	0.934	0.934	0.790
6T All Terrain Forklift 2	0.005415	0.005415	0.005415	0.005415	0.005415						0.467	0.934	0.934	0.934	0.701
Boom Truck	0.002339	0.002274	0.002241	0.002186	0.00217	0.001	0.000839	0.000819	0.000768	0.000761	0.064	0.125	0.123	0.120	0.090
Vacuum Truck/Sweeper	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.093	0.182	0.177	0.178	0.128
Cement Train Tractor 1	0.004873	0.004873	0.004873	0.004873	0.004873						0.704	1.408	1.408	1.408	1.056
Cement Train Tractor 2	0.004873	0.004873	0.004873	0.004873	0.004873						0.704	1.408	1.408	1.408	1.056
100T Gantry Crane 1	0.00487	0.00487	0.00487	0.00487	0.00487						2.161	4.321	4.321	4.321	3.241
100T Gantry Crane 2	0.00487	0.00487	0.00487	0.00487	0.00487						2.161	4.321	4.321	4.321	3.241
Truck Tractor 1	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.195	0.354	0.345	0.346	0.255
Truck Tractor 2	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.195	0.354	0.345	0.346	0.255
Skid Steer 1	0.005415	0.005415	0.005415	0.005415	0.005415						0.172	0.344	0.344	0.344	0.258
Skid Steer 2	0.005415	0.005415	0.005415	0.005415	0.005415						0.172	0.344	0.344	0.344	0.258
4000 Gal Water Truck	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.223	0.436	0.425	0.426	0.307
Cat 966 Loader 1	0.00487	0.00487	0.00487	0.00487	0.00487						1.897	3.795	3.795	3.795	2.846
Cat 966 Loader 2	0.00487	0.00487	0.00487	0.00487	0.00487						1.897	3.795	3.795	3.795	2.846
36 Meter Concrete Pump Truck	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.167	0.327	0.319	0.320	0.230
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller											0	0	0	0	0
100 KW Generators Backup Power (2)	0.00487	0.00487	0.00487	0.00487	0.00487						0.340	0.340	0.340	0.340	0.340
Ready Mix Concrete Truck 1	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.195	0.354	0.345	0.346	0.255
Ready Mix Concrete Truck 2	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.195	0.354	0.345	0.346	0.255
Ready Mix Concrete Truck 3	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.195	0.354	0.345	0.346	0.255
Ready Mix Concrete Truck 4 (reserve)	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.019	0.035	0.035	0.035	0.026
60' Manlift for Maintenance	0.00487	0.00487	0.00487	0.00487	0.00487						0.117	0.234	0.234	0.234	0.176
Dump Trucks (4)	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.918	1.770	1.726	1.732	1.436
Truck Tractor for Roll Off Trash Bins	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.102	0.172	0.168	0.169	0.128
Fuel Truck	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.121	0.209	0.204	0.204	0.153
CAT D8 Dozer	0.00487	0.00487	0.00487	0.00487	0.00487						0.228	0	0	0	0
CAT 950 Loader	0.00487	0.00487	0.00487	0.00487	0.00487						0.144	0	0	0	0.144
CAT 14H Grader	0.00487	0.00487	0.00487	0.00487	0.00487						0.384	0	0	0	0
25T Vibratory Compactor	0.00487	0.00487	0.00487	0.00487	0.00487						0.247	0	0	0	0
CAT 345 Excavator	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0	0	0.242
100T Crawler Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0.254	0	0	0	0.190

175T Crawler Crane	0.004873	0.004873	0.004873	0.004873	0.004873						0.776	0	0	0	0
185 CFM Compressor	0.005415	0.005415	0.005415	0.005415	0.005415						0.185	0	0	0	0
Miller Welder 400Amps	0.005415	0.005415	0.005415	0.005415	0.005415						0.114	0	0	0	0
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.004873	0.004873	0.004873	0.004873	0.004873						0.969	4.843	4.843	4.843	0.969
Manitowoc MLC 300 Crawler Crane Breakwater	0.004873	0.004873	0.004873	0.004873	0.004873						0.969	4.843	4.843	4.843	0.969
Manitowoc MLC 300 Crawler Crane Breakwater	0.004873	0.004873	0.004873	0.004873	0.004873						0.969	4.843	4.843	4.843	0.969
Manitowoc 999 Crawler Crane Breakwater	0.00487	0.00487	0.00487	0.00487	0.00487						0.858	4.292	4.292	4.292	0.858
Kobelco 275 Ton Crawler	0.004873	0.004873	0.004873	0.004873	0.004873						1.582	7.910	7.910	7.910	1.582
60T Hydraulic Crane Assembly Crane	0.004873	0.004873	0.004873	0.004873	0.004873						0.596	0.596	0.596	0.596	0.596
Cat 988 Loader 1	0.004873	0.004873	0.004873	0.004873	0.004873						1.736	6.945	6.945	6.945	1.736
Cat 988 Loader 2	0.004873	0.004873	0.004873	0.004873	0.004873						1.736	6.945	6.945	6.945	1.736
Cat 988 Loader 3	0.004873	0.004873	0.004873	0.004873	0.004873						1.736	6.945	6.945	6.945	1.736
100T Hydraulic Excavator 1	0.004873	0.004873	0.004873	0.004873	0.004873						1.598	6.391	6.391	6.391	1.598
100T Hydraulic Excavator 2	0.004873	0.004873	0.004873	0.004873	0.004873						1.598	6.391	6.391	6.391	1.598
CAT 745 Rock Truck 1	0.004873	0.004873	0.004873	0.004873	0.004873						1.376	5.506	5.506	5.506	1.376
CAT 745 Rock Truck 2	0.004873	0.004873	0.004873	0.004873	0.004873						0.688	2.753	2.753	2.753	0.688
8000 DWT Staging Platform											0	0	0	0	0
2000 DWT Transfer Shuttle Barge											0	0	0	0	0
Spud Barge											0	0	0	0	0
16000 DWT Barge for Armor Stone Transport											0	0	0	0	0
Inner Harbor Tug 1 Engine	0.006246	0.006246	0.006246	0.006246	0.006246						5.767	23.066	23.066	23.066	5.767
Inner Harbor Tug 1 Generator	0.006246	0.006246	0.006246	0.006246	0.006246						2.901	11.603	11.603	11.603	2.901
Inner Harbor Tug 2 Engine	0.006246	0.006246	0.006246	0.006246	0.006246						5.767	23.066	23.066	23.066	5.767
Inner Harbor Tug 2 Generator	0.006246	0.006246	0.006246	0.006246	0.006246						2.901	11.603	11.603	11.603	2.901
Ocean Going Tug for Armor Stone Transport Engine	0.006246	0.006246	0.006246	0.006246	0.006246						47.223	94.447	94.447	94.447	0
Ocean Going Tug for Armor Stone Transport Generator	0.006246	0.006246	0.006246	0.006246	0.006246						6.769	13.537	13.537	13.537	0
20' Aluminum Crew Boat	0.004299	0.0043	0.004301	0.004301	0.004302						0	0	0	0	0
10' Safety Boat 1	0.005322	0.005321	0.00532	0.005319	0.005319						0	0	0	0	0
10' Safety Boat 2	0.005322	0.005321	0.00532	0.005319	0.005319						0	0	0	0	0
Fuel Truck	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.046	0.182	0.177	0.178	0.043
Mechanic Truck 1	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.213	0.390	0.380	0.382	0.196
Mechanic Truck 2	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.213	0.390	0.380	0.382	0.196
Welding Truck	0.00487	0.00487	0.00487	0.00487	0.00487						0.176	0.706	0.706	0.706	0.176
Compressor	0.005415	0.005415	0.005415	0.005415	0.005415						0.100	0.400	0.400	0.400	0.100
Boom Truck	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.056	0.218	0.212	0.213	0.051
Water Truck	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.111	0.436	0.425	0.426	0.102
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.083	0.245	0.239	0.240	0.076
Truck Tractor for Mob/Demob/Various	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0.056	0.218	0.212	0.213	0.051
6T All Terrain Forklift	0.005415	0.005415	0.005415	0.005415	0.005415						0.374	1.494	1.494	1.494	0.374
D8 Dozer	0.00487	0.00487	0.00487	0.00487	0.00487						0.871	0	0	0	0
CAT 330 Excavator	0.00487	0.00487	0.00487	0.00487	0.00487						0.713	0	0	0	0
CAT 14H Grader	0.00487	0.00487	0.00487	0.00487	0.00487						0.871	0	0	0	0
230T Crawler Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.117	0.117	0
Kincho Vibro Hammer/Gen	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.022	0.022	0
HPSI 260Hammer w/400HP Powerpack	0.004873	0.004873	0.004873	0.004873	0.004873						0	0	0.020	0.020	0
Delmag 30-32 Hammer	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.038	0.038	0
65T Rough Terrain Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.004	0.004	0
Ocean Going Vessels (Product List)	**SO_2 Emissions Factor, Main Engine (g/kw-hr)**					**SO_2 Emissions Factor, Auxiliary Engine (g/kw-hr)**									
ADVA 140 m 58oz/CY (Concrete Additive) DARREX1 1AEA 63oz/CY (Concrete Additive) WRDA-HA 43 oz/CY (Concrete Additive)	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	1.8	0	0	0	0
Concrete Sand C-33	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	10.7	0	0	0	0
Coarse Concrete Aggregate	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	16.0	0	0	0	0
Cement 504#/CY (4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	0
Fly Ash 215 lb/CY	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	1.8	0	0	0	0

Armor Stone Bedding	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	57.6	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.002185	0.002144	0.00211	0.00208	0.002056	0.017	0.016213	0.015749	0.015275	0.014785	0	0	0.017	0.017	0
Passenger car	0.001726	0.001703	0.001675	0.001652	0.001633	0.013	0.013104	0.01267	0.012256	0.011853	0	0	0.013	0.013	0
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.002185	0.002144	0.00211	0.00208	0.002056	0.017	0.016213	0.015749	0.015275	0.014785	0	0	0.140	0.138	0
185 CFM Compressor	0.005415	0.005415	0.005415	0.005415	0.005415						0	0	0.358	0.358	0
Miller Welder	0.005415	0.005415	0.005415	0.005415	0.005415						0	0	0.075	0.075	0
90T Rough Terrain Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.052	0.052	0
175T Crawler Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.449	0.449	0
6T Forklift	0.005415	0.005415	0.005415	0.005415	0.005415						0	0	0.259	0.259	0
20' Aluminum Crew Boat	0.006246	0.006246	0.006246	0.006246	0.006246						0	0	0.187	0.187	0
10' Safety Boat	0.006246	0.006246	0.006246	0.006246	0.006246						0	0	0.006	0.006	0
230T Crawler Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.483	0.483	0
Kincho Vibro Hammer/Gen	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.090	0.090	0
HPSI 260Hammer w/400HP Powerpack	0.004873	0.004873	0.004873	0.004873	0.004873						0	0	0.087	0.087	0
Delmag 30-32 Hammer	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.155	0.155	0
65T Rough Terrain Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.016	0.016	0
Truck Tractor	0.004045	0.00396	0.003859	0.003875	0.003715	0.013	0.012855	0.012543	0.012534	0.011991	0	0	0.003	0.003	0
Spud Barge											0	0	0	0	0
Inner Harbor Tug Engine	0.006246	0.006246	0.006246	0.006246	0.006246						0	0	1.109	1.109	0
Inner Harbor Tug Generator	0.006246	0.006246	0.006246	0.006246	0.006246						0	0	0.223	0.223	0
Concrete Pump	0.004873	0.004873	0.004873	0.004873	0.004873						0	0	0.028	0.028	0
100T Crawler Crane	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.125	0.125	0
CAT 345 Excavator	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.542	0.542	0
CAT 330 Excavator	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.133	0.133	0
CAT 966 Loader	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.187	0.187	0
CAT 950 Loader	0.00487	0.00487	0.00487	0.00487	0.00487						0	0	0.083	0.083	0
										Total (lb/yr)	212.323	280.496	285.304	285.295	57.319
										Total (ton/yr)	0.106	0.140	0.143	0.143	0.029

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.

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Naval Base Guam - Apra Harbor Breakwater Repair Criteria Pollutant and Greenhouse Gas Emissions Summary from On-Road Vehicles, Off-Road Equipment, Marine Vessels, and Fugitive Dust

Emission Source	Pollutant (tons/year)									
	NO_x	CO	SO_2	PM_{10} Total	$PM_{2.5}$ Total	VOC	CO_2	CH_4	N_2O	CO_2e
2025										
Glass Breakwater Repairs										
Government Fleet Vehicles	0.005	0.112	0.000	0.002	0.000	0.002	10.199	0.001	0.000	10.234
Contractor Breakwater Fleet Vehicles	0.065	1.098	0.001	0.020	0.003	0.024	113.946	0.006	0.001	114.375
Coral Translocation (land-based equipment)	0.583	0.342	0.001	0.021	0.020	0.034	74.948	0.000	0.007	76.792
Coral Translocation (marine vessels)	6.114	0.996	0.007	0.160	0.156	0.320	736.269	0.007	0.036	745.999
Contractor Casting Yard Fleet Vehicles and Equipment	8.487	5.179	0.008	0.448	0.373	0.575	1,189.673	0.015	0.103	1,217.257
Construction (land-based equipment)	9.685	5.572	0.010	0.364	0.343	0.548	1,187.112	0.007	0.108	1,215.843
Construction (harbor craft marine vessels)	32.216	5.063	0.036	0.845	0.820	1.688	3,879.643	0.000	0.190	3,929.921
Ocean-Going Vessels (bulk shipments from off-island)	2.285	0.259	0.044	0.047	0.043	0.116	144.716	0.002	0.006	146.489
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	0.262	0.039	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	0.345	0.052	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs										
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	0.341	0.085	N/A	N/A	N/A	N/A	N/A
2025 Total	**59.440**	**18.620**	**0.106**	**2.856**	**1.935**	**3.307**	**7,336.505**	**0.037**	**0.450**	**7,456.909**
2026										
Glass Breakwater Repairs										
Government Fleet Vehicles	0.004	0.104	0.000	0.002	0.000	0.001	10.031	0.000	0.000	10.062
Contractor Breakwater Fleet Vehicles	0.072	1.498	0.001	0.030	0.005	0.023	167.733	0.007	0.001	168.289
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment	13.908	8.276	0.014	0.752	0.605	0.937	2,010.522	0.024	0.175	2,057.585
Construction (land-based equipment)	34.909	20.152	0.037	1.279	1.219	1.920	4,251.921	0.022	0.388	4,355.380
Construction (harbor craft marine vessels)	80.092	12.310	0.089	2.102	2.039	4.196	9,645.064	0.088	0.472	9,772.531
Ocean-Going Vessels (bulk shipments from off-island)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	0.823	0.123	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	0.952	0.143	N/A	N/A	N/A	N/A	N/A

Sumay Cove Repairs										
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	0.702	0.176	N/A	N/A	N/A	N/A	N/A
2026 Total	**128.985**	**42.340**	**0.140**	**6.642**	**4.310**	**7.078**	**16,085.271**	**0.141**	**1.036**	**16,363.847**
2027										
Glass Breakwater Repairs										
Government Fleet Vehicles	0.004	0.100	0.000	0.002	0.000	0.001	9.871	0.000	0.000	9.900
Contractor Breakwater Fleet Vehicles	0.062	1.402	0.001	0.030	0.005	0.019	165.082	0.006	0.001	165.590
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment	13.603	8.165	0.014	0.727	0.584	0.906	1,993.135	0.023	0.177	2,040.655
Construction (land-based equipment)	34.877	20.166	0.037	1.272	1.214	1.913	4,255.825	0.020	0.390	4,359.706
Construction (harbor craft marine vessels)	80.092	12.310	0.089	2.102	2.039	4.196	9,645.064	0.088	0.472	9,772.531
Ocean-Going Vessels (bulk shipments from off-island)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	0.817	0.122	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	0.952	0.143	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs										
Government Fleet Vehicles	0.001	0.030	0.000	0.001	0.000	0.000	2.961	0.000	0.000	2.970
Contractor Sumay Cove Vehicles/Equipment	1.512	1.007	0.002	0.059	0.057	0.081	188.152	0.002	0.016	192.478
Contractor Sumay Cove Marine Vessels	0.216	0.112	0.001	0.018	0.018	0.036	82.944	0.001	0.004	84.040
Resuspended Road Dust	N/A	N/A	N/A	0.710	0.177	N/A	N/A	N/A	N/A	N/A
2027 Total	**130.367**	**43.293**	**0.143**	**6.687**	**4.359**	**7.152**	**16,343.034**	**0.140**	**1.060**	**16,627.87**
2028										
Glass Breakwater Repairs										
Government Fleet Vehicles	0.003	0.095	0.000	0.002	0.000	0.001	9.729	0.000	0.000	9.756
Contractor Breakwater Fleet Vehicles	0.053	1.310	0.001	0.030	0.005	0.016	162.684	0.005	0.001	163.148
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment	13.460	8.074	0.014	0.658	0.518	0.891	1,995.222	0.022	0.178	2,043.100
Construction (land-based equipment)	34.821	20.139	0.037	1.243	1.186	1.907	4,257.087	0.018	0.391	4,361.080
Construction (harbor craft marine vessels)	80.092	12.310	0.089	2.102	2.039	4.196	9,645.064	0.088	0.472	9,772.531
Ocean-Going Vessels (bulk shipments from off-island)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	0.574	0.086	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	0.678	0.102	N/A	N/A	N/A	N/A	N/A

Sumay Cove Repairs										
Government Fleet Vehicles	0.001	0.028	0.000	0.001	0.000	0.000	2.919	0.000	0.000	2.927
Contractor Sumay Cove Vehicles/Equipment	1.511	1.000	0.002	0.059	0.057	0.081	187.958	0.001	0.016	192.278
Contractor Sumay Cove Marine Vessels	0.216	0.112	0.001	0.018	0.018	0.036	82.944	0.001	0.004	84.040
Resuspended Road Dust	N/A	N/A	N/A	0.710	0.177	N/A	N/A	N/A	N/A	N/A
2028 Total	**130.157**	**43.068**	**0.143**	**6.073**	**4.187**	**7.129**	**16,343.606**	**0.136**	**1.062**	**16,628.861**
2029										
Glass Breakwater Repairs										
Government Fleet Vehicles	0.002	0.089	0.000	0.002	0.000	0.001	9.620	0.000	0.000	9.645
Contractor Breakwater Fleet Vehicles	0.020	0.612	0.000	0.015	0.002	0.007	80.434	0.002	0.001	80.644
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment	10.196	6.219	0.011	0.501	0.396	0.676	1,544.928	0.016	0.142	1,583.065
Construction (land-based equipment)	8.335	4.861	0.009	0.307	0.288	0.467	1,043.277	0.005	0.096	1,068.922
Construction (harbor craft marine vessels)	7.830	1.092	0.009	0.205	0.199	0.410	942.889	0.009	0.046	955.350
Ocean-Going Vessels (bulk shipments from off-island)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs										
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	0.450	0.113	N/A	N/A	N/A	N/A	N/A
2029 Total	**26.383**	**12.870**	**0.030**	**1.480**	**1.000**	**1.560**	**3,621.150**	**0.030**	**0.290**	**3,697.630**
2030										
Glass Breakwater Repairs										
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Breakwater Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Construction (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Construction (harbor craft marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ocean-Going Vessels (bulk shipments from off-island)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A

Sumay Cove Repairs										
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A
2030 Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

N/A = Not Applicable

Naval Base Guam - Apra Harbor Breakwater Repair Hazardous Air Pollutant Emissions Summary from On-Road Vehicles, Off-Road Equipment, Marine Vessels, and Fugitive Dust

Emission Source	Pollutant (tons/year)											
	Formaldehyde	Naphthalene	Acetaldehyde	2,2,4-Trimethylpentane	Benzene	Hexane	Toluene	Acrolein	Propionaldehyde	Xylenes	Phenanthrene	1,3-Butadiene
2025												
Glass Breakwater Repairs												
Government Fleet Vehicles	0.0000279	0.0000042	0.0000212	0.0001447	0.0000870	0.0001521	0.0006397	0.0000013	0.0000016	0.0003261	0.0000004	0.0000077
Contractor Breakwater Fleet Vehicles	0.0003265	0.0000490	0.0002516	0.0014772	0.0009913	0.0015258	0.0065592	0.0000158	0.0000187	0.0034658	0.0000051	0.0000925
Coral Translocation (land-based equipment)	0.0006442	0.0000491	0.0002953	0.0000195	0.0000804	0.0000108	0.0000692	0.0000504	0.0000424	0.0001081	0.0000046	0.0000155
Coral Translocation (marine vessels)	0.0136767	0.0100275	0.0031338	0.0022807	0.0015180	0.0008937	0.0006519	0.0005920	0.0004859	0.0004555	0.0004344	0.0003245
Contractor Casting Yard Fleet Vehicles and Equipment	0.0409288	0.0023189	0.0166020	0.0014108	0.0054655	0.0007954	0.0050106	0.0032822	0.0031902	0.0040627	0.0002669	0.0165141
Construction (land-based equipment)	0.0199466	0.0008211	0.0079398	0.0005751	0.0030552	0.0001590	0.0023314	0.0014420	0.0015015	0.0019226	0.0001115	0.0061014
Construction (harbor craft marine vessels)	0.0720668	0.0528382	0.0165128	0.0120179	0.0079990	0.0047093	0.0034349	0.0031192	0.0025606	0.0024002	0.0022888	0.0017098
Ocean-Going Vessels (bulk shipments from off-island)	0.0049727	0.0036459	0.0011394	0.0008292	0.0005519	0.0003249	0.0002370	0.0002152	0.0001767	0.0001656	0.0001579	0.0001180
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs												
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	0.341	0.085	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2025 Total	**0.153**	**0.070**	**0.046**	**0.019**	**0.020**	**0.009**	**0.019**	**0.009**	**0.008**	**0.013**	**0.003**	**0.025**
2026												
Glass Breakwater Repairs												
Government Fleet Vehicles	0.0000198	0.0000029	0.0000139	0.0001322	0.0000663	0.0001378	0.0005821	0.0000010	0.0000010	0.0002838	0.0000003	0.0000045
Contractor Breakwater Fleet Vehicles	0.0003250	0.0000477	0.0002273	0.0019610	0.0010630	0.0020178	0.0086563	0.0000158	0.0000173	0.0043145	0.0000049	0.0000732
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Contractor Casting Yard Fleet Vehicles and Equipment	0.0642346	0.0038378	0.0263359	0.0021594	0.0083333	0.0012366	0.0075188	0.0051826	0.0049542	0.0064914	0.0004270	0.0163432
Construction (land-based equipment)	0.0640202	0.0021949	0.0251614	0.0018701	0.0092044	0.0003779	0.0078401	0.0040312	0.0044186	0.0063387	0.0003378	0.0063354
Construction (harbor craft marine vessels)	0.1791631	0.1313594	0.0410519	0.0298773	0.0198860	0.0117075	0.0085394	0.0077547	0.0063657	0.0059671	0.0056901	0.0042508
Ocean-Going Vessels (bulk shipments from off-island)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs												
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2026 Total	**0.308**	**0.137**	**0.093**	**0.036**	**0.039**	**0.015**	**0.033**	**0.017**	**0.016**	**0.023**	**0.006**	**0.027**
2027												
Glass Breakwater Repairs												
Government Fleet Vehicles	0.0000171	0.0000025	0.0000114	0.0001279	0.0000592	0.0001313	0.0005622	0.0000008	0.0000009	0.0002705	0.0000003	0.0000034
Contractor Breakwater Fleet Vehicles	0.0002663	0.0000385	0.0001749	0.0018516	0.0009076	0.0018819	0.0081560	0.0000130	0.0000135	0.0039828	0.0000040	0.0000508
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Contractor Casting Yard Fleet Vehicles and Equipment	0.0575179	0.0034883	0.0237256	0.0019566	0.0074295	0.0011312	0.0068406	0.0046304	0.0044128	0.0060934	0.0003835	0.0153131
Construction (land-based equipment)	0.0566376	0.0019779	0.0224728	0.0016721	0.0089758	0.0003643	0.0070159	0.0040202	0.0043335	0.0060734	0.0002996	0.0059204
Construction (harbor craft marine vessels)	0.1791631	0.1313594	0.0410519	0.0298773	0.0198860	0.0117075	0.0085394	0.0077547	0.0063657	0.0059671	0.0056901	0.0042508
Ocean-Going Vessels (bulk shipments from off-island)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs												
Government Fleet Vehicles	0.0000051	0.0000007	0.0000034	0.0000384	0.0000178	0.0000394	0.0001687	0.0000002	0.0000003	0.0000811	0.0000001	0.0000010
Contractor Sumay Cove Vehicles/Equipment	0.0035416	0.0000606	0.0013073	0.0002594	0.0006474	0.0001688	0.0011195	0.0002507	0.0003193	0.0006193	0.0000166	0.0000284

Contractor Sumay Cove Marine Vessels	0.0015407	0.0011296	0.0003530	0.0002569	0.0001710	0.0001007	0.0000734	0.0000667	0.0000547	0.0000513	0.0000489	0.0000366
Resuspended Road Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2027 Total	**0.299**	**0.138**	**0.089**	**0.036**	**0.038**	**0.016**	**0.032**	**0.017**	**0.016**	**0.023**	**0.006**	**0.026**
2028												
Glass Breakwater Repairs												
Government Fleet Vehicles	0.0000148	0.0000021	0.0000094	0.0001213	0.0000525	0.0001176	0.0005329	0.0000007	0.0000007	0.0002580	0.0000002	0.0000026
Contractor Breakwater Fleet Vehicles	0.0002314	0.0000331	0.0001443	0.0017520	0.0008071	0.0017001	0.0077133	0.0000113	0.0000113	0.0037757	0.0000034	0.0000378
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Contractor Casting Yard Fleet Vehicles and Equipment	0.0522330	0.0032958	0.0217544	0.0017875	0.0067108	0.0010477	0.0062610	0.0042028	0.0039190	0.0057631	0.0003527	0.0146110
Construction (land-based equipment)	0.0508321	0.0018434	0.0203950	0.0015149	0.0080026	0.0003443	0.0063382	0.0036202	0.0038599	0.0058629	0.0002715	0.0056364
Construction (harbor craft marine vessels)	0.1791631	0.1313594	0.0410519	0.0298773	0.0198860	0.0117075	0.0085394	0.0077547	0.0063657	0.0059671	0.0056901	0.0042508
Ocean-Going Vessels (bulk shipments from off-island)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs												
Government Fleet Vehicles	0.0000044	0.0000006	0.0000028	0.0000364	0.0000157	0.0000353	0.0001599	0.0000002	0.0000002	0.0000774	0.0000001	0.0000008
Contractor Sumay Cove Vehicles/Equipment	0.0031437	0.0000543	0.0011651	0.0002396	0.0005786	0.0001519	0.0010382	0.0002212	0.0002790	0.0005816	0.0000147	0.0000245
Contractor Sumay Cove Marine Vessels	0.0015407	0.0011296	0.0003530	0.0002569	0.0001710	0.0001007	0.0000734	0.0000667	0.0000547	0.0000513	0.0000489	0.0000366
Resuspended Road Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2028 Total	**0.287**	**0.138**	**0.085**	**0.036**	**0.036**	**0.015**	**0.031**	**0.016**	**0.014**	**0.022**	**0.006**	**0.025**
2029												
Glass Breakwater Repairs												
Government Fleet Vehicles	0.0000129	0.0000018	0.0000077	0.0001166	0.0000472	0.0001115	0.0005115	0.0000006	0.0000006	0.0002455	0.0000002	0.0000018
Contractor Breakwater Fleet Vehicles	0.0001004	0.0000142	0.0000585	0.0008301	0.0003611	0.0007994	0.0036519	0.0000049	0.0000047	0.0017696	0.0000015	0.0000131
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Contractor Casting Yard Fleet Vehicles and Equipment	0.0356199	0.0023272	0.0150129	0.0011654	0.0045110	0.0006706	0.0040345	0.0028638	0.0026138	0.0040859	0.0002428	0.0132767
Construction (land-based equipment)	0.0121908	0.0005535	0.0050325	0.0003636	0.0018244	0.0001108	0.0014646	0.0008880	0.0008964	0.0015195	0.0000699	0.0048190
Construction (harbor craft marine vessels)	0.0175147	0.0128415	0.0040132	0.0029208	0.0019440	0.0011445	0.0008348	0.0007581	0.0006223	0.0005833	0.0005563	0.0004156
Ocean-Going Vessels (bulk shipments from off-island)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs												
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	0.450	0.113	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2029 Total	**0.065**	**0.016**	**0.024**	**0.005**	**0.009**	**0.003**	**0.010**	**0.005**	**0.004**	**0.008**	**0.001**	**0.019**
2030												
Glass Breakwater Repairs												
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Breakwater Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coral Translocation (marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Construction (land-based equipment)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Construction (harbor craft marine vessels)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Ocean-Going Vessels (bulk shipments from off-island)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Concrete Casting Yard - Fugitive Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Materials Handling - Fugitive Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sumay Cove Repairs												
Government Fleet Vehicles	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles/Equipment	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Marine Vessels	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resuspended Road Dust	N/A	N/A	N/A	0.000	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A

2030 Total	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

N/A = Not Applicable

Naval Base Guam - Apra Harbor Breakwater Repair – CO Emissions

Equipment	CO Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					CO Idling Emission Factor (g/hr for on-road only)					CO Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	4.151417	3.774139	3.534127	3.300293	3.083014	5.875	4.4823	5.744616	4.684124	3.57948	0.055	0.050	0.047	0.044	0.041
Passenger car	4.303594	4.124835	4.008605	3.867456	3.652742	3.393	2.187717	2.089986	1.977768	1.826339	0.057	0.055	0.053	0.051	0.048
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	4.151417	3.774139	3.534127	3.300293	3.083014	5.875	4.4823	5.744616	4.684124	3.57948	0.110	0.150	0.140	0.131	0.061
Passenger Trucks (18), Multiple Staff (18)	4.151417	3.774139	3.534127	3.300293	3.083014	5.875	4.4823	5.744616	4.684124	3.57948	0.988	1.348	1.262	1.179	0.551
Coral Translocation															
Excavator	2.61194	2.61194	2.61194	2.61194	2.61194						0.306	0.000	0.000	0.000	0.000
Flat Bed Truck	2.043731	1.907806	1.834235	1.44699	1.551195	1.220	1.101995	1.111226	0.893838	0.970245	0.036	0.000	0.000	0.000	0.000
Tugboat (Primary Engine)	0.918732	0.918732	0.918732	0.918732	0.918732						0.435	0.000	0.000	0.000	0.000
Tugboat (Bow Thrusters)	0.918732	0.918732	0.918732	0.918732	0.918732						0.435	0.000	0.000	0.000	0.000
Tugboat (Generator)	0.918732	0.918732	0.918732	0.918732	0.918732						0.031	0.000	0.000	0.000	0.000
Twin Engine Large Dive Boat (2 engines, total hp)	0.918732	0.918732	0.918732	0.918732	0.918732						0.064	0.000	0.000	0.000	0.000
Twin Engine Small Dive Boat (2 engines, total hp)	0.918732	0.918732	0.918732	0.918732	0.918732						0.030	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	4.151417	3.774139	3.534127	3.300293	3.083014	5.875	4.4823	5.744616	4.684124	3.57948	0.183	0.250	0.234	0.218	0.102
6T All Terrain Forklift 1	3.731343	3.731343	3.731343	3.731343	3.731343						0.270	0.322	0.322	0.322	0.272
6T All Terrain Forklift 2	3.731343	3.731343	3.731343	3.731343	3.731343						0.161	0.322	0.322	0.322	0.241
Boom Truck	2.043731	1.907806	1.834235	1.44699	1.551195	1.220	1.101995	1.111226	0.893838	0.970245	0.028	0.052	0.050	0.040	0.032
Vacuum Truck/Sweeper	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.033	0.064	0.061	0.059	0.041
Cement Train Tractor 1	2.61194	2.61194	2.61194	2.61194	2.61194						0.189	0.377	0.377	0.377	0.283
Cement Train Tractor 2	2.61194	2.61194	2.61194	2.61194	2.61194						0.189	0.377	0.377	0.377	0.283
100T Gantry Crane 1	2.61194	2.61194	2.61194	2.61194	2.61194						0.579	1.159	1.159	1.159	0.869
100T Gantry Crane 2	2.61194	2.61194	2.61194	2.61194	2.61194						0.579	1.159	1.159	1.159	0.869
Truck Tractor 1	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.078	0.134	0.127	0.122	0.090
Truck Tractor 2	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.078	0.134	0.127	0.122	0.090
Skid Steer 1	3.731343	3.731343	3.731343	3.731343	3.731343						0.059	0.119	0.119	0.119	0.089
Skid Steer 2	3.731343	3.731343	3.731343	3.731343	3.731343						0.059	0.119	0.119	0.119	0.089
4000 Gal Water Truck	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.080	0.155	0.147	0.142	0.099
Cat 966 Loader 1	2.61194	2.61194	2.61194	2.61194	2.61194						0.509	1.018	1.018	1.018	0.763
Cat 966 Loader 2	2.61194	2.61194	2.61194	2.61194	2.61194						0.509	1.018	1.018	1.018	0.763
36 Meter Concrete Pump Truck	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.060	0.116	0.110	0.106	0.075
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller											0	0	0	0	0
100 KW Generators Backup Power (2)	2.61194	2.61194	2.61194	2.61194	2.61194						0.091	0.091	0.091	0.091	0.091
Ready Mix Concrete Truck 1	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.078	0.134	0.127	0.122	0.090
Ready Mix Concrete Truck 2	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.078	0.134	0.127	0.122	0.090
Ready Mix Concrete Truck 3	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.078	0.134	0.127	0.122	0.090
Ready Mix Concrete Truck 4 (reserve)	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.008	0.013	0.013	0.012	0.009
60' Manlift for Maintenance	3.731343	3.731343	3.731343	3.731343	3.731343						0.045	0.090	0.090	0.090	0.067
Dump Trucks (4)	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.338	0.637	0.603	0.582	0.472
Truck Tractor for Roll Off Trash Bins	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.045	0.069	0.066	0.063	0.048
Fuel Truck	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.052	0.082	0.078	0.074	0.057
CAT D8 Dozer	2.61194	2.61194	2.61194	2.61194	2.61194						0.061	0.000	0.000	0.000	0.000
CAT 950 Loader	2.61194	2.61194	2.61194	2.61194	2.61194						0.039	0.000	0.000	0.000	0.039
CAT 14H Grader	3.731343	3.731343	3.731343	3.731343	3.731343						0.147	0.000	0.000	0.000	0.000
25T Vibratory Compactor	3.731343	3.731343	3.731343	3.731343	3.731343						0.095	0.000	0.000	0.000	0.000
CAT 345 Excavator	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.000	0.000	0.065
100T Crawler Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.068	0.000	0.000	0.000	0.051

175T Crawler Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.208	0.000	0.000	0.000	0.000
185 CFM Compressor	3.731343	3.731343	3.731343	3.731343	3.731343						0.064	0.000	0.000	0.000	0.000
Miller Welder 400Amps	3.731343	3.731343	3.731343	3.731343	3.731343						0.039	0.000	0.000	0.000	0.000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	2.61194	2.61194	2.61194	2.61194	2.61194						0.260	1.298	1.298	1.298	0.260
Manitowoc MLC 300 Crawler Crane Breakwater	2.61194	2.61194	2.61194	2.61194	2.61194						0.260	1.298	1.298	1.298	0.260
Manitowoc MLC 300 Crawler Crane Breakwater	2.61194	2.61194	2.61194	2.61194	2.61194						0.260	1.298	1.298	1.298	0.260
Manitowoc 999 Crawler Crane Breakwater	2.61194	2.61194	2.61194	2.61194	2.61194						0.230	1.151	1.151	1.151	0.230
Kobelco 275 Ton Crawler	2.61194	2.61194	2.61194	2.61194	2.61194						0.424	2.120	2.120	2.120	0.424
60T Hydraulic Crane Assembly Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.160	0.160	0.160	0.160	0.160
Cat 988 Loader 1	2.61194	2.61194	2.61194	2.61194	2.61194						0.465	1.861	1.861	1.861	0.465
Cat 988 Loader 2	2.61194	2.61194	2.61194	2.61194	2.61194						0.465	1.861	1.861	1.861	0.465
Cat 988 Loader 3	2.61194	2.61194	2.61194	2.61194	2.61194						0.465	1.861	1.861	1.861	0.465
100T Hydraulic Excavator 1	2.61194	2.61194	2.61194	2.61194	2.61194						0.428	1.713	1.713	1.713	0.428
100T Hydraulic Excavator 2	2.61194	2.61194	2.61194	2.61194	2.61194						0.428	1.713	1.713	1.713	0.428
CAT 745 Rock Truck 1	2.61194	2.61194	2.61194	2.61194	2.61194						0.369	1.476	1.476	1.476	0.369
CAT 745 Rock Truck 2	2.61194	2.61194	2.61194	2.61194	2.61194						0.184	0.738	0.738	0.738	0.184
8000 DWT Staging Platform											0	0	0	0	0
2000 DWT Transfer Shuttle Barge											0	0	0	0	0
Spud Barge											0	0	0	0	0
16000 DWT Barge for Armor Stone Transport											0	0	0	0	0
Inner Harbor Tug 1 Engine	0.918732	0.918732	0.918732	0.918732	0.918732						0.424	1.696	1.696	1.696	0.424
Inner Harbor Tug 1 Generator	0.918732	0.918732	0.918732	0.918732	0.918732						0.030	0.122	0.122	0.122	0.030
Inner Harbor Tug 2 Engine	0.918732	0.918732	0.918732	0.918732	0.918732						0.424	1.696	1.696	1.696	0.424
Inner Harbor Tug 2 Generator	0.918732	0.918732	0.918732	0.918732	0.918732						0.213	0.853	0.853	0.853	0.213
Ocean Going Tug for Armor Stone Transport Engine	0.918732	0.918732	0.918732	0.918732	0.918732						3.473	6.946	6.946	6.946	0.000
Ocean Going Tug for Armor Stone Transport Generator	0.918732	0.918732	0.918732	0.918732	0.918732						0.498	0.996	0.996	0.996	0.000
20' Aluminum Crew Boat	118.0363	118.0128	118.0031	117.9989	118.0072						0	0	0	0	0
10' Safety Boat 1	120.9909	120.7644	120.5936	120.4783	120.439						0	0	0	0	0
10' Safety Boat 2	120.9909	120.7644	120.5936	120.4783	120.439						0	0	0	0	0
Fuel Truck	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.017	0.064	0.061	0.059	0.014
Mechanic Truck 1	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.085	0.147	0.139	0.134	0.070
Mechanic Truck 2	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.085	0.147	0.139	0.134	0.070
Welding Truck	2.61194	2.61194	2.61194	2.61194	2.61194						0.047	0.189	0.189	0.189	0.047
Compressor	3.731343	3.731343	3.731343	3.731343	3.731343						0.034	0.138	0.138	0.138	0.034
Boom Truck	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.020	0.077	0.073	0.071	0.017
Water Truck	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.040	0.155	0.147	0.142	0.033
Truck Tractor for Roll Off Trash Bins Stage at Hotel	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.038	0.095	0.090	0.086	0.032
Truck Tractor for Mob/Demob/Various	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.020	0.077	0.073	0.071	0.017
6T All Terrain Forklift	3.731343	3.731343	3.731343	3.731343	3.731343						0.129	0.515	0.515	0.515	0.129
D8 Dozer	2.61194	2.61194	2.61194	2.61194	2.61194						0.234	0.000	0.000	0.000	0.000
CAT 330 Excavator	2.61194	2.61194	2.61194	2.61194	2.61194						0.191	0.000	0.000	0.000	0.000
CAT 14H Grader	2.61194	2.61194	2.61194	2.61194	2.61194						0.234	0.000	0.000	0.000	0.000
230T Crawler Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.031	0.031	0.000
Kincho Vibro Hammer/Gen	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.006	0.006	0.000
HPSI 260Hammer w/400HP Powerpack	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.005	0.005	0.000
Delmag 30-32 Hammer	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.010	0.010	0.000
65T Rough Terrain Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.001	0.001	0.000
Ocean Going Vessels (Product List)	**CO Emissions Factor, Main Engine (g/kw-hr)**					**CO Emissions Factor, Auxiliary Engine (g/kw-hr)**									
ADVA 140 m 58oz/CY (Concrete Additive) DARREX1 1AEA 63oz/CY (Concrete Additive) WRDA-HA 43 oz/CY (Concrete Additive)	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.006	0	0	0	0
Concrete Sand C-33	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.033	0	0	0	0
Coarse Concrete Aggregate	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.050	0	0	0	0
Cement 504#/CY (4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.000	0	0	0	0
Fly Ash 215 lb/CY	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.006	0	0	0	0

Armor Stone Bedding	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.165	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	4.151417	3.774139	3.534127	3.300293	3.083014	5.875	4.4823	5.744616	4.684124	3.57948	0.000	0.000	0.014	0.013	0.000
Passenger car	4.303594	4.124835	4.008605	3.867456	3.652742	3.393	2.187717	2.089986	1.977768	1.826339	0.000	0.000	0.016	0.015	0.000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	4.151417	3.774139	3.534127	3.300293	3.083014	5.875	4.4823	5.744616	4.684124	3.57948	0.000	0.000	0.117	0.109	0.000
185 CFM Compressor	3.731343	3.731343	3.731343	3.731343	3.731343						0.000	0.000	0.123	0.123	0.000
Miller Welder	3.731343	3.731343	3.731343	3.731343	3.731343						0.000	0.000	0.026	0.026	0.000
90T Rough Terrain Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.014	0.014	0.000
175T Crawler Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.120	0.120	0.000
6T Forklift	3.731343	3.731343	3.731343	3.731343	3.731343						0.000	0.000	0.089	0.089	0.000
20' Aluminum Crew Boat	0.918732	0.918732	0.918732	0.918732	0.918732						0.000	0.000	0.014	0.014	0.000
10' Safety Boat	0.918732	0.918732	0.918732	0.918732	0.918732						0.000	0.000	0.000	0.000	0.000
230T Crawler Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.129	0.129	0.000
Kincho Vibro Hammer/Gen	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.024	0.024	0.000
HPSI 260Hammer w/400HP Powerpack	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.023	0.023	0.000
Delmag 30-32 Hammer	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.042	0.042	0.000
65T Rough Terrain Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.004	0.004	0.000
Truck Tractor	2.909132	2.812117	2.663485	2.575403	2.409108	17.213	16.66909	16.04245	14.56397	14.28308	0.000	0.000	0.001	0.001	0.000
Spud Barge															
Inner Harbor Tug Engine	0.918732	0.918732	0.918732	0.918732	0.918732						0.000	0.000	0.082	0.082	0.000
Inner Harbor Tug Generator	0.918732	0.918732	0.918732	0.918732	0.918732						0.000	0.000	0.016	0.016	0.000
Concrete Pump	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.007	0.007	0.000
100T Crawler Crane	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.033	0.033	0.000
CAT 345 Excavator	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.145	0.145	0.000
CAT 330 Excavator	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.036	0.036	0.000
CAT 966 Loader	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.050	0.050	0.000
CAT 950 Loader	2.61194	2.61194	2.61194	2.61194	2.61194						0.000	0.000	0.022	0.022	0.000
										Total (ton/yr)	**18.620**	**42.340**	**43.293**	**43.068**	**12.870**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) CO Low Load Adjustment Factor (Ocean Going Vessel Porting) = 9.68

Naval Base Guam - Apra Harbor Breakwater Repair – NO_X Emissions

Equipment	NO_X Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					NO_X Idling Emission Factor (g/hr for on-road only)					NO_X Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.246789	0.182546	0.155891	0.134566	0.134566	0.422	0.297304	0.199184	0.187426	0.162134	0.003	0.002	0.002	0.002	0.001
Passenger car	0.163779	0.129538	0.119244	0.097161	0.097161	0.330	0.222633	0.202083	0.162075	0.137319	0.002	0.002	0.002	0.001	0.001
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.246789	0.182546	0.155891	0.134566	0.098436	0.422	0.297304	0.199184	0.187426	0.162134	0.007	0.007	0.006	0.005	0.002
Passenger Trucks (18), Multiple Staff (18)	0.246789	0.182546	0.155891	0.134566	0.098436	0.422	0.297304	0.199184	0.187426	0.162134	0.059	0.065	0.056	0.048	0.018
Coral Translocation															
Excavator	4.679104	4.679104	4.679104	4.679104	4.679104						0.548	0.000	0.000	0.000	0.000
Flat Bed Truck	1.987082	1.793511	1.672605	1.371591	1.481755	1.703	1.521159	1.409135	1.106604	1.248552	0.035	0.000	0.000	0.000	0.000
Tugboat (Primary Engine)	5.642273	5.642273	5.642273	5.642273	5.642273						2.671	0.000	0.000	0.000	0.000
Tugboat (Bow Thrusters)	5.642273	5.642273	5.642273	5.642273	5.642273						2.671	0.000	0.000	0.000	0.000
Tugboat (Generator)	5.642273	5.642273	5.642273	5.642273	5.642273						0.191	0.000	0.000	0.000	0.000
Twin Engine Large Dive Boat (2 engines, total hp)	5.642273	5.642273	5.642273	5.642273	5.642273						0.393	0.000	0.000	0.000	0.000
Twin Engine Small Dive Boat (2 engines, total hp)	5.642273	5.642273	5.642273	5.642273	5.642273						0.187	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.246789	0.182546	0.155891	0.134566	0.098436	0.422	0.297304	0.199184	0.187426	0.162134	0.011	0.012	0.010	0.009	0.003
6T All Terrain Forklift 1	5.317164	5.317164	5.317164	5.317164	5.317164						0.385	0.459	0.459	0.459	0.388
6T All Terrain Forklift 2	5.317164	5.317164	5.317164	5.317164	5.317164						0.229	0.459	0.459	0.459	0.344
Boom Truck	1.987082	1.793511	1.672605	1.371591	1.481755	1.703	1.521159	1.409135	1.106604	1.248552	0.027	0.049	0.046	0.038	0.031
Vacuum Truck/Sweeper	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.061	0.116	0.105	0.101	0.061
Cement Train Tractor 1	4.537313	4.537313	4.537313	4.537313	4.537313						0.328	0.655	0.655	0.655	0.492
Cement Train Tractor 2	4.537313	4.537313	4.537313	4.537313	4.537313						0.328	0.655	0.655	0.655	0.492
100T Gantry Crane 1	4.679104	4.679104	4.679104	4.679104	4.679104						1.038	2.076	2.076	2.076	1.557
100T Gantry Crane 2	4.679104	4.679104	4.679104	4.679104	4.679104						1.038	2.076	2.076	2.076	1.557
Truck Tractor 1	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.136	0.235	0.213	0.203	0.130
Truck Tractor 2	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.136	0.235	0.213	0.203	0.130
Skid Steer 1	5.317164	5.317164	5.317164	5.317164	5.317164						0.084	0.169	0.169	0.169	0.127
Skid Steer 2	5.317164	5.317164	5.317164	5.317164	5.317164						0.084	0.169	0.169	0.169	0.127
4000 Gal Water Truck	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.145	0.279	0.253	0.242	0.146
Cat 966 Loader 1	4.679104	4.679104	4.679104	4.679104	4.679104						0.911	1.823	1.823	1.823	1.367
Cat 966 Loader 2	4.679104	4.679104	4.679104	4.679104	4.679104						0.911	1.823	1.823	1.823	1.367
36 Meter Concrete Pump Truck	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.109	0.209	0.189	0.181	0.110
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller											0	0	0	0	0
100 KW Generators Backup Power (2)	4.679104	4.679104	4.679104	4.679104	4.679104						0.163	0.163	0.163	0.163	0.163
Ready Mix Concrete Truck 1	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.136	0.235	0.213	0.203	0.130
Ready Mix Concrete Truck 2	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.136	0.235	0.213	0.203	0.130
Ready Mix Concrete Truck 3	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.136	0.235	0.213	0.203	0.130
Ready Mix Concrete Truck 4 (reserve)	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.014	0.024	0.021	0.020	0.013
60' Manlift for Maintenance	4.679104	4.679104	4.679104	4.679104	4.679104						0.056	0.113	0.113	0.113	0.084
Dump Trucks (4)	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.609	1.142	1.034	0.989	0.693
Truck Tractor for Roll Off Trash Bins	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.075	0.119	0.108	0.102	0.069
Fuel Truck	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.087	0.142	0.129	0.122	0.081
CAT D8 Dozer	4.679104	4.679104	4.679104	4.679104	4.679104						0.110	0.000	0.000	0.000	0.000
CAT 950 Loader	4.679104	4.679104	4.679104	4.679104	4.679104						0.069	0.000	0.000	0.000	0.069
CAT 14H Grader	4.679104	4.679104	4.679104	4.679104	4.679104						0.184	0.000	0.000	0.000	0.000
25T Vibratory Compactor	4.679104	4.679104	4.679104	4.679104	4.679104						0.119	0.000	0.000	0.000	0.000
CAT 345 Excavator	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.000	0.000	0.116
100T Crawler Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.122	0.000	0.000	0.000	0.091

175T Crawler Crane	4.537313	4.537313	4.537313	4.537313	4.537313						0.361	0.000	0.000	0.000	0.000
185 CFM Compressor	5.317164	5.317164	5.317164	5.317164	5.317164						0.091	0.000	0.000	0.000	0.000
Miller Welder 400Amps	5.317164	5.317164	5.317164	5.317164	5.317164						0.056	0.000	0.000	0.000	0.000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	4.537313	4.537313	4.537313	4.537313	4.537313						0.451	2.255	2.255	2.255	0.451
Manitowoc MLC 300 Crawler Crane Breakwater	4.537313	4.537313	4.537313	4.537313	4.537313						0.451	2.255	2.255	2.255	0.451
Manitowoc MLC 300 Crawler Crane Breakwater	4.537313	4.537313	4.537313	4.537313	4.537313						0.451	2.255	2.255	2.255	0.451
Manitowoc 999 Crawler Crane Breakwater	4.679104	4.679104	4.679104	4.679104	4.679104						0.412	2.062	2.062	2.062	0.412
Kobelco 275 Ton Crawler	4.537313	4.537313	4.537313	4.537313	4.537313						0.737	3.683	3.683	3.683	0.737
60T Hydraulic Crane Assembly Crane	4.537313	4.537313	4.537313	4.537313	4.537313						0.277	0.277	0.277	0.277	0.277
Cat 988 Loader 1	4.537313	4.537313	4.537313	4.537313	4.537313						0.808	3.233	3.233	3.233	0.808
Cat 988 Loader 2	4.537313	4.537313	4.537313	4.537313	4.537313						0.808	3.233	3.233	3.233	0.808
Cat 988 Loader 3	4.537313	4.537313	4.537313	4.537313	4.537313						0.808	3.233	3.233	3.233	0.808
100T Hydraulic Excavator 1	4.537313	4.537313	4.537313	4.537313	4.537313						0.744	2.976	2.976	2.976	0.744
100T Hydraulic Excavator 2	4.537313	4.537313	4.537313	4.537313	4.537313						0.744	2.976	2.976	2.976	0.744
CAT 745 Rock Truck 1	4.537313	4.537313	4.537313	4.537313	4.537313						0.641	2.563	2.563	2.563	0.641
CAT 745 Rock Truck 2	4.537313	4.537313	4.537313	4.537313	4.537313						0.320	1.282	1.282	1.282	0.320
8000 DWT Staging Platform											0	0	0	0	0
2000 DWT Transfer Shuttle Barge											0	0	0	0	0
Spud Barge											0	0	0	0	0
16000 DWT Barge for Armor Stone Transport											0	0	0	0	0
Inner Harbor Tug 1 Engine	5.642273	5.642273	5.642273	5.642273	5.642273						2.605	10.418	10.418	10.418	2.605
Inner Harbor Tug 1 Generator	5.642273	5.642273	5.642273	5.642273	5.642273						1.310	5.241	5.241	5.241	1.310
Inner Harbor Tug 2 Engine	5.642273	5.642273	5.642273	5.642273	5.642273						2.605	10.418	10.418	10.418	2.605
Inner Harbor Tug 2 Generator	5.642273	5.642273	5.642273	5.642273	5.642273						1.310	5.241	5.241	5.241	1.310
Ocean Going Tug for Armor Stone Transport Engine	5.642273	5.642273	5.642273	5.642273	5.642273						21.329	42.659	42.659	42.659	0.000
Ocean Going Tug for Armor Stone Transport Generator	5.642273	5.642273	5.642273	5.642273	5.642273						3.057	6.114	6.114	6.114	0.000
20' Aluminum Crew Boat	6.439687	6.441298	6.443155	6.444491	6.445642						0	0	0	0	0
10' Safety Boat 1	6.899151	6.923523	6.943647	6.957442	6.964048						0	0	0	0	0
10' Safety Boat 2	6.899151	6.923523	6.943647	6.957442	6.964048						0	0	0	0	0
Fuel Truck	5.286609	6.441298	6.443155	6.444491	6.445642	25.301	24.3686	22.57573	20.35282	18.68644	0.030	0.116	0.105	0.101	0.020
Mechanic Truck 1	5.286609	6.923523	6.943647	6.957442	6.964048	25.301	24.3686	22.57573	20.35282	18.68644	0.148	0.258	0.234	0.223	0.101
Mechanic Truck 2	5.286609	6.923523	6.943647	6.957442	6.964048	25.301	24.3686	22.57573	20.35282	18.68644	0.148	0.258	0.234	0.223	0.101
Welding Truck	4.679104	5.073012	4.591285	4.397157	3.547603						0.085	0.339	0.339	0.339	0.085
Compressor	5.317164	5.073012	4.591285	4.397157	3.547603						0.049	0.197	0.197	0.197	0.049
Boom Truck	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.036	0.140	0.126	0.121	0.024
Water Truck	5.286609	4.679104	4.679104	4.679104	4.679104	25.301	24.3686	22.57573	20.35282	18.68644	0.073	0.279	0.253	0.242	0.049
Truck Tractor for Roll Off Trash Bins Stage at Hotel	5.286609	5.317164	5.317164	5.317164	5.317164	25.301	24.3686	22.57573	20.35282	18.68644	0.063	0.165	0.150	0.143	0.044
Truck Tractor for Mob/Demob/Various	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.036	0.140	0.126	0.121	0.024
6T All Terrain Forklift	5.317164	5.073012	4.591285	4.397157	3.547603						0.183	0.734	0.734	0.734	0.183
D8 Dozer	4.679104	5.073012	4.591285	4.397157	3.547603						0.418	0.000	0.000	0.000	0.000
CAT 330 Excavator	4.679104	5.073012	4.591285	4.397157	3.547603						0.342	0.000	0.000	0.000	0.000
CAT 14H Grader	4.679104	5.317164	5.317164	5.317164	5.317164						0.418	0.000	0.000	0.000	0.000
230T Crawler Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.056	0.056	0.000
Kincho Vibro Hammer/Gen	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.010	0.010	0.000
HPSI 260Hammer w/400HP Powerpack	4.537313	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.009	0.009	0.000
Delmag 30-32 Hammer	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.018	0.018	0.000
65T Rough Terrain Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.002	0.002	0.000
Ocean Going Vessels (Product List)	**NO_X Emissions Factor, Main Engine (g/kw-hr)**					**NO_X Emissions Factor, Auxiliary Engine (g/kw-hr)**									
ADVA 140 m 58oz/CY (Concrete Additive) DARREX1 1AEA 63oz/CY (Concrete Additive) WRDA-HA 43 oz/CY (Concrete Additive)	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.045	0	0	0	0
Concrete Sand C-33	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.271	0	0	0	0
Coarse Concrete Aggregate	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.406	0	0	0	0
Cement 504#/CY (4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.000	0	0	0	0
Fly Ash 215 lb/CY	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	0.045	0	0	0	0

Armor Stone Bedding	1.1	1.1	1.1	1.1	1.1	2.0	2.0	2.0	2.0	2.0	1.518	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.246789	0.182546	0.155891	0.134566	0.098436	0.422	0.297304	0.199184	0.187426	0.162134	0.000	0.000	0.001	0.001	0.000
Passenger car	0.163779	0.129538	0.119244	0.097161	0.084126	0.330	0.222633	0.202083	0.162075	0.137319	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.246789	0.182546	0.155891	0.134566	0.098436	0.422	0.297304	0.199184	0.187426	0.162134	0.000	0.000	0.005	0.004	0.000
185 CFM Compressor	5.317164	5.317164	5.317164	5.317164	5.317164						0.000	0.000	0.176	0.176	0.000
Miller Welder	5.317164	5.317164	5.317164	5.317164	5.317164						0.000	0.000	0.037	0.037	0.000
90T Rough Terrain Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.025	0.025	0.000
175T Crawler Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.216	0.216	0.000
6T Forklift	5.317164	5.317164	5.317164	5.317164	5.317164						0.000	0.000	0.127	0.127	0.000
20' Aluminum Crew Boat	5.642273	5.642273	5.642273	5.642273	5.642273						0.000	0.000	0.085	0.085	0.000
10' Safety Boat	5.642273	5.642273	5.642273	5.642273	5.642273						0.000	0.000	0.003	0.003	0.000
230T Crawler Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.232	0.232	0.000
Kincho Vibro Hammer/Gen	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.043	0.043	0.000
HPSI 260Hammer w/400HP Powerpack	4.537313	4.537313	4.537313	4.537313	4.537313						0.000	0.000	0.040	0.040	0.000
Delmag 30-32 Hammer	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.075	0.075	0.000
65T Rough Terrain Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.008	0.008	0.000
Truck Tractor	5.286609	5.073012	4.591285	4.397157	3.547603	25.301	24.3686	22.57573	20.35282	18.68644	0.000	0.000	0.002	0.001	0.000
Spud Barge															
Inner Harbor Tug Engine	5.642273	5.642273	5.642273	5.642273	5.642273						0.000	0.000	0.028	0.028	0.000
Inner Harbor Tug Generator	5.642273	5.642273	5.642273	5.642273	5.642273						0.000	0.000	0.101	0.101	0.000
Concrete Pump	4.537313	4.537313	4.537313	4.537313	4.537313						0.000	0.000	0.013	0.013	0.000
100T Crawler Crane	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.060	0.060	0.000
CAT 345 Excavator	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.260	0.260	0.000
CAT 330 Excavator	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.064	0.064	0.000
CAT 966 Loader	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.090	0.090	0.000
CAT 950 Loader	4.679104	4.679104	4.679104	4.679104	4.679104						0.000	0.000	0.040	0.040	0.000
										Total (ton/yr)	**59.440**	**128.985**	**130.367**	**130.157**	**26.383**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) NO_x Low Load Adjustment Factor (Ocean Going Vessel Porting) = 4.63

Naval Base Guam - Apra Harbor Breakwater Repair – PM_{10} Emissions

Equipment	PM_{10} Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)															PM_{10} Idling Emission Factor (g/hr for on-road only)				
	2025			2026			2027			2028			2029			2025	2026	2027	2028	2029
	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW					
GLASS BREAKWATER REPAIRS																				
Government Fleet Vehicles																				
Passenger truck	0.0045	0.0587	0.0120	0.0044	0.0587	0.0120	0.0040	0.0587	0.0120	0.0038	0.0587	0.0120	0.0037	0.0587	0.0120	0.0138	0.0147	0.0140	0.0125	0.0113
Passenger car	0.0034	0.0524	0.0119	0.0033	0.0524	0.0119	0.0030	0.0524	0.0119	0.0030	0.0524	0.0119	0.0029	0.0524	0.0119	0.0308	0.0297	0.0247	0.0253	0.0268
Contractor Breakwater Fleet Vehicles																				
Passenger Trucks (3), 3 Eng. Home Office	0.0045	0.0587	0.0120	0.0044	0.0587	0.0120	0.0040	0.0587	0.0120	0.0038	0.0587	0.0120	0.0037	0.0587	0.0120	0.0138	0.0147	0.0140	0.0125	0.0113
Passenger Trucks (18), Multiple Staff (18)	0.0045	0.0587	0.0120	0.0044	0.0587	0.0120	0.0040	0.0587	0.0120	0.0038	0.0587	0.0120	0.0037	0.0587	0.0120	0.0138	0.0147	0.0140	0.0125	0.0113
Coral Translocation																				
Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
Flat Bed Truck	0.1343	0.0736	0.0174	0.1174	0.0736	0.0174	0.1091	0.0736	0.0174	0.0563	0.0737	0.0175	0.0659	0.0737	0.0175	0.0909	0.0783	0.0705	0.0528	0.0642
Tugboat (Primary Engine)	0.148049			0.148049			0.148049			0.148049			0.148049							
Tugboat (Bow Thrusters)	0.148049			0.148049			0.148049			0.148049			0.148049							
Tugboat (Generator)	0.148049			0.148049			0.148049			0.148049			0.148049							
Twin Engine Large Dive Boat (2 engines, total hp)	0.148049			0.148049			0.148049			0.148049			0.148049							
Twin Engine Small Dive Boat (2 engines, total hp)	0.148049			0.148049			0.148049			0.148049			0.148049							
Contractor Casting Yard Fleet Vehicles and Equipment																				
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.0045	0.0587	0.0120	0.0044	0.0587	0.0120	0.0040	0.0587	0.0120	0.0038	0.0587	0.0120	0.0037	0.0587	0.0120	0.0138	0.0147	0.0140	0.0125	0.0113
6T All Terrain Forklift 1	0.2985			0.2985			0.2985			0.2985			0.2985							
6T All Terrain Forklift 2	0.2985			0.2985			0.2985			0.2985			0.2985							
Boom Truck	0.1343	0.0736	0.0174	0.1174	0.0736	0.0174	0.1091	0.0736	0.0174	0.0563	0.0737	0.0175	0.0659	0.0737	0.0175	0.0909	0.0783	0.0705	0.0528	0.0642
Vacuum Truck/Sweeper	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Cement Train Tractor 1	0.1493			0.1493			0.1493			0.1493			0.1493							
Cement Train Tractor 2	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Gantry Crane 1	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Gantry Crane 2	0.1493			0.1493			0.1493			0.1493			0.1493							
Truck Tractor 1	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Truck Tractor 2	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Skid Steer 1	0.2985			0.2985			0.2985			0.2985			0.2985							
Skid Steer 2	0.2985			0.2985			0.2985			0.2985			0.2985							
4000 Gal Water Truck	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Cat 966 Loader 1	0.1493			0.1493			0.1493			0.1493			0.1493							
Cat 966 Loader 2	0.1493			0.1493			0.1493			0.1493			0.1493							
36 Meter Concrete Pump Truck	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller																				
100 KW Generators Backup Power (2)	0.1493			0.1493			0.1493			0.1493			0.1493							
Ready Mix Concrete Truck 1	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Ready Mix Concrete Truck 2	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Ready Mix Concrete Truck 3	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Ready Mix Concrete Truck 4 (reserve)	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
60' Manlift for Maintenance	0.2239			0.2239			0.2239			0.2239			0.2239							
Dump Trucks (4)	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Truck Tractor for Roll Off Trash Bins	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Fuel Truck	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
CAT D8 Dozer	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 950 Loader	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 14H Grader	0.2239			0.2239			0.2239			0.2239			0.2239							
25T Vibratory Compactor	0.2239			0.2239			0.2239			0.2239			0.2239							
CAT 345 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							

175T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
185 CFM Compressor	0.2985			0.2985			0.2985			0.2985			0.2985						
Miller Welder 400Amps	0.2985			0.2985			0.2985			0.2985			0.2985						
Construction																			
Liebherr LR1300 Crawler Crane Hotel Wharf	0.1493			0.1493			0.1493			0.1493			0.1493						
Manitowoc MLC 300 Crawler Crane Breakwater	0.1493			0.1493			0.1493			0.1493			0.1493						
Manitowoc MLC 300 Crawler Crane Breakwater	0.1493			0.1493			0.1493			0.1493			0.1493						
Manitowoc 999 Crawler Crane Breakwater	0.1493			0.1493			0.1493			0.1493			0.1493						
Kobelco 275 Ton Crawler	0.1493			0.1493			0.1493			0.1493			0.1493						
60T Hydraulic Crane Assembly Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
Cat 988 Loader 1	0.1493			0.1493			0.1493			0.1493			0.1493						
Cat 988 Loader 2	0.1493			0.1493			0.1493			0.1493			0.1493						
Cat 988 Loader 3	0.1493			0.1493			0.1493			0.1493			0.1493						
100T Hydraulic Excavator 1	0.1493			0.1493			0.1493			0.1493			0.1493						
100T Hydraulic Excavator 2	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 745 Rock Truck 1	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 745 Rock Truck 2	0.1493			0.1493			0.1493			0.1493			0.1493						
8000 DWT Staging Platform																			
2000 DWT Transfer Shuttle Barge																			
Spud Barge																			
16000 DWT Barge for Armor Stone Transport																			
Inner Harbor Tug 1 Engine	0.148049			0.148049			0.148049			0.148049			0.148049						
Inner Harbor Tug 1 Generator	0.148049			0.148049			0.148049			0.148049			0.148049						
Inner Harbor Tug 2 Engine	0.148049			0.148049			0.148049			0.148049			0.148049						
Inner Harbor Tug 2 Generator	0.148049			0.148049			0.148049			0.148049			0.148049						
Ocean Going Tug for Armor Stone Transport Engine	0.148049			0.148049			0.148049			0.148049			0.148049						
Ocean Going Tug for Armor Stone Transport Generator	0.148049			0.148049			0.148049			0.148049			0.148049						
20' Aluminum Crew Boat	0.0617			0.0611			0.0605			0.0602			0.0600						
10' Safety Boat 1	0.0891			0.0778			0.0688			0.0627			0.0600						
10' Safety Boat 2	0.0891			0.0778			0.0688			0.0627			0.0600						
Fuel Truck	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Mechanic Truck 1	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Mechanic Truck 2	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Welding Truck	0.1493			0.1493			0.1493			0.1493			0.1493						
Compressor	0.2985			0.2985			0.2985			0.2985			0.2985						
Boom Truck	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Water Truck	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Truck Tractor for Mob/Demob/Various	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
6T All Terrain Forklift	0.2985			0.2985			0.2985			0.2985			0.2985						
D8 Dozer	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 330 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 14H Grader	0.1493			0.1493			0.1493			0.1493			0.1493						
230T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
Kincho Vibro Hammer/Gen	0.1493			0.1493			0.1493			0.1493			0.1493						
HPSI 260Hammer w/400HP Powerpack	0.1493			0.1493			0.1493			0.1493			0.1493						
Delmag 30-32 Hammer	0.1493			0.1493			0.1493			0.1493			0.1493						
65T Rough Terrain Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
Ocean Going Vessels (Product List)	**PM_{10} Emissions Factor, Main Engine (g/kw-hr)**															**PM_{10} Emissions Factor, Auxiliary Engine (g/kw-hr)**				
ADVA 140 m 58oz/CY (Concrete Additive)	0.32			0.32			0.32			0.32			0.32			0.309	0.309	0.309	0.309	0.309
DARREX1 1AEA 63oz/CY (Concrete Additive)																				
WRDA-HA 43 oz/CY (Concrete Additive)																				
Concrete Sand C-33	0.32			0.32			0.32			0.32			0.32			0.309	0.309	0.309	0.309	0.309
Coarse Concrete Aggregate	0.19			0.19			0.19			0.19			0.19			0.309	0.309	0.309	0.309	0.309
Cement 504#/CY (4)	N/A			N/A			N/A			N/A			N/A			N/A	N/A	N/A	N/A	N/A
Fly Ash 215 lb/CY	0.19			0.19			0.19			0.19			0.19			0.309	0.309	0.309	0.309	0.309

Armor Stone Bedding	0.19			0.19			0.19			0.19			0.19			0.309	0.309	0.309	0.309	0.309
SUMAY COVE REPAIRS																				
Government Fleet Vehicles																				
Passenger truck	0.0045	0.0587	0.0120	0.0044	0.0587	0.0120	0.0040	0.0587	0.0120	0.0038	0.0587	0.0120	0.0037	0.0587	0.0120	0.0138	0.0147	0.0140	0.0125	0.0113
Passenger car	0.0034	0.0524	0.0119	0.0033	0.0524	0.0119	0.0030	0.0524	0.0119	0.0030	0.0524	0.0119	0.0029	0.0524	0.0119	0.0308	0.0297	0.0247	0.0253	0.0268
Contractor Sumay Cove Vehicles																				
Passenger trucks (5), Multiple Staff (5)	0.0045	0.0587	0.0120	0.0044	0.0587	0.0120	0.0040	0.0587	0.0120	0.0038	0.0587	0.0120	0.0037	0.0587	0.0120	0.0138	0.0147	0.0140	0.0125	0.0113
185 CFM Compressor	0.2985			0.2985			0.2985			0.2985			0.2985							
Miller Welder	0.2985			0.2985			0.2985			0.2985			0.2985							
90T Rough Terrain Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
175T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
6T Forklift	0.2985			0.2985			0.2985			0.2985			0.2985							
20' Aluminum Crew Boat	0.148049			0.148049			0.148049			0.148049			0.148049							
10' Safety Boat	0.148049			0.148049			0.148049			0.148049			0.148049							
230T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
Kincho Vibro Hammer/Gen	0.1493			0.1493			0.1493			0.1493			0.1493							
HPSI 260Hammer w/400HP Powerpack	0.1493			0.1493			0.1493			0.1493			0.1493							
Delmag 30-32 Hammer	0.1493			0.1493			0.1493			0.1493			0.1493							
65T Rough Terrain Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
Truck Tractor	0.3761	0.2144	0.0231	0.3568	0.2136	0.0230	0.3225	0.2089	0.0228	0.2044	0.2150	0.0230	0.1763	0.2072	0.0226	2.1805	2.0509	1.8759	1.6867	1.5126
Spud Barge																				
Inner Harbor Tug Engine	0.148049			0.148049			0.148049			0.148049			0.148049							
Inner Harbor Tug Generator	0.148049			0.148049			0.148049			0.148049			0.148049							
Concrete Pump	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 345 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 330 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 966 Loader	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 950 Loader	0.1493			0.1493			0.1493			0.1493			0.1493							

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) PM_{10} Low Load Adjustment Factor (Ocean Going Vessel Porting) = 7.29

Naval Base Guam - Apra Harbor Breakwater Repairs – PM_{10} Emissions (continued)

Equipment	PM_{10} Emissions (tons/yr)														
	2025			2026			2027			2028			2029		
	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000
Passenger car	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001	0.000
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.001	0.000
Passenger Trucks (18), Multiple Staff (18)	0.001	0.014	0.003	0.002	0.021	0.004	0.001	0.021	0.004	0.001	0.021	0.004	0.001	0.010	0.002
Coral Translocation															
Excavator	0.017			0.000			0.000			0.000			0.000		
Flat Bed Truck	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tugboat (Primary Engine)	0.070			0.000			0.000			0.000			0.000		
Tugboat (Bow Thrusters)	0.070			0.000			0.000			0.000			0.000		
Tugboat (Generator)	0.005			0.000			0.000			0.000			0.000		
Twin Engine Large Dive Boat (2 engines, total hp)	0.010			0.000			0.000			0.000			0.000		
Twin Engine Small Dive Boat (2 engines, total hp)	0.005			0.000			0.000			0.000			0.000		
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000	0.003	0.001	0.000	0.004	0.001	0.000	0.004	0.001	0.000	0.004	0.001	0.000	0.002	0.000
6T All Terrain Forklift 1	0.022			0.026			0.026			0.026			0.022		
6T All Terrain Forklift 2	0.013			0.026			0.026			0.026			0.019		
Boom Truck	0.002	0.001	0.000	0.003	0.002	0.000	0.003	0.002	0.000	0.002	0.002	0.000	0.001	0.002	0.000
Vacuum Truck/Sweeper	0.004	0.002	0.000	0.008	0.005	0.001	0.007	0.005	0.001	0.005	0.005	0.001	0.003	0.004	0.000
Cement Train Tractor 1	0.011			0.022			0.022			0.022			0.016		
Cement Train Tractor 2	0.011			0.022			0.022			0.022			0.016		
100T Gantry Crane 1	0.033			0.066			0.066			0.066			0.050		
100T Gantry Crane 2	0.033			0.066			0.066			0.066			0.050		
Truck Tractor 1	0.010	0.004	0.000	0.017	0.009	0.001	0.015	0.009	0.001	0.010	0.009	0.001	0.007	0.006	0.001
Truck Tractor 2	0.010	0.004	0.000	0.017	0.009	0.001	0.015	0.009	0.001	0.010	0.009	0.001	0.007	0.006	0.001
Skid Steer 1	0.005			0.009			0.009			0.009			0.007		
Skid Steer 2	0.005			0.009			0.009			0.009			0.007		
4000 Gal Water Truck	0.010	0.006	0.001	0.020	0.012	0.001	0.018	0.011	0.001	0.011	0.012	0.001	0.007	0.009	0.001
Cat 966 Loader 1	0.029			0.058			0.058			0.058			0.044		
Cat 966 Loader 2	0.029			0.058			0.058			0.058			0.044		
36 Meter Concrete Pump Truck	0.008	0.004	0.000	0.015	0.009	0.001	0.013	0.009	0.001	0.008	0.009	0.001	0.005	0.006	0.001
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.005			0.005			0.005			0.005			0.005		
Ready Mix Concrete Truck 1	0.010	0.004	0.000	0.017	0.009	0.001	0.015	0.009	0.001	0.010	0.009	0.001	0.007	0.006	0.001
Ready Mix Concrete Truck 2	0.010	0.004	0.000	0.017	0.009	0.001	0.015	0.009	0.001	0.010	0.009	0.001	0.007	0.006	0.001
Ready Mix Concrete Truck 3	0.010	0.004	0.000	0.017	0.009	0.001	0.015	0.009	0.001	0.010	0.009	0.001	0.007	0.006	0.001
Ready Mix Concrete Truck 4 (reserve)	0.001	0.000	0.000	0.002	0.001	0.000	0.002	0.001	0.000	0.001	0.001	0.000	0.001	0.001	0.000
60' Manlift for Maintenance	0.003			0.005			0.005			0.005			0.004		
Dump Trucks (4)	0.044	0.024	0.003	0.081	0.047	0.005	0.073	0.046	0.005	0.047	0.047	0.005	0.035	0.039	0.004
Truck Tractor for Roll Off Trash Bins	0.006	0.002	0.000	0.009	0.004	0.000	0.008	0.004	0.000	0.006	0.004	0.000	0.004	0.003	0.000
Fuel Truck	0.007	0.002	0.000	0.010	0.005	0.001	0.009	0.005	0.001	0.006	0.005	0.001	0.005	0.004	0.000
CAT D8 Dozer	0.003			0.000			0.000			0.000			0.000		
CAT 950 Loader	0.002			0.000			0.000			0.000			0.002		
CAT 14H Grader	0.009			0.000			0.000			0.000			0.000		
25T Vibratory Compactor	0.006			0.000			0.000			0.000			0.000		
CAT 345 Excavator	0.000			0.000			0.000			0.000			0.004		
100T Crawler Crane	0.004			0.000			0.000			0.000			0.003		

175T Crawler Crane	0.012			0.000			0.000			0.000			0.000		
185 CFM Compressor	0.005			0.000			0.000			0.000			0.000		
Miller Welder 400Amps	0.003			0.000			0.000			0.000			0.000		
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.015			0.074			0.074			0.074			0.015		
Manitowoc MLC 300 Crawler Crane Breakwater	0.015			0.074			0.074			0.074			0.015		
Manitowoc MLC 300 Crawler Crane Breakwater	0.015			0.074			0.074			0.074			0.015		
Manitowoc 999 Crawler Crane Breakwater	0.013			0.066			0.066			0.066			0.013		
Kobelco 275 Ton Crawler	0.024			0.121			0.121			0.121			0.024		
60T Hydraulic Crane Assembly Crane	0.009			0.009			0.009			0.009			0.009		
Cat 988 Loader 1	0.027			0.106			0.106			0.106			0.027		
Cat 988 Loader 2	0.027			0.106			0.106			0.106			0.027		
Cat 988 Loader 3	0.027			0.106			0.106			0.106			0.027		
100T Hydraulic Excavator 1	0.024			0.098			0.098			0.098			0.024		
100T Hydraulic Excavator 2	0.024			0.098			0.098			0.098			0.024		
CAT 745 Rock Truck 1	0.021			0.084			0.084			0.084			0.021		
CAT 745 Rock Truck 2	0.011			0.042			0.042			0.042			0.011		
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.068			0.273			0.273			0.273			0.068		
Inner Harbor Tug 1 Generator	0.034			0.138			0.138			0.138			0.034		
Inner Harbor Tug 2 Engine	0.068			0.273			0.273			0.273			0.068		
Inner Harbor Tug 2 Generator	0.034			0.138			0.138			0.138			0.034		
Ocean Going Tug for Armor Stone Transport Engine	0.560			1.119			1.119			1.119			0.000		
Ocean Going Tug for Armor Stone Transport Generator	0.080			0.160			0.160			0.160			0.000		
20' Aluminum Crew Boat	0.000			0.000			0.000			0.000			0.000		
10' Safety Boat 1	0.000			0.000			0.000			0.000			0.000		
10' Safety Boat 2	0.000			0.000			0.000			0.000			0.000		
Fuel Truck	0.002	0.001	0.000	0.008	0.005	0.001	0.007	0.005	0.001	0.005	0.005	0.001	0.001	0.001	0.000
Mechanic Truck 1	0.011	0.005	0.001	0.019	0.010	0.001	0.017	0.010	0.001	0.011	0.010	0.001	0.006	0.005	0.001
Mechanic Truck 2	0.011	0.005	0.001	0.019	0.010	0.001	0.017	0.010	0.001	0.011	0.010	0.001	0.006	0.005	0.001
Welding Truck	0.003			0.011			0.011			0.011			0.003		
Compressor	0.003			0.011			0.011			0.011			0.003		
Boom Truck	0.003	0.001	0.000	0.010	0.006	0.001	0.009	0.006	0.001	0.006	0.006	0.001	0.001	0.001	0.000
Water Truck	0.005	0.003	0.000	0.020	0.012	0.001	0.018	0.011	0.001	0.011	0.012	0.001	0.002	0.003	0.000
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.005	0.001	0.000	0.012	0.006	0.001	0.011	0.006	0.001	0.007	0.006	0.001	0.003	0.001	0.000
Truck Tractor for Mob/Demob/Various	0.003	0.001	0.000	0.010	0.006	0.001	0.009	0.006	0.001	0.006	0.006	0.001	0.001	0.001	0.000
6T All Terrain Forklift	0.010			0.041			0.041			0.041			0.010		
D8 Dozer	0.013			0.000			0.000			0.000			0.000		
CAT 330 Excavator	0.011			0.000			0.000			0.000			0.000		
CAT 14H Grader	0.013			0.000			0.000			0.000			0.000		
230T Crawler Crane	0.000			0.000			0.002			0.002			0.000		
Kincho Vibro Hammer/Gen	0.000			0.000			0.000			0.000			0.000		
HPSI 260Hammer w/400HP Powerpack	0.000			0.000			0.000			0.000			0.000		
Delmag 30-32 Hammer	0.000			0.000			0.001			0.001			0.000		
65T Rough Terrain Crane	0.000			0.000			0.000			0.000			0.000		
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	0.001			0			0			0			0		
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33	0.008			0			0			0			0		
Coarse Concrete Aggregate	0.008			0			0			0			0		
Cement 504#/CY (4)	0.000			0			0			0			0		
Fly Ash 215 lb/CY	0.001			0			0			0			0		

Armor Stone Bedding	0.028			0			0			0			0			
SUMAY COVE REPAIRS																
Government Fleet Vehicles																
Passenger truck	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Passenger car	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Contractor Sumay Cove Vehicles																
Passenger trucks (5), Multiple Staff (5)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.000	0.000	0.002	0.000	0.000	0.000	0.000	
185 CFM Compressor	0.000			0.000			0.010			0.010			0.000			
Miller Welder	0.000			0.000			0.002			0.002			0.000			
90T Rough Terrain Crane	0.000			0.000			0.001			0.001			0.000			
175T Crawler Crane	0.000			0.000			0.007			0.007			0.000			
6T Forklift	0.000			0.000			0.007			0.007			0.000			
20' Aluminum Crew Boat	0.000			0.000			0.002			0.002			0.000			
10' Safety Boat	0.000			0.000			0.000			0.000			0.000			
230T Crawler Crane	0.000			0.000			0.007			0.007			0.000			
Kincho Vibro Hammer/Gen	0.000			0.000			0.001			0.001			0.000			
HPSI 260Hammer w/400HP Powerpack	0.000			0.000			0.001			0.001			0.000			
Delmag 30-32 Hammer	0.000			0.000			0.002			0.002			0.000			
65T Rough Terrain Crane	0.000			0.000			0.000			0.000			0.000			
Truck Tractor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Spud Barge																
Inner Harbor Tug Engine	0.000			0.013			0.013			0.000			0.000			
Inner Harbor Tug Generator	0.000			0.003			0.003			0.000			0.000			
Concrete Pump	0.000			0.000			0.000			0.000			0.000			
100T Crawler Crane	0.000			0.000			0.002			0.002			0.000			
CAT 345 Excavator	0.000			0.000			0.008			0.008			0.000			
CAT 330 Excavator	0.000			0.000			0.002			0.002			0.000			
CAT 966 Loader	0.000			0.000			0.003			0.003			0.000			
CAT 950 Loader	0.000			0.000			0.001			0.001			0.000			
	2025			**2026**			**2027**			**2028**			**2029**			
	Exh	**BW**	**TW**	**Exh**	**BW**	**TW**	**Exh**	**BW**	**TW**	**Exh**	**BW**	**TW**	**Exh**	**BW**	**TW**	
Total (ton/yr)	**0.739**	**0.104**	**0.013**	**1.826**	**0211**	**0.026**	**1.851**	**0.209**	**0.026**	**1.748**	**0.214**	**0.026**	**0.677**	**0.131**	**0.016**	
	PM_{10} Total			**PM_{10} Total**			**PM_{10} Total**			**PM_{10} Total**			**PM_{10} Total**			
Total (ton/yr)	**2.856**			**6.642**			**6.687**			**6.073**			**1.480**			

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) PM_{10} Low Load Adjustment Factor (Ocean Going Vessel Porting) =7.29

Naval Base Guam - Apra Harbor Breakwater Repair – $PM_{2.5}$ Emissions

Equipment	$PM_{2.5}$ Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)															$PM_{2.5}$ Idling Emission Factor (g/hr for on-road only)				
	2025			2026			2027			2028			2029			2025	2026	2027	2028	2029
	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW					
GLASS BREAKWATER REPAIRS																				
Government Fleet Vehicles																				
Passenger truck	0.0040	0.0073	0.0018	0.0039	0.0073	0.0018	0.0035	0.0073	0.0018	0.0034	0.0073	0.0018	0.0032	0.0073	0.0018	0.0122	0.0130	0.0124	0.0111	0.0100
Passenger car	0.0030	0.0066	0.0018	0.0029	0.0066	0.0018	0.0027	0.0066	0.0018	0.0026	0.0066	0.0018	0.0026	0.0066	0.0018	0.0272	0.0263	0.0219	0.0224	0.0237
Contractor Breakwater Fleet Vehicles																				
Passenger Trucks (3), 3 Eng. Home Office	0.0040	0.0073	0.0018	0.0039	0.0073	0.0018	0.0035	0.0073	0.0018	0.0034	0.0073	0.0018	0.0032	0.0073	0.0018	0.0122	0.0130	0.0124	0.0111	0.0100
Passenger Trucks (18), Multiple Staff (18)	0.0040	0.0073	0.0018	0.0039	0.0073	0.0018	0.0035	0.0073	0.0018	0.0034	0.0073	0.0018	0.0032	0.0073	0.0018	0.0122	0.0130	0.0124	0.0111	0.0100
Coral Translocation																				
Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
Flat Bed Truck	0.1236	0.0092	0.0026	0.1080	0.0092	0.0026	0.1003	0.0092	0.0026	0.0518	0.0092	0.0026	0.0606	0.0092	0.0026	0.0837	0.0720	0.0648	0.0486	0.0591
Tugboat (Primary Engine)	0.143608			0.143608			0.143608			0.143608			0.143608							
Tugboat (Bow Thrusters)	0.143608			0.143608			0.143608			0.143608			0.143608							
Tugboat (Generator)	0.143608			0.143608			0.143608			0.143608			0.143608							
Twin Engine Large Dive Boat (2 engines, total hp)	0.143608			0.143608			0.143608			0.143608			0.143608							
Twin Engine Small Dive Boat (2 engines, total hp)	0.143608			0.143608			0.143608			0.143608			0.143608							
Contractor Casting Yard Fleet Vehicles and Equipment																				
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.0040	0.0073	0.0018	0.0039	0.0073	0.0018	0.0035	0.0073	0.0018	0.0034	0.0073	0.0018	0.0032	0.0073	0.0018	0.0122	0.0130	0.0124	0.0111	0.0100
6T All Terrain Forklift 1	0.2985			0.2985			0.2985			0.2985			0.2985							
6T All Terrain Forklift 2	0.2985			0.2985			0.2985			0.2985			0.2985							
Boom Truck	0.1236	0.0092	0.0026	0.1080	0.0092	0.0026	0.1003	0.0092	0.0026	0.0518	0.0092	0.0026	0.0606	0.0092	0.0026	0.0837	0.0720	0.0648	0.0486	0.0591
Vacuum Truck/Sweeper	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Cement Train Tractor 1	0.1493			0.1493			0.1493			0.1493			0.1493							
Cement Train Tractor 2	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Gantry Crane 1	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Gantry Crane 2	0.1493			0.1493			0.1493			0.1493			0.1493							
Truck Tractor 1	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Truck Tractor 2	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Skid Steer 1	0.2985			0.2985			0.2985			0.2985			0.2985							
Skid Steer 2	0.2985			0.2985			0.2985			0.2985			0.2985							
4000 Gal Water Truck	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Cat 966 Loader 1	0.1493			0.1493			0.1493			0.1493			0.1493							
Cat 966 Loader 2	0.1493			0.1493			0.1493			0.1493			0.1493							
36 Meter Concrete Pump Truck	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller																				
100 KW Generators Backup Power (2)	0.1493			0.1493			0.1493			0.1493			0.1493							
Ready Mix Concrete Truck 1	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Ready Mix Concrete Truck 2	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Ready Mix Concrete Truck 3	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Ready Mix Concrete Truck 4 (reserve)	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
60' Manlift for Maintenance	0.2239			0.2239			0.2239			0.2239			0.2239							
Dump Trucks (4)	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Truck Tractor for Roll Off Trash Bins	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Fuel Truck	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
CAT D8 Dozer	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 950 Loader	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 14H Grader	0.2239			0.2239			0.2239			0.2239			0.2239							
25T Vibratory Compactor	0.2239			0.2239			0.2239			0.2239			0.2239							
CAT 345 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							

175T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
185 CFM Compressor	0.2985			0.2985			0.2985			0.2985			0.2985						
Miller Welder 400Amps	0.2985			0.2985			0.2985			0.2985			0.2985						
Construction																			
Liebherr LR1300 Crawler Crane Hotel Wharf	0.1493			0.1493			0.1493			0.1493			0.1493						
Manitowoc MLC 300 Crawler Crane Breakwater	0.1493			0.1493			0.1493			0.1493			0.1493						
Manitowoc MLC 300 Crawler Crane Breakwater	0.1493			0.1493			0.1493			0.1493			0.1493						
Manitowoc 999 Crawler Crane Breakwater	0.1493			0.1493			0.1493			0.1493			0.1493						
Kobelco 275 Ton Crawler	0.1493			0.1493			0.1493			0.1493			0.1493						
60T Hydraulic Crane Assembly Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
Cat 988 Loader 1	0.1493			0.1493			0.1493			0.1493			0.1493						
Cat 988 Loader 2	0.1493			0.1493			0.1493			0.1493			0.1493						
Cat 988 Loader 3	0.1493			0.1493			0.1493			0.1493			0.1493						
100T Hydraulic Excavator 1	0.1493			0.1493			0.1493			0.1493			0.1493						
100T Hydraulic Excavator 2	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 745 Rock Truck 1	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 745 Rock Truck 2	0.1493			0.1493			0.1493			0.1493			0.1493						
8000 DWT Staging Platform																			
2000 DWT Transfer Shuttle Barge																			
Spud Barge																			
16000 DWT Barge for Armor Stone Transport																			
Inner Harbor Tug 1 Engine	0.143608			0.143608			0.143608			0.143608			0.143608						
Inner Harbor Tug 1 Generator	0.143608			0.143608			0.143608			0.143608			0.143608						
Inner Harbor Tug 2 Engine	0.143608			0.143608			0.143608			0.143608			0.143608						
Inner Harbor Tug 2 Generator	0.143608			0.143608			0.143608			0.143608			0.143608						
Ocean Going Tug for Armor Stone Transport Engine	0.143608			0.143608			0.143608			0.143608			0.143608						
Ocean Going Tug for Armor Stone Transport Generator	0.143608			0.143608			0.143608			0.143608			0.143608						
20' Aluminum Crew Boat	0.0568			0.0562			0.0557			0.0553			0.0552						
10' Safety Boat 1	0.0820			0.0716			0.0633			0.0577			0.0552						
10' Safety Boat 2	0.0820			0.0716			0.0633			0.0577			0.0552						
Fuel Truck	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Mechanic Truck 1	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Mechanic Truck 2	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Welding Truck	0.1493			0.1493			0.1493			0.1493			0.1493						
Compressor	0.2985			0.2985			0.2985			0.2985			0.2985						
Boom Truck	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Water Truck	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Truck Tractor for Mob/Demob/Various	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
6T All Terrain Forklift	0.2985			0.2985			0.2985			0.2985			0.2985						
D8 Dozer	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 330 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493						
CAT 14H Grader	0.1493			0.1493			0.1493			0.1493			0.1493						
230T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
Kincho Vibro Hammer/Gen	0.1493			0.1493			0.1493			0.1493			0.1493						
HPSI 260Hammer w/400HP Powerpack	0.1493			0.1493			0.1493			0.1493			0.1493						
Delmag 30-32 Hammer	0.1493			0.1493			0.1493			0.1493			0.1493						
65T Rough Terrain Crane	0.1493			0.1493			0.1493			0.1493			0.1493						
Ocean Going Vessels (Product List)	**$PM_{2.5}$ Emissions Factor, Main Engine (g/kw-hr)**															**$PM_{2.5}$ Emissions Factor, Auxiliary Engine (g/kw-hr)**				
ADVA 140 m 58oz/CY (Concrete Additive)	0.29			0.29			0.29			0.29			0.29			0.2995	0.2995	0.2995	0.2995	0.2995
DARREX1 1AEA 63oz/CY (Concrete Additive)																				
WRDA-HA 43 oz/CY (Concrete Additive)																				
Concrete Sand C-33	0.29			0.29			0.29			0.29			0.29			0.2995	0.2995	0.2995	0.2995	0.2995
Coarse Concrete Aggregate	0.17			0.17			0.17			0.17			0.17			0.2995	0.2995	0.2995	0.2995	0.2995
Cement 504#/CY (4)	N/A			N/A			N/A			N/A			N/A			N/A	N/A	N/A	N/A	N/A
Fly Ash 215 lb/CY	0.17			0.17			0.17			0.17			0.17			0.2995	0.2995	0.2995	0.2995	0.2995

Armor Stone Bedding	0.17			0.17			0.17			0.17			0.17			0.2995	0.2995	0.2995	0.2995	0.2995
SUMAY COVE REPAIRS																				
Government Fleet Vehicles																				
Passenger truck	0.0040	0.0073	0.0018	0.0039	0.0073	0.0018	0.0035	0.0073	0.0018	0.0034	0.0073	0.0018	0.0032	0.0073	0.0018	0.0122	0.0130	0.0124	0.0111	0.0100
Passenger car	0.0030	0.0066	0.0018	0.0029	0.0066	0.0018	0.0027	0.0066	0.0018	0.0026	0.0066	0.0018	0.0026	0.0066	0.0018	0.0272	0.0263	0.0219	0.0224	0.0237
Contractor Sumay Cove Vehicles																				
Passenger trucks (5), Multiple Staff (5)	0.0040	0.0073	0.0018	0.0039	0.0073	0.0018	0.0035	0.0073	0.0018	0.0034	0.0073	0.0018	0.0032	0.0073	0.0018	0.0122	0.0130	0.0124	0.0111	0.0100
185 CFM Compressor	0.2985			0.2985			0.2985			0.2985			0.2985							
Miller Welder	0.2985			0.2985			0.2985			0.2985			0.2985							
90T Rough Terrain Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
175T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
6T Forklift	0.2985			0.2985			0.2985			0.2985			0.2985							
20' Aluminum Crew Boat	0.143608			0.143608			0.143608			0.143608			0.143608							
10' Safety Boat	0.143608			0.143608			0.143608			0.143608			0.143608							
230T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
Kincho Vibro Hammer/Gen	0.1493			0.1493			0.1493			0.1493			0.1493							
HPSI 260Hammer w/400HP Powerpack	0.1493			0.1493			0.1493			0.1493			0.1493							
Delmag 30-32 Hammer	0.1493			0.1493			0.1493			0.1493			0.1493							
65T Rough Terrain Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
Truck Tractor	0.3460	0.0268	0.0035	0.3282	0.0267	0.0035	0.2967	0.0261	0.0034	0.1880	0.0269	0.0035	0.1622	0.0259	0.0034	2.0061	1.8868	1.7258	1.5518	1.3916
Spud Barge																				
Inner Harbor Tug Engine	0.143608			0.143608			0.143608			0.143608			0.143608							
Inner Harbor Tug Generator	0.143608			0.143608			0.143608			0.143608			0.143608							
Concrete Pump	0.1493			0.1493			0.1493			0.1493			0.1493							
100T Crawler Crane	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 345 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 330 Excavator	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 966 Loader	0.1493			0.1493			0.1493			0.1493			0.1493							
CAT 950 Loader	0.1493			0.1493			0.1493			0.1493			0.1493							

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) $PM_{2.5}$ Low Load Adjustment Factor (Ocean Going Vessel Porting) = 7.29

Naval Base Guam - Apra Harbor Breakwater Repairs – $PM_{2.5}$ Emissions (continued)

Equipment	$PM_{2.5}$ Emissions (tons/yr)														
	2025			2026			2027			2028			2029		
	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW	Exh	BW	TW
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	0.0001	0.0000
Passenger car	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	0.0001	0.0000
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0001	0.0001	0.0000
Passenger Trucks (18), Multiple Staff (18)	0.001	0.002	0.000	0.001	0.003	0.001	0.001	0.003	0.001	0.001	0.003	0.001	0.0006	0.0013	0.0003
Coral Translocation															
Excavator	0.017			0.000			0.000			0.000			0.0000		
Flat Bed Truck	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000	0.0000	0.0000
Tugboat (Primary Engine)	0.068			0.000			0.000			0.000			0.000		
Tugboat (Bow Thrusters)	0.068			0.000			0.000			0.000			0.000		
Tugboat (Generator)	0.005			0.000			0.000			0.000			0.000		
Twin Engine Large Dive Boat (2 engines, total hp)	0.010			0.000			0.000			0.000			0.000		
Twin Engine Small Dive Boat (2 engines, total hp)	0.005			0.000			0.000			0.000			0.000		
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0001	0.0002	0.0001
6T All Terrain Forklift 1	0.022			0.026			0.026			0.026			0.0218		
6T All Terrain Forklift 2	0.013			0.026			0.026			0.026			0.0193		
Boom Truck	0.002	0.000	0.000	0.003	0.000	0.000	0.003	0.000	0.000	0.001	0.000	0.000	0.0013	0.0002	0.0001
Vacuum Truck/Sweeper	0.004	0.000	0.000	0.008	0.001	0.000	0.007	0.001	0.000	0.004	0.001	0.000	0.0028	0.0004	0.0001
Cement Train Tractor 1	0.011			0.022			0.022			0.022			0.0162		
Cement Train Tractor 2	0.011			0.022			0.022			0.022			0.0162		
100T Gantry Crane 1	0.033			0.066			0.066			0.066			0.0497		
100T Gantry Crane 2	0.033			0.066			0.066			0.066			0.0497		
Truck Tractor 1	0.009	0.001	0.000	0.016	0.001	0.000	0.014	0.001	0.000	0.009	0.001	0.000	0.0065	0.0008	0.0001
Truck Tractor 2	0.009	0.001	0.000	0.016	0.001	0.000	0.014	0.001	0.000	0.009	0.001	0.000	0.0065	0.0008	0.0001
Skid Steer 1	0.005			0.009			0.009			0.009			0.0071		
Skid Steer 2	0.005			0.009			0.009			0.009			0.0071		
4000 Gal Water Truck	0.010	0.001	0.000	0.018	0.001	0.000	0.016	0.001	0.000	0.010	0.001	0.000	0.0067	0.0011	0.0001
Cat 966 Loader 1	0.029			0.058			0.058			0.058			0.0436		
Cat 966 Loader 2	0.029			0.058			0.058			0.058			0.0436		
36 Meter Concrete Pump Truck	0.007	0.001	0.000	0.014	0.001	0.000	0.012	0.001	0.000	0.008	0.001	0.000	0.0050	0.0008	0.0001
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.005			0.005			0.005			0.005			0.0052		
Ready Mix Concrete Truck 1	0.009	0.001	0.000	0.016	0.001	0.000	0.014	0.001	0.000	0.009	0.001	0.000	0.0065	0.0008	0.0001
Ready Mix Concrete Truck 2	0.009	0.001	0.000	0.016	0.001	0.000	0.014	0.001	0.000	0.009	0.001	0.000	0.0065	0.0008	0.0001
Ready Mix Concrete Truck 3	0.009	0.001	0.000	0.016	0.001	0.000	0.014	0.001	0.000	0.009	0.001	0.000	0.0065	0.0008	0.0001
Ready Mix Concrete Truck 4 (reserve)	0.001	0.000	0.000	0.002	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.0006	0.0001	0.0000
60' Manlift for Maintenance	0.003			0.005			0.005			0.005			0.0040		
Dump Trucks (4)	0.040	0.003	0.000	0.074	0.006	0.001	0.067	0.006	0.001	0.043	0.006	0.001	0.0322	0.0049	0.0006
Truck Tractor for Roll Off Trash Bins	0.005	0.000	0.000	0.008	0.000	0.000	0.007	0.000	0.000	0.005	0.000	0.000	0.0037	0.0004	0.0000
Fuel Truck	0.006	0.000	0.000	0.010	0.001	0.000	0.009	0.001	0.000	0.006	0.001	0.000	0.0043	0.0004	0.0001
CAT D8 Dozer	0.003			0.000			0.000			0.000			0.0000		
CAT 950 Loader	0.002			0.000			0.000			0.000			0.0022		
CAT 14H Grader	0.009			0.000			0.000			0.000			0.0000		
25T Vibratory Compactor	0.006			0.000			0.000			0.000			0.0000		
CAT 345 Excavator	0.000			0.000			0.000			0.000			0.0037		
100T Crawler Crane	0.004			0.000			0.000			0.000			0.0029		

175T Crawler Crane	0.012			0.000			0.000			0.000			0.0000		
185 CFM Compressor	0.005			0.000			0.000			0.000			0.0000		
Miller Welder 400Amps	0.003			0.000			0.000			0.000			0.0000		
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.015			0.074			0.074			0.074			0.0148		
Manitowoc MLC 300 Crawler Crane Breakwater	0.015			0.074			0.074			0.074			0.0148		
Manitowoc MLC 300 Crawler Crane Breakwater	0.015			0.074			0.074			0.074			0.0148		
Manitowoc 999 Crawler Crane Breakwater	0.013			0.066			0.066			0.066			0.0132		
Kobelco 275 Ton Crawler	0.024			0.121			0.121			0.121			0.0242		
60T Hydraulic Crane Assembly Crane	0.009			0.009			0.009			0.009			0.0091		
Cat 988 Loader 1	0.027			0.106			0.106			0.106			0.0266		
Cat 988 Loader 2	0.027			0.106			0.106			0.106			0.0266		
Cat 988 Loader 3	0.027			0.106			0.106			0.106			0.0266		
100T Hydraulic Excavator 1	0.024			0.098			0.098			0.098			0.0245		
100T Hydraulic Excavator 2	0.024			0.098			0.098			0.098			0.0245		
CAT 745 Rock Truck 1	0.021			0.084			0.084			0.084			0.0211		
CAT 745 Rock Truck 2	0.011			0.042			0.042			0.042			0.0105		
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.066			0.265			0.265			0.265			0.066		
Inner Harbor Tug 1 Generator	0.033			0.133			0.133			0.133			0.033		
Inner Harbor Tug 2 Engine	0.066			0.265			0.265			0.265			0.066		
Inner Harbor Tug 2 Generator	0.033			0.133			0.133			0.133			0.033		
Ocean Going Tug for Armor Stone Transport Engine	0.543			1.086			1.086			1.086			0.000		
Ocean Going Tug for Armor Stone Transport Generator	0.078			0.156			0.156			0.156			0.000		
20' Aluminum Crew Boat	0.000			0.000			0.000			0.000			0.0000		
10' Safety Boat 1	0.000			0.000			0.000			0.000			0.0000		
10' Safety Boat 2	0.000			0.000			0.000			0.000			0.0000		
Fuel Truck	0.002	0.000	0.000	0.008	0.001	0.000	0.007	0.001	0.000	0.004	0.001	0.000	0.0009	0.0001	0.0000
Mechanic Truck 1	0.010	0.001	0.000	0.017	0.001	0.000	0.015	0.001	0.000	0.010	0.001	0.000	0.0052	0.0006	0.0001
Mechanic Truck 2	0.010	0.001	0.000	0.017	0.001	0.000	0.015	0.001	0.000	0.010	0.001	0.000	0.0052	0.0006	0.0001
Welding Truck	0.003			0.011			0.011			0.011			0.0027		
Compressor	0.003			0.011			0.011			0.011			0.0028		
Boom Truck	0.002	0.000	0.000	0.009	0.001	0.000	0.008	0.001	0.000	0.005	0.001	0.000	0.0011	0.0002	0.0000
Water Truck	0.005	0.000	0.000	0.018	0.001	0.000	0.016	0.001	0.000	0.010	0.001	0.000	0.0022	0.0004	0.0000
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.005	0.000	0.000	0.011	0.001	0.000	0.010	0.001	0.000	0.007	0.001	0.000	0.0026	0.0002	0.0000
Truck Tractor for Mob/Demob/Various	0.002	0.000	0.000	0.009	0.001	0.000	0.008	0.001	0.000	0.005	0.001	0.000	0.0011	0.0002	0.0000
6T All Terrain Forklift	0.010			0.041			0.041			0.041			0.0103		
D8 Dozer	0.013			0.000			0.000			0.000			0.0000		
CAT 330 Excavator	0.011			0.000			0.000			0.000			0.0000		
CAT 14H Grader	0.013			0.000			0.000			0.000			0.0000		
230T Crawler Crane	0.000			0.000			0.002			0.002			0.0000		
Kincho Vibro Hammer/Gen	0.000			0.000			0.000			0.000			0.0000		
HPSI 260Hammer w/400HP Powerpack	0.000			0.000			0.000			0.000			0.0000		
Delmag 30-32 Hammer	0.000			0.000			0.001			0.001			0.0000		
65T Rough Terrain Crane	0.000			0.000			0.000			0.000			0.0000		
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	0.001			0			0			0			0		
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33	0.008			0			0			0			0		
Coarse Concrete Aggregate	0.008			0			0			0			0		
Cement 504#/CY (4)	0.000			0			0			0			0		
Fly Ash 215 lb/CY	0.001			0			0			0			0		

Armor Stone Bedding	0.026			0			0			0			0			
SUMAY COVE REPAIRS																
Government Fleet Vehicles																
Passenger truck	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Passenger car	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Contractor Sumay Cove Vehicles																
Passenger trucks (5), Multiple Staff (5)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
185 CFM Compressor	0.000			0.000			0.010			0.010			0.000			
Miller Welder	0.000			0.000			0.002			0.002			0.000			
90T Rough Terrain Crane	0.000			0.000			0.001			0.001			0.000			
175T Crawler Crane	0.000			0.000			0.007			0.007			0.000			
6T Forklift	0.000			0.000			0.007			0.007			0.000			
20' Aluminum Crew Boat	0.000			0.000			0.002			0.002			0.000			
10' Safety Boat	0.000			0.000			0.000			0.000			0.000			
230T Crawler Crane	0.000			0.000			0.007			0.007			0.000			
Kincho Vibro Hammer/Gen	0.000			0.000			0.001			0.001			0.000			
HPSI 260Hammer w/400HP Powerpack	0.000			0.000			0.001			0.001			0.000			
Delmag 30-32 Hammer	0.000			0.000			0.002			0.002			0.000			
65T Rough Terrain Crane	0.000			0.000			0.000			0.000			0.000			
Truck Tractor	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
Spud Barge																
Inner Harbor Tug Engine	0.000			0.000			0.013			0.013			0.000			
Inner Harbor Tug Generator	0.000			0.000			0.003			0.003			0.000			
Concrete Pump	0.000			0.000			0.000			0.000			0.000			
100T Crawler Crane	0.000			0.000			0.002			0.002			0.000			
CAT 345 Excavator	0.000			0.000			0.008			0.008			0.000			
CAT 330 Excavator	0.000			0.000			0.002			0.002			0.000			
CAT 966 Loader	0.000			0.000			0.003			0.003			0.000			
CAT 950 Loader	0.000			0.000			0.001			0.001			0.000			
	2025			**2026**			**2027**			**2028**			**2029**			
	Exh	**BW**	**TW**	**Exh**	**BW**	**TW**	**Exh**	**BW**	**TW**	**Exh**	**BW**	**TW**	**Exh**	**BW**	**TW**	
Total (ton/yr)	**0.725**	**0.013**	**0.002**	**1.800**	**0.026**	**0.004**	**1.827**	**0.026**	**0.004**	**1.732**	**0.027**	**0.004**	**0.668**	**0.016**	**0.002**	
	$PM_{2.5}$ Total			**$PM_{2.5}$ Total**			**$PM_{2.5}$ Total**			**$PM_{2.5}$ Total**			**$PM_{2.5}$ Total**			
Total (ton/yr)	**1.935**			**4.310**			**4.359**			**4.187**			**1.000**			

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) $PM_{2.5}$ Low Load Adjustment Factor (Ocean Going Vessel Porting) =7.29

Guam Apra Harbor Waterfront Repairs - Bulk Materials Handling and Storage Fugitive Dust Emissions Calculations

Year	Activities	Area Affected (acres)[3]	WRAP Level[4]	Duration (year or days/year) or Tonnage (tons/year)[5]	Emission Factor Unit	Emission Factor [1,2]			Emissions (tons/year)	
						PM_{10}	$PM_{2.5}$	Control Efficiency[6]	PM_{10}	$PM_{2.5}$
2025	Concrete mix components (sand, coarse aggregate, fly ash) off-loading from barges to storage piles.	---	---	---	---	---	---	---	---	---
	Sand	NA	NA	11,739	lbs/ton	6.78E-04	1.02E-04	73%	0.001	1.6E-04
	Coarse aggregate	NA	NA	17,609	lbs/ton	1.84E-02	2.76E-03	73%	0.044	6.6E-03
	Fly ash	NA	NA	1,752	lbs/ton	1.11E-04	1.66E-05	73%	0.000	3.9E-06
2025	Loading concrete mix components (sand, coarse aggregate, fly ash) from storage piles to dump trucks for delivery to local concrete batch plant. [7]	---	---	---	---	---	---	---	---	---
	Sand	NA	NA	11,739	lbs/ton	6.78E-04	1.02E-04	73%	0.001	1.6E-04
	Coarse aggregate	NA	NA	17,609	lbs/ton	1.84E-02	2.76E-03	73%	0.044	6.6E-03
	Fly ash	NA	NA	1,752	lbs/ton	1.11E-04	1.66E-05	73%	0.000	3.9E-06
2025	Loading cement at Hanson Cement Guam to Trucks [8]	NA	NA	4,107	lbs/ton	0.46	0.069	73%	0.26	0.04
2025	Wind Erosion (concrete mix components storage piles)	---	---	---	---	---	---	---	---	---
	Sand	0.5	NA	156	lbs/day-acre	6.96	1.04	90%	0.03	4.1E-03
	Coarse aggregate	0.5	NA	156	lbs/day-acre	4.28	0.64	90%	0.02	2.5E-03
2025	**2025 Fugitive Dust Total**								**0.34**	**0.05**
2026	Loading concrete mix components (sand, coarse aggregate, fly ash) from storage piles to dump trucks for delivery to local concrete batch plant. [7]	---	---	---	---	---	---	---	---	---
	Sand	NA	NA	37,260	lbs/ton	6.78E-04	1.02E-04	73%	0.003	5.1E-04
	Coarse aggregate	NA	NA	55,890	lbs/ton	1.84E-02	2.76E-03	73%	0.139	2.1E-02
	Fly ash	NA	NA	5,561	lbs/ton	1.11E-04	1.66E-05	73%	0.000	1.2E-05
2026	Loading cement at Hanson Cement Guam to Trucks [8]	NA	NA	13,037	lbs/ton	0.46	0.069	73%	0.81	0.12
2026	Wind Erosion (concrete mix components storage piles)	---	---	---	---	---	---	---	---	---
	Sand	0.5	NA	312	lbs/day-acre	6.96	1.04	90%	0.05	8.1E-03
	Coarse aggregate	0.5	NA	312	lbs/day-acre	4.28	0.64	90%	0.03	5.0E-03
2026	**2026 Fugitive Dust Total**								**0.95**	**0.14**
2027	Loading concrete mix components (sand, coarse aggregate, fly ash) from storage piles to dump trucks for delivery to local concrete batch plant. [7]	---	---	---	---	---	---	---	---	---
	Sand	NA	NA	37,260	lbs/ton	6.78E-04	1.02E-04	73%	0.003	5.1E-04
	Coarse aggregate	NA	NA	55,890	lbs/ton	1.84E-02	2.76E-03	73%	0.139	2.1E-02
	Fly ash	NA	NA	5,561	lbs/ton	1.11E-04	1.66E-05	73%	0.000	1.2E-05
2027	Loading cement at Hanson Cement Guam to Trucks [8]	NA	NA	13,037	lbs/ton	0.46	0.069	73%	0.81	0.12
2027	Wind Erosion (concrete mix components storage piles)	---	---	---	---	---	---	---	---	---
	Sand	0.5	NA	312	lbs/day-acre	6.96	1.04	90%	0.05	8.1E-03

	Coarse aggregate	0.5	NA	312	lbs/day-acre	4.28	0.64	90%	0.03	5.0E-03
2027	**2027 2028 Fugitive Dust Total**								**0.95**	**0.14**
2028	Loading concrete mix components (sand, coarse aggregate, fly ash) from storage piles to dump trucks for delivery to local concrete batch plant. [7]	---	---	---	---	---	---	---	---	---
	Sand	NA	NA	26,541	lbs/ton	6.78E-04	1.02E-04	73%	0.002	3.6E-04
	Coarse aggregate	NA	NA	39,812	lbs/ton	1.84E-02	2.76E-03	73%	0.099	1.5E-02
	Fly ash	NA	NA	3,961	lbs/ton	1.11E-04	1.66E-05	73%	0.000	8.9E-06
2028	Loading cement at Hanson Cement Guam to Trucks [8]	NA	NA	9,286	lbs/ton	0.46	0.069	73%	0.58	0.09
2028	Wind Erosion (concrete mix components storage piles)	---	---	---	---	---	---	---	---	---
	Sand	0.5	NA	234	lbs/day-acre	6.96	1.04	90%	0.04	6.1E-03
	Coarse aggregate	0.5	NA	234	lbs/day-acre	4.28	0.64	90%	0.03	3.8E-03
2028	**Fugitive Dust Total**								**0.68**	**0.10**

Notes:

(1) PM2.5 fraction of PM10 is set at 0.15 per guidelines listed in Sections 3, 4 and 9 within WRAP Fugitive Dust Handbook, September 7, 2006, prepared by Countess Environmental. Accessed online at: https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf

(2) Wind Erosion Emission Factor extracted from WRAP handbook Table 11-6, assumed 100% of TSP is PM10

(3) Assumed concrete components storage piles cover 1.5 acres, with 0.5 acres for sand and 0.5 acres for coarse aggregate.

(4) WRAP level from Table 3-2 Ch 3 of WRAP Fugitive Dust Handbook Sep/2006: https://www.env.nm.gov/wp-content/uploads/sites/2/2017/02/WRAP_FDHandbook_Rev_06.pdf

(5) The unit for Duration is "year" or "days/year" to match the emission factor Unit. Sand, coarse aggregate, fly ash, and cement tons are from concrete batching annual quantities produced.

(6) Assumed 57.8% of construction days with rainfall based on average of 211 days per year of rainfall from Guam climate data. Guam rainfall data from online source: https://www.climatestotravel.com/climate/guam#temperature_rain; accessed on December 22, 2024. Assume rain provides 90% control of particulates. Then consider 50% control applied on dry days using wet suppression. That sums to an average annual PM10/PM2.5 control efficiency of 73% for material handling operations. Assume uncovered/unprotected material storage piles will be sprayed with water each day that there is no precipitation, resulting in 90 percent PM10/PM2.5 control efficiency for wind erosion of active storage piles per Table 9-4 in WRAP Handbook.

(7) Fugitive dust from unloading of concrete mix components at the Concrete Batch Plant is included in the Concrete Casting Yard emission factors and calculations.

(8) Assume PM10 emission factor for loading cement from cement plant silo to delivery trucks is equivalent to PM10 emission factor for loading cement from trucks to cement silo in WRAP document, Table 11-3, which is 0.46 lbs/ton.

Supporting Data/Calculations

Mean wind speed (mph) – Guam =13.9 mph - annual avg.[a]

Concrete Aggregate Materials Moisture Content[b]

Sand = 7.4 percent mean

Coarse Aggregate (crushed limestone)= 0.7 percent mean

Fly Ash = 27 percent mean

[a]Based on Guam climate data from Weather Spark online reference: https://weatherspark.com/y/150233/Average-Weather-in-Guam-Year-Round. Averaged the average monthly wind speed over the 12 months of the year.

[b]Concrete component materials moisture contents from WRAP document, Table 4-1.

Formula for PM10 Emission Factor (lbs/ton processed) for Materials Handling [Chapter 4, Equation (1) of WRAP document]: =k*0.0032*(u/5)1.3/(M/2)1.4

k = particle size multiplier, which is 0.35 for PM-10 from WRAP document Chapter 4.

u = mean wind speed in miles/hour (see above)

M = material moisture content (see above)

Formula for PM10 Emission Factor (lbs/day-acre) for Wind Erosion of Active Storage Piles = 0.85 (s/1.5) (f/15)

Formula for PM2.5 Emission Factor (lbs/day-acre) for Wind Erosion of Active Storage Piles = 0.13 (s/1.5) (f/15)

WRAP Fugitive Dust Handbook Section 9.3, uncontrolled emission factor equation for wind erosion of active storage piles.

s = silt content

f = percent of time unobstructed wind speed is greater than 12 mph at mean pile height

Average silt content (%), s =

Sand = 2.6

Aggregate = 1.6 used average of range for crushed limestone

Sand: 6.96 lb/day-acre

Aggregate: 4.28 lb/day-acre

Assumptions/Notes:

Assume fly ash piles are kept covered, or enclosed, when not being transferred from storage piles to trucks or storage piles to the concrete batching feed hoppers. Therefore, emissions from wind erosion of fly ash piles is assumed to be negligible.

Assume cement is either kept covered, or enclosed, when not being transferred from storage piles to trucks or storage piles to the concrete batching feed hoppers, or it is batch transferred directly from the Guam Hanson Cement plant directly into the Concrete Batch Plant feed hoppers.

Assumed the percentage of time the wind speed is greater than 12 mph is based on Guam climate wind data indicating 8.5 months of the year the average wind speed is greater than 12 mph.

Assume material storage piles are only active for 6 months in 2025 and 9 months in 2028 but 12 months in 2026 and 2027 based on concrete batching schedule.

Fugitive dust from vehicle transit over paved roads is included in the onroad vehicles portion of this analysis; separate tab called Resuspended Road Dust and within MOVES emission factors. This includes from resuspension of road dust, brake and tire wear. All vehicle transit is considered over paved roads.

There are no HAP emissions from Bulk Materials Handling as there is no data on speciation for HAPs from these activities.

Guam Apra Harbor Waterfront Repairs – Concrete Casting Yard Materials Handling Fugitive Dust Emissions

Contract Item	Quantities				Schedule		Days				Cubic Yards per Year			
	CAUs	CY/EA	# REQW	CY	Start Date	End Date	2025	2026	2027	2028	2025	2026	2027	2028
SLIN 000103 - Glass Breakwater Supplemental Repair STA 24+00 to 36+50, STA 54+00 to 56+00, STA 10+00 to 11+00 & STA 10+00 to 12+00 (Harbor Side)	40 to 50 T CAU	26.11	1272	33212	9/8/2025	5/18/2026	115	137	0	0	15,156	18,056	0	0
SLIN 000104 - Glass Breakwater Repair Supplemental Breakwater Head Radial, STA 10+00 (0-180 deg),	40 to 50 T CAU	26.11	407	10627	5/19/2026	8/11/2026	0	85	0	0	0	10,627	0	0
SLIN 000201 - Glass Breakwater Supplemental Repair STA 11+00 to 24+00 & STA 23+50 to 24+50 (Harbor Side)	40 to 50 T CAU	26.11	1040	27154	8/12/2026	3/3/2027	0	143	63	0	0	18,850	8,305	0
SLIN 000301 -- Glass Breakwater Supplemental Repair STA 36+50 to 42+50	40 to 50 T CAU	26.11	518	13525	3/4/2027	6/17/2027	0	0	106	0	0	0	13,525	0
SLIN 000401 - Glass Breakwater Supplemental Repair STA 42+50 to 49+00	40 to 50 T CAU	26.11	557	14543	6/18/2027	10/8/2027	0	0	113	0	0	0	14,543	0
SLIN 000501 - Glass Breakwater Supplemental Repair 49+00 to 54+00	40 to 50 T CAU	26.11	592	15457	10/9/2027	2/5/2028	0	0	83	36	0	0	10,781	4,676
SLIN 000601 - Glass Breakwater Supplemental Repair STA 56+00 to 62+00	40 to 50 T CAU	26.11	510	13316	2/6/2028	5/21/2028	0	0	0	105	0	0	0	13,316
SLIN 000701 - Glass Breakwater Supplemental Repair STA 62+00 to 68+00	40 to 50 T CAU	26.11	580	15144	5/22/2028	9/18/2028	0	0	0	119	0	0	0	15,144
						Total	115	365	365	260	**15,156**	**47,532**	**47,154**	**33,136**
										PM_{10} Emissions (lbs/yr)	525	1,646	1,633	1,148
										PM_{10} Emissions (tons/yr)	**0.26**	**0.82**	**0.82**	**0.57**
										$PM_{2.5}$ Emissions (lbs/yr)	79	247	245	172
										$PM_{2.5}$ Emissions (tons/yr)	**0.04**	**0.12**	**0.12**	**0.09**

Notes:

Raw Materials Source: Port McNeil, BC, Canada for aggregates. Assume Los Angeles, CA for admixtures and Fly Ash. Cement is from Hanson Guam.

Raw Materials Round Trip Distance: 5,426 miles for the aggregates

Feb. 2025 TPC-Nan data indicated 6,582 total CAUs at 21 CY each which is 138,222 CY of concrete. However, previous data indicated a more conservative total of 142,978 CY based on 5,476 CAUs at 26.11 CY each. The higher, more conservative total is being used.

Total Concrete (Components)	Source Location	Quantity: 142,978 (total)	CY
ADVA 140 m 58oz/CY	Los Angeles, CA	67,721	Gallons
DARREX1 1AEA 63oz/C	Los Angeles, CA	73,551	Gallons
WRDA-HA 43 oz/CY	Los Angeles, CA	49,273	Gallons
Concrete Sand C-33	Assume BC, Canada	112,800	Tons

Coarse Concrete Aggregate	BC, Canada	169,200	TN
Cement 504#/CY	Guam - via truck	39,467	TN
Fly Ash 215 lb/CY	Los Angeles, CA	16,836	TN

Annual Prorated Quantities of Dry Concrete Mix Components (tons)					
2025	**2026**	**2027**	**2028**	**Total**	**Material**
4,107	13,037	13,037	9,286	39,467	Cement
11,739	37,260	37,260	26,541	112,800	Sand
17,609	55,890	55,890	39,812	169,200	Coarse Aggregate
1,752	5,561	5,561	3,961	16,836	Fly Ash

Piti Location: Polaris Point Access Road	Hours per day	Days annually	Hours Annually
Operating Schedule	6 Days per week/10 Hours per day	300	3000

Quantity of Concrete Produced (daily/monthly/annually) Plan is to average 36 CAU'S per week/156 CAU's monthly/1872 CAU's annually

Raw Materials Source Port McNeil, BC, Canada

Raw Materials Round trip distance 5,426 miles x 2 = 10,852 miles

Quantity/type of material shipped 236,000 Tons/Basalt Aggregates

Erie Strayer - MG-12CP Highly Mobile Central Mix Paving Plant - 400 CY/hr capacity - runs on Island Grid electricity. Uses C&W Dust Collector systems

Assumptions:

(1) Actual mix design is pending; above quantities are approximate.

(2) CAU sizes to be validated through modeling.

(3) Anticipated import of bedding for Armor Stone of 235,000 tons. Shipping via 16,000 DWT ocean-going barge. Point of pick-up is the southern part of South Korea; trip distance is approximately 1,800 miles.

(4) Uncontrolled Total Plant-wide Emission Factors are from Table 11-3 (TSP and PM10 Emission Factors for Non-metallic Ore Processing Operations) for Concrete Batching operations in the WRAP Fugitive Dust Handbook, September 7, 2006, prepared by Countess Environmental. This document references AP-42 Section 11.12 - Concrete Batching. Emissions calculated include coarse aggregate, sand, cement, and fly ash delivery unloading to the batch plant.

(5) Plant-wide PM10 uncontrolled emission factor of 1.723 lbs/ton of concrete was calculated by summing the following concrete batching operations and associated emission factors (lbs/ton) from Table 11-3: (1) aggregate transfer = 0.0033; (2) sand transfer = 0.00099; (3) cement unloading to storage silo = 0.46; (4) cement supplement (fly ash) unloading to silo = 1.10; (5) weigh hopper loading = 0.0024; (6) mixer loading (central mix) = 0.156.

(6) Conservatively assume 99.0% particulate control efficiency for concrete batch plant based on C&W dust collection systems specification sheet, which is actually at least 99.9%.

(7) Assume PM2.5/PM10 ratio is 0.15 as per Chapter 4 - Materials Handling in the WRAP handbook.

(8) Assume one cubic yard of concrete is equivalent to 2.01 tons (4024 lbs/cubic yard) per Table 11-12.2 footnote (a) within Section 11.12 of AP-42.

(9) There are no HAP emissions from the Concret Batch Plant as there is no data on speciation for HAPs from the fugitive particulate dust generated.

Naval Base Guam - Apra Harbor Breakwater Repairs – VOC Emissions

Equipment	VOC Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					VOC Idling Emission Factor (g/hr for on-road only)					VOC Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.0895029	0.0580663	0.0469218	0.040334	0.0345175	0.3406723	0.1921828	0.1257118	0.1041296	0.0997939	0.001	0.001	0.001	0.001	0.000
Passenger car	0.0627226	0.0481996	0.0438711	0.0373784	0.0322914	0.5499396	0.1964372	0.1757922	0.1469312	0.1241322	0.001	0.001	0.001	0.000	0.000
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.0895029	0.0580663	0.0469218	0.040334	0.0345175	0.3406723	0.1921828	0.1257118	0.1041296	0.0997939	0.002	0.002	0.002	0.002	0.001
Passenger Trucks (18), Multiple Staff (18)	0.0895029	0.0580663	0.0469218	0.040334	0.0345175	0.3406723	0.1921828	0.1257118	0.1041296	0.0997939	0.021	0.021	0.017	0.014	0.006
Coral Translocation															
Excavator	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.029	0.000	0.000	0.000	0.000
Flat Bed Truck	0.294423	0.2527994	0.2286278	0.1817646	0.2111572	0.2172943	0.1865985	0.1668048	0.1325626	0.154656	0.005	0.000	0.000	0.000	0.000
Tugboat (Primary Engine)	0.295615	0.295615	0.295615	0.295615	0.295615						0.140	0.000	0.000	0.000	0.000
Tugboat (Bow Thrusters)	0.295615	0.295615	0.295615	0.295615	0.295615						0.140	0.000	0.000	0.000	0.000
Tugboat (Generator)	0.295615	0.295615	0.295615	0.295615	0.295615						0.010	0.000	0.000	0.000	0.000
Twin Engine Large Dive Boat (2 engines, total hp)	0.295615	0.295615	0.295615	0.295615	0.295615						0.021	0.000	0.000	0.000	0.000
Twin Engine Small Dive Boat (2 engines, total hp)	0.295615	0.295615	0.295615	0.295615	0.295615						0.010	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.0895029	0.0580663	0.0469218	0.040334	0.0345175	0.3406723	0.1921828	0.1257118	0.1041296	0.0997939	0.004	0.004	0.003	0.003	0.001
6T All Terrain Forklift 1	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.020	0.024	0.024	0.024	0.020
6T All Terrain Forklift 2	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.012	0.024	0.024	0.024	0.018
Boom Truck	0.294423	0.2527994	0.2286278	0.1817646	0.2111572	0.2172943	0.1865985	0.1668048	0.1325626	0.154656	0.004	0.007	0.006	0.005	0.004
Vacuum Truck/Sweeper	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.007	0.013	0.012	0.011	0.007
Cement Train Tractor 1	0.238806	0.238806	0.238806	0.238806	0.238806						0.017	0.034	0.034	0.034	0.026
Cement Train Tractor 2	0.238806	0.238806	0.238806	0.238806	0.238806						0.017	0.034	0.034	0.034	0.026
100T Gantry Crane 1	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.055	0.109	0.109	0.109	0.082
100T Gantry Crane 2	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.055	0.109	0.109	0.109	0.082
Truck Tractor 1	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.017	0.028	0.025	0.024	0.017
Truck Tractor 2	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.017	0.028	0.025	0.024	0.017
Skid Steer 1	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.004	0.009	0.009	0.009	0.007
Skid Steer 2	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.004	0.009	0.009	0.009	0.007
4000 Gal Water Truck	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.016	0.031	0.028	0.027	0.018
Cat 966 Loader 1	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.048	0.096	0.096	0.096	0.072
Cat 966 Loader 2	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.048	0.096	0.096	0.096	0.072
36 Meter Concrete Pump Truck	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.012	0.023	0.021	0.020	0.013
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller											0	0	0	0	0
100 KW Generators Backup Power (2)	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.009	0.009	0.009	0.009	0.009
Ready Mix Concrete Truck 1	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.028	0.025	0.024	0.017	0.028
Ready Mix Concrete Truck 2	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.028	0.025	0.024	0.017	0.028
Ready Mix Concrete Truck 3	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.028	0.025	0.024	0.017	0.028
Ready Mix Concrete Truck 4 (reserve)	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.003	0.003	0.002	0.002	0.003
60' Manlift for Maintenance	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.006	0.006	0.006	0.004	0.006
Dump Trucks (4)	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.127	0.117	0.113	0.086	0.127
Truck Tractor for Roll Off Trash Bins	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.015	0.014	0.013	0.009	0.015
Fuel Truck	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.017	0.016	0.015	0.011	0.017
CAT D8 Dozer	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.000	0.000
CAT 950 Loader	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.004	0.000
CAT 14H Grader	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.000	0.000
25T Vibratory Compactor	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.000	0.000
CAT 345 Excavator	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.006	0.000
100T Crawler Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.005	0.000

175T Crawler Crane	0.238806	0.238806	0.238806	0.238806	0.238806						0.000	0.000	0.000	0.000	0.000
185 CFM Compressor	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.000	0.000	0.000	0.000	0.000
Miller Welder 400Amps	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.000	0.000	0.000	0.000	0.000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.238806	0.238806	0.238806	0.238806	0.238806						0.024	0.119	0.119	0.119	0.024
Manitowoc MLC 300 Crawler Crane Breakwater	0.238806	0.238806	0.238806	0.238806	0.238806						0.024	0.119	0.119	0.119	0.024
Manitowoc MLC 300 Crawler Crane Breakwater	0.238806	0.238806	0.238806	0.238806	0.238806						0.024	0.119	0.119	0.119	0.024
Manitowoc 999 Crawler Crane Breakwater	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.022	0.109	0.109	0.109	0.022
Kobelco 275 Ton Crawler	0.238806	0.238806	0.238806	0.238806	0.238806						0.039	0.194	0.194	0.194	0.039
60T Hydraulic Crane Assembly Crane	0.238806	0.238806	0.238806	0.238806	0.238806						0.015	0.015	0.015	0.015	0.015
Cat 988 Loader 1	0.238806	0.238806	0.238806	0.238806	0.238806						0.043	0.170	0.170	0.170	0.043
Cat 988 Loader 2	0.238806	0.238806	0.238806	0.238806	0.238806						0.043	0.170	0.170	0.170	0.043
Cat 988 Loader 3	0.238806	0.238806	0.238806	0.238806	0.238806						0.043	0.170	0.170	0.170	0.043
100T Hydraulic Excavator 1	0.238806	0.238806	0.238806	0.238806	0.238806						0.039	0.157	0.157	0.157	0.039
100T Hydraulic Excavator 2	0.238806	0.238806	0.238806	0.238806	0.238806						0.039	0.157	0.157	0.157	0.039
CAT 745 Rock Truck 1	0.238806	0.238806	0.238806	0.238806	0.238806						0.034	0.135	0.135	0.135	0.034
CAT 745 Rock Truck 2	0.238806	0.238806	0.238806	0.238806	0.238806						0.017	0.067	0.067	0.067	0.017
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.295615	0.295615	0.295615	0.295615	0.295615						0.136	0.546	0.546	0.546	0.136
Inner Harbor Tug 1 Generator	0.295615	0.295615	0.295615	0.295615	0.295615						0.069	0.275	0.275	0.275	0.069
Inner Harbor Tug 2 Engine	0.295615	0.295615	0.295615	0.295615	0.295615						0.136	0.546	0.546	0.546	0.136
Inner Harbor Tug 2 Generator	0.295615	0.295615	0.295615	0.295615	0.295615						0.069	0.275	0.275	0.275	0.069
Ocean Going Tug for Armor Stone Transport Engine	0.295615	0.295615	0.295615	0.295615	0.295615						1.118	2.235	2.235	2.235	0.000
Ocean Going Tug for Armor Stone Transport Generator	0.295615	0.295615	0.295615	0.295615	0.295615						0.160	0.320	0.320	0.320	0.000
20' Aluminum Crew Boat	6.1582796	6.117313	6.0850914	6.0631385	6.0541604						0.000	0.000	0.000	0.000	0.000
10' Safety Boat 1	7.4584053	6.9312109	6.5101586	6.2225703	6.0984639						0.000	0.000	0.000	0.000	0.000
10' Safety Boat 2	7.4584053	6.9312109	6.5101586	6.2225703	6.0984639						0.000	0.000	0.000	0.000	0.000
Fuel Truck	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.003	0.013	0.012	0.011	0.002
Mechanic Truck 1	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.019	0.030	0.028	0.027	0.013
Mechanic Truck 2	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.019	0.030	0.028	0.027	0.013
Welding Truck	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.004	0.018	0.018	0.018	0.004
Compressor	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.003	0.010	0.010	0.010	0.003
Boom Truck	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.004	0.015	0.014	0.014	0.003
Water Truck	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.008	0.031	0.028	0.027	0.006
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.009	0.020	0.018	0.018	0.006
Truck Tractor for Mob/Demob/Various	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.004	0.015	0.014	0.014	0.003
6T All Terrain Forklift	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.010	0.039	0.039	0.039	0.010
D8 Dozer	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.022	0.000	0.000	0.000	0.000
CAT 330 Excavator	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.018	0.000	0.000	0.000	0.000
CAT 14H Grader	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.022	0.000	0.000	0.000	0.000
230T Crawler Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.003	0.003	0.000
Kincho Vibro Hammer/Gen	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.001	0.001	0.000
HPSI 260Hammer w/400HP Powerpack	0.238806	0.238806	0.238806	0.238806	0.238806						0.000	0.000	0.000	0.000	0.000
Delmag 30-32 Hammer	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.001	0.001	0.000
65T Rough Terrain Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.000	0.000
Ocean Going Vessels (Product List)	**VOC Emissions Factor, Main Engine (g/kw-hr)**					**VOC Emissions Factor, Auxiliary Engine (g/kw-hr)**									
ADVA 140 m 58oz/CY (Concrete Additive)	0.53	0.53	0.53	0.53	0.53	0.1411	0.1411	0.1411	0.1411	0.1411	0.002	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33	0.53	0.53	0.53	0.53	0.53	0.1411	0.1411	0.1411	0.1411	0.1411	0.013	0	0	0	0
Coarse Concrete Aggregate	0.53	0.53	0.53	0.53	0.53	0.1411	0.1411	0.1411	0.1411	0.1411	0.020	0	0	0	0
Cement 504#/CY (4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.000	0	0	0	0
Fly Ash 215 lb/CY	0.53	0.53	0.53	0.53	0.53	0.1411	0.1411	0.1411	0.1411	0.1411	0.002	0	0	0	0

Armor Stone Bedding	0.53	0.53	0.53	0.53	0.53	0.1411	0.1411	0.1411	0.1411	0.1411	0.079	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.0895029	0.0580663	0.0469218	0.040334	0.0345175	0.3406723	0.1921828	0.1257118	0.1041296	0.0997939	0.000	0.000	0.000	0.000	0.000
Passenger car	0.0627226	0.0481996	0.0438711	0.0373784	0.0322914	0.5499396	0.1964372	0.1757922	0.1469312	0.1241322	0.000	0.000	0.000	0.000	0.000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.0895029	0.0580663	0.0469218	0.040334	0.0345175	0.3406723	0.1921828	0.1257118	0.1041296	0.0997939	0.000	0.000	0.002	0.001	0.000
185 CFM Compressor	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.000	0.000	0.009	0.009	0.000
Miller Welder	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.000	0.000	0.002	0.002	0.000
90T Rough Terrain Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.001	0.001	0.000
175T Crawler Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.011	0.011	0.000
6T Forklift	0.2798507	0.2798507	0.2798507	0.2798507	0.2798507						0.000	0.000	0.007	0.007	0.000
20' Aluminum Crew Boat	0.295615	0.295615	0.295615	0.295615	0.295615						0.000	0.000	0.004	0.004	0.000
10' Safety Boat	0.295615	0.295615	0.295615	0.295615	0.295615						0.000	0.000	0.000	0.000	0.000
230T Crawler Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.012	0.012	0.000
Kincho Vibro Hammer/Gen	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.002	0.002	0.000
HPSI 260Hammer w/400HP Powerpack	0.238806	0.238806	0.238806	0.238806	0.238806						0.000	0.000	0.002	0.002	0.000
Delmag 30-32 Hammer	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.004	0.004	0.000
65T Rough Terrain Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.000	0.000	0.000
Truck Tractor	0.5979426	0.5575424	0.511788	0.4939323	0.434963	4.59247	4.312517	3.9494	3.701679	3.295896	0.000	0.000	0.000	0.000	0.000
Spud Barge															
Inner Harbor Tug Engine	0.295615	0.295615	0.295615	0.295615	0.295615						0.000	0.000	0.026	0.026	0.000
Inner Harbor Tug Generator	0.295615	0.295615	0.295615	0.295615	0.295615						0.000	0.000	0.005	0.005	0.000
Concrete Pump	0.238806	0.238806	0.238806	0.238806	0.238806						0.000	0.000	0.001	0.001	0.000
100T Crawler Crane	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.003	0.003	0.000
CAT 345 Excavator	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.014	0.014	0.000
CAT 330 Excavator	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.003	0.003	0.000
CAT 966 Loader	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.005	0.005	0.000
CAT 950 Loader	0.2462687	0.2462687	0.2462687	0.2462687	0.2462687						0.000	0.000	0.002	0.002	0.000
										Total (ton/yr)	**18.620**	**42.340**	**43.293**	**43.068**	**12.870**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) VOC Low Load Adjustment Factor (Ocean Going Vessel Porting) = 21.18

Naval Base Guam - Apra Harbor Breakwater Repairs – CO_2 Emissions

Equipment	CO_2 Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					CO_2 Idling Emission Factor (g/hr for on-road only)					CO_2 Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	430.708	422.681	416.000	409.956	405.380	3302.670	3195.870	3104.480	3011.100	2914.440	5.697	5.591	5.503	5.423	5.362
Passenger car	340.305	335.622	330.207	325.565	321.900	2657.190	2583.030	2497.520	2416.020	2336.590	4.501	4.440	4.368	4.306	4.258
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	430.708	422.681	416.000	409.956	405.380	3302.670	3195.870	3104.480	3011.100	2914.440	11.395	16.773	16.508	16.268	8.043
Passenger Trucks (18), Multiple Staff (18)	430.708	422.681	416.000	409.956	405.380	3302.670	3195.870	3104.480	3011.100	2914.440	102.551	150.960	148.574	146.415	72.390
Coral Translocation															
Excavator	536.795	536.798	536.799	536.800	536.801						62.840	0.000	0.000	0.000	0.000
Flat Bed Truck	686.489	668.786	659.528	645.503	640.196	257.309	247.101	241.450	227.064	224.910	12.108	0.000	0.000	0.000	0.000
Tugboat (Primary Engine)	679.470	679.470	679.470	679.470	679.470						321.702	0.000	0.000	0.000	0.000
Tugboat (Bow Thrusters)	679.470	679.470	679.470	679.470	679.470						321.702	0.000	0.000	0.000	0.000
Tugboat (Generator)	679.470	679.470	679.470	679.470	679.470						23.055	0.000	0.000	0.000	0.000
Twin Engine Large Dive Boat (2 engines, total hp)	679.470	679.470	679.470	679.470	679.470						47.290	0.000	0.000	0.000	0.000
Twin Engine Small Dive Boat (2 engines, total hp)	679.470	679.470	679.470	679.470	679.470						22.519	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	430.708	422.681	416.000	409.956	405.380	3302.670	3195.870	3104.480	3011.100	2914.440	18.991	27.956	27.514	27.114	13.406
6T All Terrain Forklift 1	596.135	596.135	596.137	596.136	596.135						43.171	51.410	51.410	51.410	43.500
6T All Terrain Forklift 2	596.135	596.135	596.137	596.136	596.135						25.705	51.410	51.410	51.410	38.557
Boom Truck	686.489	668.786	659.528	645.503	640.196	257.309	247.101	241.450	227.064	224.910	9.444	18.401	18.146	17.760	13.211
Vacuum Truck/Sweeper	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	13.475	26.419	25.798	25.908	18.686
Cement Train Tractor 1	625.854	625.931	626.001	626.072	626.139						45.201	90.414	90.424	90.434	67.833
Cement Train Tractor 2	625.854	625.931	626.001	626.072	626.139						45.201	90.414	90.424	90.434	67.833
100T Gantry Crane 1	530.973	530.987	530.994	531.001	531.004						117.785	235.577	235.580	235.583	176.688
100T Gantry Crane 2	530.973	530.987	530.994	531.001	531.004						117.785	235.577	235.580	235.583	176.688
Truck Tractor 1	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	28.302	51.522	50.315	50.511	37.354
Truck Tractor 2	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	28.302	51.522	50.315	50.511	37.354
Skid Steer 1	693.982	694.076	694.236	694.487	694.745						11.027	22.057	22.062	22.070	16.558
Skid Steer 2	693.982	694.076	694.236	694.487	694.745						11.027	22.057	22.062	22.070	16.558
4000 Gal Water Truck	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	32.340	63.406	61.916	62.180	44.848
Cat 966 Loader 1	536.768	536.780	536.786	536.790	536.792						104.561	209.126	209.129	209.130	156.848
Cat 966 Loader 2	536.768	536.780	536.786	536.790	536.792						104.561	209.126	209.129	209.130	156.848
36 Meter Concrete Pump Truck	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	24.255	47.555	46.437	46.635	33.636
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller											0	0	0	0	0
100 KW Generators Backup Power (2)	536.717	536.732	536.750	536.763	536.776						18.710	18.710	18.711	18.711	18.712
Ready Mix Concrete Truck 1	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	28.302	51.522	50.315	50.511	37.354
Ready Mix Concrete Truck 2	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	28.302	51.522	50.315	50.511	37.354
Ready Mix Concrete Truck 3	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	28.302	51.522	50.315	50.511	37.354
Ready Mix Concrete Truck 4 (reserve)	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	2.830	5.152	5.031	5.051	3.735
60' Manlift for Maintenance	625.518	625.624	625.731	625.841	625.949						7.530	15.062	15.064	15.067	11.302
Dump Trucks (4)	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	133.406	257.593	251.542	252.597	209.941
Truck Tractor for Roll Off Trash Bins	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	14.827	25.103	24.517	24.603	18.668
Fuel Truck	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	17.522	30.387	29.676	29.785	22.405
CAT D8 Dozer	536.787	536.791	536.793	536.796	536.799						12.568	0.000	0.000	0.000	0.000
CAT 950 Loader	536.768	536.780	536.786	536.790	536.792						7.959	0.000	0.000	0.000	7.960
CAT 14H Grader	536.790	536.795	536.801	536.802	536.804						21.156	0.000	0.000	0.000	0.000
25T Vibratory Compactor	536.711	536.729	536.747	536.761	536.777						13.613	0.000	0.000	0.000	0.000
CAT 345 Excavator	536.795	536.798	536.799	536.800	536.801						0.000	0.000	0.000	0.000	13.354
100T Crawler Crane	530.973	530.987	530.994	531.001	531.004						13.842	0.000	0.000	0.000	10.382

175T Crawler Crane	530.924	530.935	530.944	530.952	530.960						42.278	0.000	0.000	0.000	0.000
185 CFM Compressor	590.062	590.092	590.131	590.150	590.165						10.069	0.000	0.000	0.000	0.000
Miller Welder 400Amps	694.237	694.374	694.539	694.736	694.919						7.328	0.000	0.000	0.000	0.000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	530.924	530.935	530.944	530.952	530.960						52.763	263.820	263.825	263.829	52.767
Manitowoc MLC 300 Crawler Crane Breakwater	530.924	530.935	530.944	530.952	530.960						52.763	263.820	263.825	263.829	52.767
Manitowoc MLC 300 Crawler Crane Breakwater	530.924	530.935	530.944	530.952	530.960						52.763	263.820	263.825	263.829	52.767
Manitowoc 999 Crawler Crane Breakwater	530.973	530.987	530.994	531.001	531.004						46.800	234.006	234.009	234.012	46.803
Kobelco 275 Ton Crawler	536.746	536.755	536.769	536.777	536.788						87.130	435.659	435.670	435.677	87.137
60T Hydraulic Crane Assembly Crane	530.924	530.935	530.944	530.952	530.960						32.470	32.470	32.471	32.471	32.472
Cat 988 Loader 1	536.722	536.731	536.740	536.749	536.757						95.621	382.492	382.498	382.504	95.628
Cat 988 Loader 2	536.722	536.731	536.740	536.749	536.757						95.621	382.492	382.498	382.504	95.628
Cat 988 Loader 3	536.722	536.731	536.740	536.749	536.757						95.621	382.492	382.498	382.504	95.628
100T Hydraulic Excavator 1	536.767	536.776	536.784	536.789	536.793						88.005	352.026	352.031	352.035	88.009
100T Hydraulic Excavator 2	536.767	536.776	536.784	536.789	536.793						88.005	352.026	352.031	352.035	88.009
CAT 745 Rock Truck 1	536.796	536.798	536.799	536.801	536.801						75.810	303.243	303.244	303.245	75.811
CAT 745 Rock Truck 2	536.796	536.798	536.799	536.801	536.801						37.905	151.622	151.622	151.622	37.906
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	679.470	679.470	679.470	679.470	679.470						313.660	1254.638	1254.638	1254.638	313.660
Inner Harbor Tug 1 Generator	679.470	679.470	679.470	679.470	679.470						157.785	631.139	631.139	631.139	157.785
Inner Harbor Tug 2 Engine	679.470	679.470	679.470	679.470	679.470						313.660	1254.638	1254.638	1254.638	313.660
Inner Harbor Tug 2 Generator	679.470	679.470	679.470	679.470	679.470						157.785	631.139	631.139	631.139	157.785
Ocean Going Tug for Armor Stone Transport Engine	679.470	679.470	679.470	679.470	679.470						2568.590	5137.180	5137.180	5137.180	0.000
Ocean Going Tug for Armor Stone Transport Generator	679.470	679.470	679.470	679.470	679.470						368.165	736.329	736.329	736.329	0.000
20' Aluminum Crew Boat	917.595	917.799	917.965	918.075	918.123						0.000	0.000	0.000	0.000	0.000
10' Safety Boat 1	1135.892	1135.549	1135.274	1135.087	1135.002						0.000	0.000	0.000	0.000	0.000
10' Safety Boat 2	1135.892	1135.549	1135.274	1135.087	1135.002						0.000	0.000	0.000	0.000	0.000
Fuel Truck	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	6.737	26.419	25.798	25.908	6.229
Mechanic Truck 1	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	30.996	56.806	55.475	55.693	28.634
Mechanic Truck 2	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	30.996	56.806	55.475	55.693	28.634
Welding Truck	625.672	625.750	625.832	625.922	626.005						11.335	45.344	45.350	45.357	11.341
Compressor	590.062	590.092	590.131	590.150	590.165						5.454	21.817	21.818	21.819	5.455
Boom Truck	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	8.085	31.703	30.958	31.090	7.475
Water Truck	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	16.170	63.406	61.916	62.180	14.949
Truck Tractor for Roll Off Trash Bins Stage at Hotel	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	12.132	35.671	34.836	34.966	11.193
Truck Tractor for Mob/Demob/Various	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	8.085	31.703	30.958	31.090	7.475
6T All Terrain Forklift	596.135	596.135	596.137	596.136	596.135						20.564	82.255	82.256	82.256	20.564
D8 Dozer	536.787	536.791	536.793	536.796	536.799						48.002	0.000	0.000	0.000	0.000
CAT 330 Excavator	536.795	536.798	536.799	536.800	536.801						39.275	0.000	0.000	0.000	0.000
CAT 14H Grader	536.788	536.794	536.794	536.797	536.799						48.002	0.000	0.000	0.000	0.000
230T Crawler Crane	530.973	530.987	530.994	531.001	531.004						0.000	0.000	6.377	6.377	0.000
Kincho Vibro Hammer/Gen	530.958	530.970	530.985	530.992	531.001						0.000	0.000	1.177	1.177	0.000
HPSI 260Hammer w/400HP Powerpack	530.880	530.905	530.925	530.939	530.956						0.000	0.000	1.107	1.107	0.000
Delmag 30-32 Hammer	530.958	530.970	530.985	530.992	531.001						0.000	0.000	2.080	2.080	0.000
65T Rough Terrain Crane	530.973	530.987	530.994	531.001	531.004						0.000	0.000	0.195	0.195	0.000
Ocean Going Vessels (Product List)	**CO_2 Emissions Factor, Main Engine (g/kw-hr)**					**CO_2 Emissions Factor, Auxiliary Engine (g/kw-hr)**									
ADVA 140 m 58oz/CY (Concrete Additive) DARREX1 1AEA 63oz/CY (Concrete Additive) WRDA-HA 43 oz/CY (Concrete Additive)	657.23	657.23	657.23	657.23	657.23	679.47	679.47	679.47	679.47	679.47	2.922	0	0	0	0
Concrete Sand C-33	657.23	657.23	657.23	657.23	657.23	679.47	679.47	679.47	679.47	679.47	17.530	0	0	0	0
Coarse Concrete Aggregate	657.23	657.23	657.23	657.23	657.23	679.47	679.47	679.47	679.47	679.47	26.295	0	0	0	0
Cement 504#/CY (4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.000	0	0	0	0
Fly Ash 215 lb/CY	657.23	657.23	657.23	657.23	657.23	679.47	679.47	679.47	679.47	679.47	2.922	0	0	0	0

Armor Stone Bedding	657.23	657.23	657.23	657.23	657.23	679.47	679.47	679.47	679.47	679.47	95.048	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	430.708	422.681	416.000	409.956	405.380	3302.670	3195.870	3104.480	3011.100	2914.440	0.000	0.000	1.651	1.627	0.000
Passenger car	340.305	335.622	330.207	325.565	321.900	2657.190	2583.030	2497.520	2416.020	2336.590	0.000	0.000	1.310	1.292	0.000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	430.708	422.681	416.000	409.956	405.380	3302.670	3195.870	3104.480	3011.100	2914.440	0.000	0.000	13.757	13.557	0.000
185 CFM Compressor	590.062	590.092	590.131	590.150	590.165						0.000	0.000	19.510	19.511	0.000
Miller Welder	694.130	694.264	694.424	694.615	694.793						0.000	0.000	4.822	4.824	0.000
90T Rough Terrain Crane	530.973	530.987	530.994	531.001	531.004						0.000	0.000	2.838	2.838	0.000
175T Crawler Crane	530.973	530.987	530.994	531.001	531.004						0.000	0.000	24.464	24.464	0.000
6T Forklift	596.135	596.135	596.137	596.136	596.135						0.000	0.000	14.237	14.237	0.000
20' Aluminum Crew Boat	679.470	679.470	679.470	679.470	679.470						0.000	0.000	10.194	10.194	0.000
10' Safety Boat	679.470	679.470	679.470	679.470	679.470						0.000	0.000	0.327	0.327	0.000
230T Crawler Crane	530.973	530.987	530.994	531.001	531.004						0.000	0.000	26.314	26.314	0.000
Kincho Vibro Hammer/Gen	530.958	530.970	530.985	530.992	531.001						0.000	0.000	4.914	4.914	0.000
HPSI 260Hammer w/400HP Powerpack	530.880	530.905	530.925	530.939	530.956						0.000	0.000	4.731	4.731	0.000
Delmag 30-32 Hammer	530.958	530.970	530.985	530.992	531.001						0.000	0.000	8.464	8.464	0.000
65T Rough Terrain Crane	530.973	530.987	530.994	531.001	531.004						0.000	0.000	0.879	0.879	0.000
Truck Tractor	1175.406	1152.271	1125.187	1129.987	1086.672	3824.060	3749.360	3664.540	3663.000	3513.980	0.000	0.000	0.372	0.374	0.000
Spud Barge															
Inner Harbor Tug Engine	679.470	679.470	679.470	679.470	679.470						0.000	0.000	60.319	60.319	0.000
Inner Harbor Tug Generator	679.470	679.470	679.470	679.470	679.470						0.000	0.000	12.104	12.104	0.000
Concrete Pump	530.880	530.905	530.925	530.939	530.956						0.000	0.000	1.510	1.510	0.000
100T Crawler Crane	530.973	530.987	530.994	531.001	531.004						0.000	0.000	6.796	6.796	0.000
CAT 345 Excavator	536.795	536.798	536.799	536.800	536.801						0.000	0.000	29.849	29.849	0.000
CAT 330 Excavator	536.795	536.798	536.799	536.800	536.801						0.000	0.000	7.331	7.331	0.000
CAT 966 Loader	625.967	626.051	626.112	626.157	626.197						0.000	0.000	12.001	12.002	0.000
CAT 950 Loader	625.967	626.051	626.112	626.157	626.197						0.000	0.000	5.363	5.363	0.000
										Total (ton/yr)	**7336.505**	**16085.271**	**16343.034**	**16343.606**	**3621.150**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) CO_2 Low Load Adjustment Factor (Ocean Going Vessel Porting) = 3.28

Naval Base Guam - Apra Harbor Breakwater Repairs – CH_4 Emissions

Equipment	CH_4 Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					CH_4 Idling Emission Factor (g/hr for on-road only)					CH_4 Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.0219519	0.0165448	0.0145723	0.0133906	0.0123707	0.0848758	0.0590252	0.0470758	0.0427569	0.0413609	0.00029	0.00029	0.00019	0.00018	0.00016
Passenger car	0.0175857	0.0150820	0.0142960	0.0131222	0.0121684	0.1220106	0.0614667	0.0572841	0.0515825	0.0467767	0.00023	0.00023	0.00019	0.00017	0.00016
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.0219519	0.0165448	0.0145723	0.0133906	0.0123707	0.0848758	0.0590252	0.0470758	0.0427569	0.0413609	0.00058	0.00058	0.00058	0.00053	0.00025
Passenger Trucks (18), Multiple Staff (18)	0.0219519	0.0165448	0.0145723	0.0133906	0.0123707	0.0848758	0.0590252	0.0470758	0.0427569	0.0413609	0.00523	0.00523	0.00520	0.00478	0.00221
Coral Translocation															
Excavator	0.0006615	0.0005367	0.0004542	0.0004054	0.0003798						0.00008	0.00008	0.00000	0.00000	0.00000
Flat Bed Truck	0.0156737	0.0153791	0.0150654	0.0152751	0.0146391	0.0134809	0.0130632	0.0126774	0.0122939	0.0119021	0.00028	0.00028	0.00000	0.00000	0.00000
Tugboat (Primary Engine)	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.003	0.000	0.000	0.000	0.000
Tugboat (Bow Thrusters)	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.003	0.000	0.000	0.000	0.000
Tugboat (Generator)	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.000	0.000	0.000	0.000	0.000
Twin Engine Large Dive Boat (2 engines, total hp)	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.000	0.000	0.000	0.000	0.000
Twin Engine Small Dive Boat (2 engines, total hp)	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.000	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.0219519	0.0165448	0.0145723	0.0133906	0.0123707	0.0848758	0.0590252	0.0470758	0.0427569	0.0413609	0.00097	0.00097	0.00096	0.00089	0.00041
6T All Terrain Forklift 1	0.0005471	0.0005395	0.0005394	0.0005394	0.0005394						0.00004	0.00004	0.00005	0.00005	0.00004
6T All Terrain Forklift 2	0.0005471	0.0005395	0.0005394	0.0005394	0.0005394						0.00002	0.00002	0.00005	0.00005	0.00003
Boom Truck	0.0156737	0.0153791	0.0150654	0.0152751	0.0146391	0.0134809	0.0130632	0.0126774	0.0122939	0.0119021	0.00022	0.00022	0.00041	0.00042	0.00030
Vacuum Truck/Sweeper	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00026	0.00026	0.00051	0.00050	0.00037
Cement Train Tractor 1	0.0122265	0.0112895	0.0102420	0.0090623	0.0078363						0.00088	0.00088	0.00148	0.00131	0.00085
Cement Train Tractor 2	0.0122265	0.0112895	0.0102420	0.0090623	0.0078363						0.00088	0.00088	0.00148	0.00131	0.00085
100T Gantry Crane 1	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00040	0.00040	0.00046	0.00038	0.00025
100T Gantry Crane 2	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00040	0.00040	0.00046	0.00038	0.00025
Truck Tractor 1	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00066	0.00066	0.00110	0.00108	0.00085
Truck Tractor 2	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00066	0.00066	0.00110	0.00108	0.00085
Skid Steer 1	0.0312432	0.0306132	0.0295676	0.0279092	0.0250839						0.00050	0.00050	0.00094	0.00089	0.00060
Skid Steer 2	0.0312432	0.0306132	0.0295676	0.0279092	0.0250839						0.00050	0.00050	0.00094	0.00089	0.00060
4000 Gal Water Truck	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00063	0.00063	0.00121	0.00119	0.00089
Cat 966 Loader 1	0.0015845	0.0012228	0.0009738	0.0008150	0.0007201						0.00031	0.00031	0.00038	0.00032	0.00021
Cat 966 Loader 2	0.0015845	0.0012228	0.0009738	0.0008150	0.0007201						0.00031	0.00031	0.00038	0.00032	0.00021
36 Meter Concrete Pump Truck	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00047	0.00047	0.00091	0.00090	0.00067
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller											0	0	0	0	0
100 KW Generators Backup Power (2)	0.0028475	0.0024161	0.0019625	0.0015131	0.0011729						0.00010	0.00010	0.00007	0.00005	0.00004
Ready Mix Concrete Truck 1	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00066	0.00066	0.00110	0.00108	0.00085
Ready Mix Concrete Truck 2	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00066	0.00066	0.00110	0.00108	0.00085
Ready Mix Concrete Truck 3	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00066	0.00066	0.00110	0.00108	0.00085
Ready Mix Concrete Truck 4 (reserve)	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00007	0.00007	0.00011	0.00011	0.00008
60' Manlift for Maintenance	0.0182161	0.0169212	0.0155571	0.0138023	0.0117612						0.00022	0.00022	0.00037	0.00033	0.00021
Dump Trucks (4)	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00270	0.00270	0.00504	0.00496	0.00427
Truck Tractor for Roll Off Trash Bins	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00040	0.00040	0.00059	0.00058	0.00048
Fuel Truck	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00045	0.00045	0.00069	0.00068	0.00055
CAT D8 Dozer	0.0009972	0.0008094	0.0006723	0.0005571	0.0004706						0.00002	0.00002	0.00000	0.00000	0.00000
CAT 950 Loader	0.0015845	0.0012228	0.0009738	0.0008150	0.0007201						0.00002	0.00002	0.00000	0.00000	0.00001
CAT 14H Grader	0.0010773	0.0009391	0.0008242	0.0007249	0.0006574						0.00004	0.00004	0.00000	0.00000	0.00000
25T Vibratory Compactor	0.0032609	0.0027842	0.0023358	0.0018928	0.0014614						0.00008	0.00008	0.00000	0.00000	0.00000
CAT 345 Excavator	0.0006615	0.0005367	0.0004542	0.0004054	0.0003798						0.00000	0.00000	0.00000	0.00000	0.00001
100T Crawler Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00005	0.00005	0.00000	0.00000	0.00001

175T Crawler Crane	0.0029898	0.0027325	0.0025015	0.0022831	0.0020437						0.00024	0.00024	0.00000	0.00000	0.00000
185 CFM Compressor	0.0120462	0.0114821	0.0107104	0.0102962	0.0099590						0.00021	0.00021	0.00000	0.00000	0.00000
Miller Welder 400Amps	0.0247919	0.0236210	0.0221833	0.0203991	0.0181814						0.00026	0.00026	0.00000	0.00000	0.00000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.0029898	0.0027325	0.0025015	0.0022831	0.0020437						0.00030	0.00030	0.00124	0.00113	0.00020
Manitowoc MLC 300 Crawler Crane Breakwater	0.0029898	0.0027325	0.0025015	0.0022831	0.0020437						0.00030	0.00030	0.00124	0.00113	0.00020
Manitowoc MLC 300 Crawler Crane Breakwater	0.0029898	0.0027325	0.0025015	0.0022831	0.0020437						0.00030	0.00030	0.00124	0.00113	0.00020
Manitowoc 999 Crawler Crane Breakwater	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00016	0.00016	0.00046	0.00038	0.00007
Kobelco 275 Ton Crawler	0.0022303	0.0018809	0.0014692	0.0011663	0.0009053						0.00036	0.00036	0.00119	0.00095	0.00015
60T Hydraulic Crane Assembly Crane	0.0029898	0.0027325	0.0025015	0.0022831	0.0020437						0.00018	0.00018	0.00015	0.00014	0.00012
Cat 988 Loader 1	0.0027854	0.0025360	0.0023073	0.0020572	0.0017757						0.00050	0.00050	0.00164	0.00147	0.00032
Cat 988 Loader 2	0.0027854	0.0025360	0.0023073	0.0020572	0.0017757						0.00050	0.00050	0.00164	0.00147	0.00032
Cat 988 Loader 3	0.0027854	0.0025360	0.0023073	0.0020572	0.0017757						0.00050	0.00050	0.00164	0.00147	0.00032
100T Hydraulic Excavator 1	0.0016337	0.0012702	0.0010001	0.0008328	0.0007323						0.00027	0.00027	0.00066	0.00055	0.00012
100T Hydraulic Excavator 2	0.0016337	0.0012702	0.0010001	0.0008328	0.0007323						0.00027	0.00027	0.00066	0.00055	0.00012
CAT 745 Rock Truck 1	0.0006406	0.0005215	0.0004457	0.0004000	0.0003773						0.00009	0.00009	0.00025	0.00023	0.00005
CAT 745 Rock Truck 2	0.0006406	0.0005215	0.0004457	0.0004000	0.0003773						0.00005	0.00005	0.00013	0.00011	0.00003
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.003	0.011	0.011	0.011	0.003
Inner Harbor Tug 1 Generator	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.001	0.006	0.006	0.006	0.001
Inner Harbor Tug 2 Engine	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.003	0.011	0.011	0.011	0.003
Inner Harbor Tug 2 Generator	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.001	0.006	0.006	0.006	0.001
Ocean Going Tug for Armor Stone Transport Engine	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.024	0.047	0.047	0.047	0.000
Ocean Going Tug for Armor Stone Transport Generator	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.003	0.007	0.007	0.007	0.000
20' Aluminum Crew Boat	1.0268494	1.0257000	1.0248722	1.0243162	1.0241664						0.00000	0.00000	0.00000	0.00000	0.00000
10' Safety Boat 1	1.0448187	1.0396143	1.0355426	1.0327720	1.0316605						0.00000	0.00000	0.00000	0.00000	0.00000
10' Safety Boat 2	1.0448187	1.0396143	1.0355426	1.0327720	1.0316605						0.00000	0.00000	0.00000	0.00000	0.00000
Fuel Truck	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00013	0.00013	0.00051	0.00050	0.00012
Mechanic Truck 1	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00071	0.00071	0.00120	0.00118	0.00068
Mechanic Truck 2	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00071	0.00071	0.00120	0.00118	0.00068
Welding Truck	0.0154130	0.0146129	0.0135011	0.0120174	0.0105103						0.00028	0.00028	0.00098	0.00087	0.00019
Compressor	0.0120462	0.0114821	0.0107104	0.0102962	0.0099590						0.00011	0.00011	0.00040	0.00038	0.00009
Boom Truck	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00016	0.00016	0.00061	0.00060	0.00015
Water Truck	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00031	0.00031	0.00121	0.00119	0.00030
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00035	0.00035	0.00079	0.00078	0.00033
Truck Tractor for Mob/Demob/Various	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00016	0.00016	0.00061	0.00060	0.00015
6T All Terrain Forklift	0.0005471	0.0005395	0.0005394	0.0005394	0.0005394						0.00002	0.00002	0.00007	0.00007	0.00002
D8 Dozer	0.0009972	0.0008094	0.0006723	0.0005571	0.0004706						0.00009	0.00009	0.00000	0.00000	0.00000
CAT 330 Excavator	0.0006615	0.0005367	0.0004542	0.0004054	0.0003798						0.00005	0.00005	0.00000	0.00000	0.00000
CAT 14H Grader	0.0009487	0.0007590	0.0006254	0.0005198	0.0004458						0.00008	0.00008	0.00000	0.00000	0.00000
230T Crawler Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00000	0.00000	0.00001	0.00001	0.00000
Kincho Vibro Hammer/Gen	0.0022297	0.0017605	0.0013691	0.0010825	0.0008551						0.00000	0.00000	0.00000	0.00000	0.00000
HPSI 260Hammer w/400HP Powerpack	0.0040091	0.0034158	0.0029412	0.0026076	0.0021567						0.00000	0.00000	0.00001	0.00001	0.00000
Delmag 30-32 Hammer	0.0022297	0.0017605	0.0013691	0.0010825	0.0008551						0.00000	0.00000	0.00001	0.00000	0.00000
65T Rough Terrain Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00000	0.00000	0.00000	0.00000	0.00000
Ocean Going Vessels (Product List)	**CH_4 Emissions Factor, Main Engine (g/kw-hr)**					**CH_4 Emissions Factor, Auxiliary Engine (g/kw-hr)**									
ADVA 140 m 58oz/CY (Concrete Additive) DARREX1 1AEA 63oz/CY (Concrete Additive) WRDA-HA 43 oz/CY (Concrete Additive)	0.01	0.01	0.01	0.01	0.01	0.0027	0.0027	0.0027	0.0027	0.0027	0.000041	0	0	0	0
Concrete Sand C-33	0.01	0.01	0.01	0.01	0.01	0.0027	0.0027	0.0027	0.0027	0.0027	0.000249	0	0	0	0
Coarse Concrete Aggregate	0.01	0.01	0.01	0.01	0.01	0.0027	0.0027	0.0027	0.0027	0.0027	0.000373	0	0	0	0
Cement 504#/CY (4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.000000	0	0	0	0
Fly Ash 215 lb/CY	0.01	0.01	0.01	0.01	0.01	0.0027	0.0027	0.0027	0.0027	0.0027	0.000041	0	0	0	0

Armor Stone Bedding	0.01	0.01	0.01	0.01	0.01	0.0027	0.0027	0.0027	0.0027	0.0027	0.001507	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.0219519	0.0165448	0.0145723	0.0133906	0.0123707	0.0848758	0.0590252	0.0470758	0.0427569	0.0413609	0.00000	0.00000	0.00006	0.00005	0.00000
Passenger car	0.0175857	0.0150820	0.0142960	0.0131222	0.0121684	0.1220106	0.0614667	0.0572841	0.0515825	0.0467767	0.00000	0.00000	0.00006	0.00005	0.00000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.0219519	0.0165448	0.0145723	0.0133906	0.0123707	0.0848758	0.0590252	0.0470758	0.0427569	0.0413609	0.00000	0.00000	0.00048	0.00044	0.00000
185 CFM Compressor	0.0120462	0.0114821	0.0107104	0.0102962	0.0099590						0.00000	0.00000	0.00035	0.00034	0.00000
Miller Welder	0.0300250	0.0290910	0.0279548	0.0265423	0.0247042						0.00000	0.00000	0.00019	0.00018	0.00000
90T Rough Terrain Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00000	0.00000	0.00001	0.00000	0.00000
175T Crawler Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00000	0.00000	0.00005	0.00004	0.00000
6T Forklift	0.0005471	0.0005395	0.0005394	0.0005394	0.0005394						0.00000	0.00000	0.00001	0.00001	0.00000
20' Aluminum Crew Boat	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.00000	0.00000	0.00009	0.00009	0.00000
10' Safety Boat	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.00000	0.00000	0.00000	0.00000	0.00000
230T Crawler Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00000	0.00000	0.00005	0.00004	0.00000
Kincho Vibro Hammer/Gen	0.0022297	0.0017605	0.0013691	0.0010825	0.0008551						0.00000	0.00000	0.00001	0.00001	0.00000
HPSI 260Hammer w/400HP Powerpack	0.0040091	0.0034158	0.0029412	0.0026076	0.0021567						0.00000	0.00000	0.00003	0.00002	0.00000
Delmag 30-32 Hammer	0.0022297	0.0017605	0.0013691	0.0010825	0.0008551						0.00000	0.00000	0.00002	0.00002	0.00000
65T Rough Terrain Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00000	0.00000	0.00000	0.00000	0.00000
Truck Tractor	0.0227716	0.0223226	0.0220667	0.0216904	0.0215665	0.1788758	0.1768518	0.1748259	0.1723290	0.1710141	0.00000	0.00000	0.00001	0.00001	0.00000
Spud Barge															
Inner Harbor Tug Engine	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.00000	0.00000	0.00055	0.00055	0.00000
Inner Harbor Tug Generator	0.0062257	0.0062257	0.0062257	0.0062257	0.0062257						0.00000	0.00000	0.00011	0.00011	0.00000
Concrete Pump	0.0040091	0.0034158	0.0029412	0.0026076	0.0021567						0.00000	0.00000	0.00001	0.00001	0.00000
100T Crawler Crane	0.0018255	0.0013521	0.0010368	0.0008535	0.0007454						0.00000	0.00000	0.00001	0.00001	0.00000
CAT 345 Excavator	0.0006615	0.0005367	0.0004542	0.0004054	0.0003798						0.00000	0.00000	0.00003	0.00002	0.00000
CAT 330 Excavator	0.0006615	0.0005367	0.0004542	0.0004054	0.0003798						0.00000	0.00000	0.00001	0.00001	0.00000
CAT 966 Loader	0.0127368	0.0108630	0.0096360	0.0086949	0.0078971						0.00000	0.00000	0.00018	0.00017	0.00000
CAT 950 Loader	0.0127368	0.0108630	0.0096360	0.0086949	0.0078971						0.00000	0.00000	0.00008	0.00007	0.00000
										Total (ton/yr)	**0.037**	**0.141**	**0.140**	**0.136**	**0.030**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) CH_4 Low Load Adjustment Factor (Ocean Going Vessel Porting) = 21.18

Naval Base Guam - Apra Harbor Breakwater Repairs – N_2O Emissions

Equipment	N_2O Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					N_2O Idling Emission Factor (g/hr for on-road only)					N_2O Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.0037995	0.0035319	0.0032909	0.0029992	0.0026846	0.0904260	0.0829141	0.0762175	0.0683516	0.0598773	0.00005	0.00005	0.00004	0.00004	0.00004
Passenger car	0.0022021	0.0020096	0.0019722	0.0019035	0.0018049	0.0527546	0.0474319	0.0457673	0.0433355	0.0401831	0.00003	0.00003	0.00003	0.00003	0.00002
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.0037995	0.0035319	0.0032909	0.0029992	0.0026846	0.0904260	0.0829141	0.0762175	0.0683516	0.0598773	0.00010	0.00014	0.00013	0.00012	0.00005
Passenger Trucks (18), Multiple Staff (18)	0.0037995	0.0035319	0.0032909	0.0029992	0.0026846	0.0904260	0.0829141	0.0762175	0.0683516	0.0598773	0.00090	0.00126	0.00118	0.00107	0.00048
Coral Translocation															
Excavator	0.0494209	0.0494212	0.0494213	0.0494213	0.0494214						0.00579	0.00000	0.00000	0.00000	0.00000
Flat Bed Truck	0.0643964	0.0657388	0.0667297	0.0696911	0.0687013	0.0254367	0.0254975	0.0254975	0.0252789	0.0251386	0.00114	0.00000	0.00000	0.00000	0.00000
Tugboat (Primary Engine)	0.033228	0.033228	0.033228	0.033228	0.033228						0.016	0.000	0.000	0.000	0.000
Tugboat (Bow Thrusters)	0.033228	0.033228	0.033228	0.033228	0.033228						0.016	0.000	0.000	0.000	0.000
Tugboat (Generator)	0.033228	0.033228	0.033228	0.033228	0.033228						0.001	0.000	0.000	0.000	0.000
Twin Engine Large Dive Boat (2 engines, total hp)	0.033228	0.033228	0.033228	0.033228	0.033228						0.002	0.000	0.000	0.000	0.000
Twin Engine Small Dive Boat (2 engines, total hp)	0.033228	0.033228	0.033228	0.033228	0.033228						0.001	0.000	0.000	0.000	0.000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.0037995	0.0035319	0.0032909	0.0029992	0.0026846	0.0904260	0.0829141	0.0762175	0.0683516	0.0598773	0.00017	0.00023	0.00022	0.00020	0.00009
6T All Terrain Forklift 1	0.0548841	0.0548841	0.0548843	0.0548842	0.0548841						0.00397	0.00473	0.00473	0.00473	0.00400
6T All Terrain Forklift 2	0.0548841	0.0548841	0.0548843	0.0548842	0.0548841						0.00237	0.00473	0.00473	0.00473	0.00355
Boom Truck	0.0643964	0.0657388	0.0667297	0.0696911	0.0687013	0.0254367	0.0254975	0.0254975	0.0252789	0.0251386	0.00089	0.00181	0.00184	0.00192	0.00142
Vacuum Truck/Sweeper	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00104	0.00213	0.00220	0.00226	0.00174
Cement Train Tractor 1	0.0576203	0.0576273	0.0576338	0.0576403	0.0576465						0.00416	0.00832	0.00833	0.00833	0.00625
Cement Train Tractor 2	0.0576203	0.0576273	0.0576338	0.0576403	0.0576465						0.00416	0.00832	0.00833	0.00833	0.00625
100T Gantry Crane 1	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.01084	0.02169	0.02169	0.02169	0.01627
100T Gantry Crane 2	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.01084	0.02169	0.02169	0.02169	0.01627
Truck Tractor 1	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00221	0.00419	0.00432	0.00442	0.00351
Truck Tractor 2	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00221	0.00419	0.00432	0.00442	0.00351
Skid Steer 1	0.0638926	0.0639012	0.0639159	0.0639391	0.0639629						0.00102	0.00203	0.00203	0.00203	0.00152
Skid Steer 2	0.0638926	0.0639012	0.0639159	0.0639391	0.0639629						0.00102	0.00203	0.00203	0.00203	0.00152
4000 Gal Water Truck	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00249	0.00512	0.00529	0.00541	0.00419
Cat 966 Loader 1	0.0494184	0.0494195	0.0494201	0.0494204	0.0494206						0.00963	0.01925	0.01925	0.01925	0.01444
Cat 966 Loader 2	0.0494184	0.0494195	0.0494201	0.0494204	0.0494206						0.00963	0.01925	0.01925	0.01925	0.01444
36 Meter Concrete Pump Truck	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00187	0.00384	0.00396	0.00406	0.00314
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller											0	0	0	0	0
100 KW Generators Backup Power (2)	0.0494137	0.0494151	0.0494168	0.0494179	0.0494192						0.00172	0.00172	0.00172	0.00172	0.00172
Ready Mix Concrete Truck 1	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00221	0.00419	0.00432	0.00442	0.00351
Ready Mix Concrete Truck 2	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00221	0.00419	0.00432	0.00442	0.00351
Ready Mix Concrete Truck 3	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00221	0.00419	0.00432	0.00442	0.00351
Ready Mix Concrete Truck 4 (reserve)	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00022	0.00042	0.00043	0.00044	0.00035
60' Manlift for Maintenance	0.0575893	0.0575991	0.0576090	0.0576191	0.0576290						0.00069	0.00139	0.00139	0.00139	0.00104
Dump Trucks (4)	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.01032	0.02083	0.02150	0.02201	0.01962
Truck Tractor for Roll Off Trash Bins	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00117	0.00206	0.00212	0.00217	0.00177
Fuel Truck	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00138	0.00248	0.00256	0.00262	0.00211
CAT D8 Dozer	0.0494202	0.0494206	0.0494207	0.0494210	0.0494212						0.00116	0.00000	0.00000	0.00000	0.00000
CAT 950 Loader	0.0494184	0.0494195	0.0494201	0.0494204	0.0494206						0.00073	0.00000	0.00000	0.00000	0.00073
CAT 14H Grader	0.0494204	0.0494209	0.0494214	0.0494216	0.0494217						0.00195	0.00000	0.00000	0.00000	0.00000
25T Vibratory Compactor	0.0494132	0.0494148	0.0494164	0.0494178	0.0494193						0.00125	0.00000	0.00000	0.00000	0.00000
CAT 345 Excavator	0.0494209	0.0494212	0.0494213	0.0494213	0.0494214						0.00000	0.00000	0.00000	0.00000	0.00123
100T Crawler Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00127	0.00000	0.00000	0.00000	0.00096

175T Crawler Crane	0.0488804	0.0488814	0.0488822	0.0488830	0.0488837						0.00389	0.00000	0.00000	0.00000	0.00000
185 CFM Compressor	0.0543250	0.0543277	0.0543314	0.0543331	0.0543345						0.00093	0.00000	0.00000	0.00000	0.00000
Miller Welder 400Amps	0.0639160	0.0639287	0.0639438	0.0639620	0.0639789						0.00067	0.00000	0.00000	0.00000	0.00000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.0488804	0.0488814	0.0488822	0.0488830	0.0488837						0.00486	0.02429	0.02429	0.02429	0.00486
Manitowoc MLC 300 Crawler Crane Breakwater	0.0488804	0.0488814	0.0488822	0.0488830	0.0488837						0.00486	0.02429	0.02429	0.02429	0.00486
Manitowoc MLC 300 Crawler Crane Breakwater	0.0488804	0.0488814	0.0488822	0.0488830	0.0488837						0.00486	0.02429	0.02429	0.02429	0.00486
Manitowoc 999 Crawler Crane Breakwater	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00431	0.02154	0.02154	0.02154	0.00431
Kobelco 275 Ton Crawler	0.0494164	0.0494172	0.0494185	0.0494193	0.0494203						0.00802	0.04011	0.04011	0.04011	0.00802
60T Hydraulic Crane Assembly Crane	0.0488804	0.0488814	0.0488822	0.0488830	0.0488837						0.00299	0.00299	0.00299	0.00299	0.00299
Cat 988 Loader 1	0.0494141	0.0494150	0.0494159	0.0494166	0.0494174						0.00880	0.03521	0.03522	0.03522	0.00880
Cat 988 Loader 2	0.0494141	0.0494150	0.0494159	0.0494166	0.0494174						0.00880	0.03521	0.03522	0.03522	0.00880
Cat 988 Loader 3	0.0494141	0.0494150	0.0494159	0.0494166	0.0494174						0.00880	0.03521	0.03522	0.03522	0.00880
100T Hydraulic Excavator 1	0.0494183	0.0494191	0.0494198	0.0494203	0.0494207						0.00810	0.03241	0.03241	0.03241	0.00810
100T Hydraulic Excavator 2	0.0494183	0.0494191	0.0494198	0.0494203	0.0494207						0.00810	0.03241	0.03241	0.03241	0.00810
CAT 745 Rock Truck 1	0.0494210	0.0494211	0.0494212	0.0494214	0.0494214						0.00698	0.02792	0.02792	0.02792	0.00698
CAT 745 Rock Truck 2	0.0494210	0.0494211	0.0494212	0.0494214	0.0494214						0.00349	0.01396	0.01396	0.01396	0.00349
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.033228	0.033228	0.033228	0.033228	0.033228						0.015	0.061	0.061	0.061	0.015
Inner Harbor Tug 1 Generator	0.033228	0.033228	0.033228	0.033228	0.033228						0.008	0.031	0.031	0.031	0.008
Inner Harbor Tug 2 Engine	0.033228	0.033228	0.033228	0.033228	0.033228						0.015	0.061	0.061	0.061	0.015
Inner Harbor Tug 2 Generator	0.033228	0.033228	0.033228	0.033228	0.033228						0.008	0.031	0.031	0.031	0.008
Ocean Going Tug for Armor Stone Transport Engine	0.033228	0.033228	0.033228	0.033228	0.033228						0.126	0.251	0.251	0.251	0.000
Ocean Going Tug for Armor Stone Transport Generator	0.033228	0.033228	0.033228	0.033228	0.033228						0.018	0.036	0.036	0.036	0.000
20' Aluminum Crew Boat	0.1536292	0.1536634	0.1536912	0.1537096	0.1537176						0.00000	0.00000	0.00000	0.00000	0.00000
10' Safety Boat 1	0.1901779	0.1901203	0.1900743	0.1900430	0.1900288						0.00000	0.00000	0.00000	0.00000	0.00000
10' Safety Boat 2	0.1901779	0.1901203	0.1900743	0.1900430	0.1900288						0.00000	0.00000	0.00000	0.00000	0.00000
Fuel Truck	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00052	0.00213	0.00220	0.00226	0.00058
Mechanic Truck 1	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00242	0.00462	0.00476	0.00487	0.00270
Mechanic Truck 2	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00242	0.00462	0.00476	0.00487	0.00270
Welding Truck	0.0576035	0.0576107	0.0576182	0.0576265	0.0576342						0.00104	0.00417	0.00418	0.00418	0.00104
Compressor	0.0543250	0.0543277	0.0543314	0.0543331	0.0543345						0.00050	0.00201	0.00201	0.00201	0.00050
Boom Truck	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00062	0.00256	0.00264	0.00271	0.00070
Water Truck	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00125	0.00512	0.00529	0.00541	0.00140
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00096	0.00291	0.00300	0.00307	0.00107
Truck Tractor for Mob/Demob/Various	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00062	0.00256	0.00264	0.00271	0.00070
6T All Terrain Forklift	0.0548841	0.0548841	0.0548843	0.0548842	0.0548841						0.00189	0.00757	0.00757	0.00757	0.00189
D8 Dozer	0.0494202	0.0494206	0.0494207	0.0494210	0.0494212						0.00442	0.00000	0.00000	0.00000	0.00000
CAT 330 Excavator	0.0494209	0.0494212	0.0494213	0.0494213	0.0494214						0.00362	0.00000	0.00000	0.00000	0.00000
CAT 14H Grader	0.0494202	0.0494208	0.0494208	0.0494211	0.0494212						0.00442	0.00000	0.00000	0.00000	0.00000
230T Crawler Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00000	0.00000	0.00059	0.00059	0.00000
Kincho Vibro Hammer/Gen	0.0488835	0.0488846	0.0488859	0.0488866	0.0488874						0.00000	0.00000	0.00011	0.00011	0.00000
HPSI 260Hammer w/400HP Powerpack	0.0488763	0.0488786	0.0488804	0.0488817	0.0488833						0.00000	0.00000	0.00010	0.00010	0.00000
Delmag 30-32 Hammer	0.0488835	0.0488846	0.0488859	0.0488866	0.0488874						0.00000	0.00000	0.00019	0.00019	0.00000
65T Rough Terrain Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00000	0.00000	0.00002	0.00002	0.00000
Ocean Going Vessels (Product List)	**N_2O Emissions Factor, Main Engine (g/kw-hr)**					**N_2O Emissions Factor, Auxiliary Engine (g/kw-hr)**									
ADVA 140 m 58oz/CY (Concrete Additive) DARREX1 1AEA 63oz/CY (Concrete Additive) WRDA-HA 43 oz/CY (Concrete Additive)	0.029	0.029	0.029	0.029	0.029	0.033	0.033	0.033	0.033	0.033	0.000132	0	0	0	0
Concrete Sand C-33	0.029	0.029	0.029	0.029	0.029	0.033	0.033	0.033	0.033	0.033	0.000790	0	0	0	0
Coarse Concrete Aggregate	0.029	0.029	0.029	0.029	0.029	0.033	0.033	0.033	0.033	0.033	0.001184	0	0	0	0
Cement 504#/CY (4)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0.000000	0	0	0	0
Fly Ash 215 lb/CY	0.029	0.029	0.029	0.029	0.029	0.033	0.033	0.033	0.033	0.033	0.000132	0	0	0	0

Armor Stone Bedding	0.029	0.029	0.029	0.029	0.029	0.033	0.033	0.033	0.033	0.033	0.004222	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.0037995	0.0035319	0.0032909	0.0029992	0.0026846	0.0904260	0.0829141	0.0762175	0.0683516	0.0598773	0.00000	0.00000	0.00001	0.00001	0.00000
Passenger car	0.0022021	0.0020096	0.0019722	0.0019035	0.0018049	0.0527546	0.0474319	0.0457673	0.0433355	0.0401831	0.00000	0.00000	0.00001	0.00001	0.00000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.0037995	0.0035319	0.0032909	0.0029992	0.0026846	0.0904260	0.0829141	0.0762175	0.0683516	0.0598773	0.00000	0.00000	0.00011	0.00010	0.00000
185 CFM Compressor	0.0543250	0.0543277	0.0543314	0.0543331	0.0543345						0.00000	0.00000	0.00180	0.00180	0.00000
Miller Welder	0.0639062	0.0639186	0.0639332	0.0639509	0.0639672						0.00000	0.00000	0.00044	0.00044	0.00000
90T Rough Terrain Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00000	0.00000	0.00026	0.00026	0.00000
175T Crawler Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00000	0.00000	0.00225	0.00225	0.00000
6T Forklift	0.0548841	0.0548841	0.0548843	0.0548842	0.0548841						0.00000	0.00000	0.00131	0.00131	0.00000
20' Aluminum Crew Boat	0.033228	0.033228	0.033228	0.033228	0.033228						0.00000	0.00000	0.00050	0.00050	0.00000
10' Safety Boat	0.033228	0.033228	0.033228	0.033228	0.033228						0.00000	0.00000	0.00002	0.00002	0.00000
230T Crawler Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00000	0.00000	0.00242	0.00242	0.00000
Kincho Vibro Hammer/Gen	0.0488835	0.0488846	0.0488859	0.0488866	0.0488874						0.00000	0.00000	0.00045	0.00045	0.00000
HPSI 260Hammer w/400HP Powerpack	0.0488763	0.0488786	0.0488804	0.0488817	0.0488833						0.00000	0.00000	0.00044	0.00044	0.00000
Delmag 30-32 Hammer	0.0488835	0.0488846	0.0488859	0.0488866	0.0488874						0.00000	0.00000	0.00078	0.00078	0.00000
65T Rough Terrain Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00000	0.00000	0.00008	0.00008	0.00000
Truck Tractor	0.0906615	0.0930596	0.0960638	0.0983526	0.1014671	0.3211880	0.3293650	0.3364360	0.3422300	0.3488800	0.00000	0.00000	0.00003	0.00003	0.00000
Spud Barge															
Inner Harbor Tug Engine	0.033228	0.033228	0.033228	0.033228	0.033228						0.00000	0.00000	0.00295	0.00295	0.00000
Inner Harbor Tug Generator	0.033228	0.033228	0.033228	0.033228	0.033228						0.00000	0.00000	0.00059	0.00059	0.00000
Concrete Pump	0.0488763	0.0488786	0.0488804	0.0488817	0.0488833						0.00000	0.00000	0.00014	0.00014	0.00000
100T Crawler Crane	0.0488849	0.0488861	0.0488868	0.0488874	0.0488877						0.00000	0.00000	0.00063	0.00063	0.00000
CAT 345 Excavator	0.0494209	0.0494212	0.0494213	0.0494213	0.0494214						0.00000	0.00000	0.00275	0.00275	0.00000
CAT 330 Excavator	0.0494209	0.0494212	0.0494213	0.0494213	0.0494214						0.00000	0.00000	0.00067	0.00067	0.00000
CAT 966 Loader	0.0576307	0.0576384	0.0576440	0.0576481	0.0576519						0.00000	0.00000	0.00110	0.00110	0.00000
CAT 950 Loader	0.0576307	0.0576384	0.0576440	0.0576481	0.0576519						0.00000	0.00000	0.00049	0.00049	0.00000
										Total (ton/yr)	**0.450**	**1.036**	**1.060**	**1.062**	**3.894**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs
(8) N_2O Low Load Adjustment Factor (Ocean Going Vessel Porting) = 4.63

Naval Base Guam - Apra Harbor Breakwater Repair – Formaldehyde Emissions

Equipment	Formaldehyde Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Formaldehyde Idling Emission Factor (g/hr for on-road only)					Formaldehyde Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.001234	0.000819	0.000671	0.000583	0.000506	0.004721	0.002757	0.001873	0.001580	0.001515	0.0000163	0.0000108	0.0000089	0.0000077	0.0000067
Passenger car	0.000871	0.000680	0.000622	0.000536	0.000469	0.007428	0.002770	0.002494	0.002109	0.001802	0.0000115	0.0000090	0.0000082	0.0000071	0.0000062
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.001234	0.000819	0.000671	0.000583	0.000506	0.004721	0.002757	0.001873	0.001580	0.001515	0.0000327	0.0000325	0.0000266	0.0000231	0.0000100
Passenger Trucks (18), Multiple Staff (18)	0.001234	0.000819	0.000671	0.000583	0.000506	0.004721	0.002757	0.001873	0.001580	0.001515	0.0002939	0.0002925	0.0002397	0.0002083	0.0000903
Coral Translocation															
Excavator	0.002074	0.001794	0.001599	0.001465	0.001382						0.0002428	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.022756	0.019421	0.017463	0.013722	0.015984	0.016677	0.014218	0.012622	0.009904	0.011603	0.0004013	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.012622	0.012622	0.012622	0.012622	0.012622						0.0059758	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.012622	0.012622	0.012622	0.012622	0.012622						0.0059758	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.012622	0.012622	0.012622	0.012622	0.012622						0.0004283	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.012622	0.012622	0.012622	0.012622	0.012622						0.0008784	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.012622	0.012622	0.012622	0.012622	0.012622						0.0004183	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.001234	0.000819	0.000671	0.000583	0.000506	0.004721	0.002757	0.001873	0.001580	0.001515	0.0000544	0.0000542	0.0000444	0.0000386	0.0000167
6T All Terrain Forklift 1	0.001849	0.001824	0.001824	0.001824	0.001824						0.0001339	0.0001573	0.0001573	0.0001573	0.0001331
6T All Terrain Forklift 2	0.001849	0.001824	0.001824	0.001824	0.001824						0.0000797	0.0001573	0.0001573	0.0001573	0.0001180
Boom Truck	0.022756	0.019421	0.017463	0.013722	0.015984	0.016677	0.014218	0.012622	0.009904	0.011603	0.0003131	0.0005344	0.0004805	0.0003775	0.0003298
Vacuum Truck/Sweeper	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0005424	0.0010094	0.0009247	0.0008903	0.0005867
Cement Train Tractor 1	0.059081	0.052973	0.046993	0.040894	0.034952						0.0042670	0.0076518	0.0067880	0.0059070	0.0037865
Cement Train Tractor 2	0.059081	0.052973	0.046993	0.040894	0.034952						0.0042670	0.0076518	0.0067880	0.0059070	0.0037865
100T Gantry Crane 1	0.005696	0.004198	0.003214	0.002666	0.002362						0.0012635	0.0018625	0.0014257	0.0011827	0.0007859
100T Gantry Crane 2	0.005696	0.004198	0.003214	0.002666	0.002362						0.0012635	0.0018625	0.0014257	0.0011827	0.0007859
Truck Tractor 1	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0013589	0.0021752	0.0019919	0.0019084	0.0013276
Truck Tractor 2	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0013589	0.0021752	0.0019919	0.0019084	0.0013276
Skid Steer 1	0.168373	0.161205	0.148982	0.129626	0.108533						0.0026753	0.0051228	0.0047344	0.0041193	0.0025868
Skid Steer 2	0.168373	0.161205	0.148982	0.129626	0.108533						0.0026753	0.0051228	0.0047344	0.0041193	0.0025868
4000 Gal Water Truck	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0013018	0.0024225	0.0022194	0.0021366	0.0014080
Cat 966 Loader 1	0.004830	0.003731	0.002988	0.002534	0.002281						0.0009409	0.0014535	0.0011641	0.0009872	0.0006665
Cat 966 Loader 2	0.004830	0.003731	0.002988	0.002534	0.002281						0.0009409	0.0014535	0.0011641	0.0009872	0.0006665
36 Meter Concrete Pump Truck	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0009764	0.0018169	0.0016645	0.0016025	0.0010560
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.009661	0.008221	0.006680	0.005085	0.003888						0.0003368	0.0002866	0.0002329	0.0001773	0.0001355
Ready Mix Concrete Truck 1	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0013589	0.0021752	0.0019919	0.0019084	0.0013276
Ready Mix Concrete Truck 2	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0013589	0.0021752	0.0019919	0.0019084	0.0013276
Ready Mix Concrete Truck 3	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0013589	0.0021752	0.0019919	0.0019084	0.0013276
Ready Mix Concrete Truck 4 (reserve)	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0001359	0.0002175	0.0001992	0.0001908	0.0001328
60' Manlift for Maintenance	0.089290	0.080560	0.071851	0.062457	0.052857						0.0010748	0.0019394	0.0017298	0.0015036	0.0009544
Dump Trucks (4)	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0055898	0.0100484	0.0092049	0.0088524	0.0067461
Truck Tractor for Roll Off Trash Bins	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0008165	0.0011658	0.0010671	0.0010182	0.0007409
Fuel Truck	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0009250	0.0013677	0.0012521	0.0011962	0.0008582
CAT D8 Dozer	0.002903	0.002427	0.002103	0.001844	0.001644						0.0000680	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.004830	0.003731	0.002988	0.002534	0.002281						0.0000716	0.0000000	0.0000000	0.0000000	0.0000338
CAT 14H Grader	0.003310	0.002909	0.002577	0.002287	0.002095						0.0001305	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.011252	0.009477	0.007841	0.006292	0.004765						0.0002854	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.002074	0.001794	0.001599	0.001465	0.001382						0.0000000	0.0000000	0.0000000	0.0000000	0.0000344
100T Crawler Crane	0.005696	0.004198	0.003214	0.002666	0.002362						0.0001485	0.0000000	0.0000000	0.0000000	0.0000462

175T Crawler Crane	0.010287	0.009259	0.008381	0.007587	0.006804						0.0008192	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.028734	0.025775	0.022346	0.020369	0.018805						0.0004903	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.146521	0.135868	0.123172	0.107827	0.092969						0.0015466	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.010287	0.009259	0.008381	0.007587	0.006804						0.0010223	0.0046010	0.0041645	0.0037701	0.0006762
Manitowoc MLC 300 Crawler Crane Breakwater	0.010287	0.009259	0.008381	0.007587	0.006804						0.0010223	0.0046010	0.0041645	0.0037701	0.0006762
Manitowoc MLC 300 Crawler Crane Breakwater	0.010287	0.009259	0.008381	0.007587	0.006804						0.0010223	0.0046010	0.0041645	0.0037701	0.0006762
Manitowoc 999 Crawler Crane Breakwater	0.005696	0.004198	0.003214	0.002666	0.002362						0.0005020	0.0018501	0.0014162	0.0011748	0.0002082
Kobelco 275 Ton Crawler	0.007061	0.006084	0.004762	0.003779	0.002934						0.0011462	0.0049384	0.0038648	0.0030671	0.0004762
60T Hydraulic Crane Assembly Crane	0.010287	0.009259	0.008381	0.007587	0.006804						0.0006291	0.0005663	0.0005126	0.0004640	0.0004161
Cat 988 Loader 1	0.009343	0.008404	0.007587	0.006790	0.005964						0.0016645	0.0059893	0.0054067	0.0048391	0.0010626
Cat 988 Loader 2	0.009343	0.008404	0.007587	0.006790	0.005964						0.0016645	0.0059893	0.0054067	0.0048391	0.0010626
Cat 988 Loader 3	0.009343	0.008404	0.007587	0.006790	0.005964						0.0016645	0.0059893	0.0054067	0.0048391	0.0010626
100T Hydraulic Excavator 1	0.004954	0.003858	0.003044	0.002558	0.002288						0.0008122	0.0025302	0.0019961	0.0016774	0.0003751
100T Hydraulic Excavator 2	0.004954	0.003858	0.003044	0.002558	0.002288						0.0008122	0.0025302	0.0019961	0.0016774	0.0003751
CAT 745 Rock Truck 1	0.001993	0.001734	0.001568	0.001447	0.001374						0.0002815	0.0009796	0.0008856	0.0008176	0.0001940
CAT 745 Rock Truck 2	0.001993	0.001734	0.001568	0.001447	0.001374						0.0001407	0.0004898	0.0004428	0.0004088	0.0000970
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.012622	0.012622	0.012622	0.012622	0.012622						0.0058264	0.0233057	0.0233057	0.0233057	0.0058264
Inner Harbor Tug 1 Generator	0.012622	0.012622	0.012622	0.012622	0.012622						0.0029310	0.0117238	0.0117238	0.0117238	0.0029310
Inner Harbor Tug 2 Engine	0.012622	0.012622	0.012622	0.012622	0.012622						0.0058264	0.0233057	0.0233057	0.0233057	0.0058264
Inner Harbor Tug 2 Generator	0.012622	0.012622	0.012622	0.012622	0.012622						0.0029310	0.0117238	0.0117238	0.0117238	0.0029310
Ocean Going Tug for Armor Stone Transport Engine	0.012622	0.012622	0.012622	0.012622	0.012622						0.0477132	0.0954263	0.0954263	0.0954263	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.012622	0.012622	0.012622	0.012622	0.012622						0.0068389	0.0136778	0.0136778	0.0136778	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0002712	0.0010094	0.0009247	0.0008903	0.0001956
Mechanic Truck 1	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0014674	0.0023771	0.0021768	0.0020865	0.0010538
Mechanic Truck 2	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0014674	0.0023771	0.0021768	0.0020865	0.0010538
Welding Truck	0.074862	0.068750	0.061965	0.054230	0.046802						0.0013562	0.0049819	0.0044903	0.0039297	0.0008479
Compressor	0.028734	0.025775	0.022346	0.020369	0.018805						0.0002656	0.0009529	0.0008262	0.0007531	0.0001738
Boom Truck	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0003255	0.0012113	0.0011097	0.0010683	0.0002347
Water Truck	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0006509	0.0024225	0.0022194	0.0021366	0.0004693
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0007080	0.0015696	0.0014370	0.0013743	0.0005062
Truck Tractor for Mob/Demob/Various	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0003255	0.0012113	0.0011097	0.0010683	0.0002347
6T All Terrain Forklift	0.001849	0.001824	0.001824	0.001824	0.001824						0.0000638	0.0002517	0.0002517	0.0002516	0.0000629
D8 Dozer	0.002903	0.002427	0.002103	0.001844	0.001644						0.0002596	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.002074	0.001794	0.001599	0.001465	0.001382						0.0001518	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.002792	0.002306	0.001997	0.001759	0.001580						0.0002496	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.005696	0.004198	0.003214	0.002666	4.679104					0.000000	0.0000000	0.0000000	0.0000386	0.0000320	0.0000000
Kincho Vibro Hammer/Gen	0.007013	0.005653	0.004388	0.003476	4.679104					0.000000	0.0000000	0.0000000	0.0000097	0.0000077	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.014295	0.011931	0.010043	0.008698	4.537313					0.000000	0.0000000	0.0000000	0.0000209	0.0000181	0.0000000
Delmag 30-32 Hammer	0.007013	0.005653	0.004388	0.003476	4.679104					0.000000	0.0000000	0.0000000	0.0000172	0.0000136	0.0000000
65T Rough Terrain Crane	0.005696	0.004198	0.003214	0.002666	4.679104					0.000000	0.0000000	0.0000000	0.0000012	0.0000010	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000932	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0005595	0	0	0	0
Coarse Concrete Aggregate											0.0008392	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000932	0	0	0	0

Armor Stone Bedding											0.0033875	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.001234	0.000819	0.000671	0.000583	0.000506	0.004721	0.002757	0.001873	0.001580	0.001515	0.0000000	0.0000000	0.0000027	0.0000023	0.0000000
Passenger car	0.000871	0.000680	0.000622	0.000536	0.000469	0.007428	0.002770	0.002494	0.002109	0.001802	0.0000000	0.0000000	0.0000025	0.0000021	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.001234	0.000819	0.000671	0.000583	0.000506	0.004721	0.002757	0.001873	0.001580	0.001515	0.0000000	0.0000000	0.0000222	0.0000193	0.0000000
185 CFM Compressor	0.028734	0.025775	0.022346	0.020369	0.018805						0.0000000	0.0000000	0.0007388	0.0006734	0.0000000
Miller Welder	0.156769	0.146418	0.134123	0.119264	0.104931						0.0000000	0.0000000	0.0009314	0.0008282	0.0000000
90T Rough Terrain Crane	0.005696	0.004198	0.003214	0.002666	0.002362						0.0000000	0.0000000	0.0000172	0.0000142	0.0000000
175T Crawler Crane	0.005696	0.004198	0.003214	0.002666	0.002362						0.0000000	0.0000000	0.0001481	0.0001228	0.0000000
6T Forklift	0.001849	0.001824	0.001824	0.001824	0.001824						0.0000000	0.0000000	0.0000436	0.0000436	0.0000000
20' Aluminum Crew Boat	0.012622	0.012622	0.012622	0.012622	0.012622						0.0000000	0.0000000	0.0001894	0.0001894	0.0000000
10' Safety Boat	0.012622	0.012622	0.012622	0.012622	0.012622						0.0000000	0.0000000	0.0000061	0.0000061	0.0000000
230T Crawler Crane	0.005696	0.004198	0.003214	0.002666	0.002362						0.0000000	0.0000000	0.0001593	0.0001321	0.0000000
Kincho Vibro Hammer/Gen	0.007013	0.005653	0.004388	0.003476	0.002755						0.0000000	0.0000000	0.0000406	0.0000322	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.014295	0.011931	0.010043	0.008698	0.007051						0.0000000	0.0000000	0.0000895	0.0000775	0.0000000
Delmag 30-32 Hammer	0.007013	0.005653	0.004388	0.003476	0.002755						0.0000000	0.0000000	0.0000699	0.0000554	0.0000000
65T Rough Terrain Crane	0.005696	0.004198	0.003214	0.002666	0.002362						0.0000000	0.0000000	0.0000053	0.0000044	0.0000000
Truck Tractor	0.047315	0.044024	0.040332	0.038828	0.034117	0.361528	0.338615	0.309323	0.289116	0.256608	0.0000000	0.0000000	0.0000133	0.0000128	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.012622	0.012622	0.012622	0.012622	0.012622						0.0000000	0.0000000	0.0011205	0.0011205	0.0000000
Inner Harbor Tug Generator	0.012622	0.012622	0.012622	0.012622	0.012622						0.0000000	0.0000000	0.0002248	0.0002248	0.0000000
Concrete Pump	0.014295	0.011931	0.010043	0.008698	0.007051						0.0000000	0.0000000	0.0000286	0.0000247	0.0000000
100T Crawler Crane	0.005696	0.004198	0.003214	0.002666	0.002362						0.0000000	0.0000000	0.0000411	0.0000341	0.0000000
CAT 345 Excavator	0.002074	0.001794	0.001599	0.001465	0.001382						0.0000000	0.0000000	0.0000889	0.0000815	0.0000000
CAT 330 Excavator	0.002074	0.001794	0.001599	0.001465	0.001382						0.0000000	0.0000000	0.0000218	0.0000200	0.0000000
CAT 966 Loader	0.052357	0.044451	0.039017	0.034881	0.031282						0.0000000	0.0000000	0.0007478	0.0006686	0.0000000
CAT 950 Loader	0.052357	0.044451	0.039017	0.034881	0.031282						0.0000000	0.0000000	0.0003342	0.0002988	0.0000000
										Total (ton/yr)	**0.153**	**0.308**	**0.299**	**0.287**	**0.065**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Naphthalene Emissions

Equipment	Naphthalene Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Naphthalene Idling Emission Factor (g/hr for on-road only)					Naphthalene Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000185	0.000120	0.000097	0.000083	0.000071	0.000705	0.000398	0.000260	0.000215	0.000206	0.0000024	0.0000016	0.0000013	0.0000011	0.0000009
Passenger car	0.000130	0.000100	0.000091	0.000077	0.000067	0.001138	0.000406	0.000364	0.000304	0.000257	0.0000017	0.0000013	0.0000012	0.0000010	0.0000009
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000185	0.000120	0.000097	0.000083	0.000071	0.000705	0.000398	0.000260	0.000215	0.000206	0.0000049	0.0000048	0.0000039	0.0000033	0.0000014
Passenger Trucks (18), Multiple Staff (18)	0.000185	0.000120	0.000097	0.000083	0.000071	0.000705	0.000398	0.000260	0.000215	0.000206	0.0000441	0.0000429	0.0000347	0.0000298	0.0000128
Coral Translocation															
Excavator	0.000035	0.000030	0.000026	0.000024	0.000023						0.0000041	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.002551	0.002168	0.001945	0.001513	0.001778	0.001861	0.001580	0.001398	0.001087	0.001286	0.0000450	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.009254	0.009254	0.009254	0.009254	0.009254						0.0043814	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.009254	0.009254	0.009254	0.009254	0.009254						0.0043814	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.009254	0.009254	0.009254	0.009254	0.009254						0.0003140	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.009254	0.009254	0.009254	0.009254	0.009254						0.0006441	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.009254	0.009254	0.009254	0.009254	0.009254						0.0003067	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000185	0.000120	0.000097	0.000083	0.000071	0.000705	0.000398	0.000260	0.000215	0.000206	0.0000082	0.0000079	0.0000064	0.0000055	0.0000024
6T All Terrain Forklift 1	0.000030	0.000029	0.000029	0.000029	0.000029						0.0000021	0.0000025	0.0000025	0.0000025	0.0000021
6T All Terrain Forklift 2	0.000030	0.000029	0.000029	0.000029	0.000029						0.0000013	0.0000025	0.0000025	0.0000025	0.0000019
Boom Truck	0.002551	0.002168	0.001945	0.001513	0.001778	0.001861	0.001580	0.001398	0.001087	0.001286	0.0000351	0.0000597	0.0000535	0.0000416	0.0000367
Vacuum Truck/Sweeper	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000608	0.0001130	0.0001033	0.0000995	0.0000653
Cement Train Tractor 1	0.000911	0.000819	0.000728	0.000634	0.000543						0.0000658	0.0001183	0.0001051	0.0000916	0.0000588
Cement Train Tractor 2	0.000911	0.000819	0.000728	0.000634	0.000543						0.0000658	0.0001183	0.0001051	0.0000916	0.0000588
100T Gantry Crane 1	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000206	0.0000306	0.0000236	0.0000196	0.0000131
100T Gantry Crane 2	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000206	0.0000306	0.0000236	0.0000196	0.0000131
Truck Tractor 1	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001524	0.0002436	0.0002226	0.0002133	0.0001478
Truck Tractor 2	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001524	0.0002436	0.0002226	0.0002133	0.0001478
Skid Steer 1	0.002406	0.002306	0.002147	0.001901	0.001617						0.0000382	0.0000733	0.0000682	0.0000604	0.0000385
Skid Steer 2	0.002406	0.002306	0.002147	0.001901	0.001617						0.0000382	0.0000733	0.0000682	0.0000604	0.0000385
4000 Gal Water Truck	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001459	0.0002712	0.0002480	0.0002387	0.0001567
Cat 966 Loader 1	0.000079	0.000062	0.000050	0.000042	0.000038						0.0000155	0.0000241	0.0000194	0.0000164	0.0000111
Cat 966 Loader 2	0.000079	0.000062	0.000050	0.000042	0.000038						0.0000155	0.0000241	0.0000194	0.0000164	0.0000111
36 Meter Concrete Pump Truck	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001094	0.0002034	0.0001860	0.0001791	0.0001175
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000153	0.000130	0.000106	0.000082	0.000063						0.0000053	0.0000045	0.0000037	0.0000028	0.0000022
Ready Mix Concrete Truck 1	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001524	0.0002436	0.0002226	0.0002133	0.0001478
Ready Mix Concrete Truck 2	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001524	0.0002436	0.0002226	0.0002133	0.0001478
Ready Mix Concrete Truck 3	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001524	0.0002436	0.0002226	0.0002133	0.0001478
Ready Mix Concrete Truck 4 (reserve)	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000152	0.0000244	0.0000223	0.0000213	0.0000148
60' Manlift for Maintenance	0.001345	0.001218	0.001091	0.000951	0.000806						0.0000162	0.0000293	0.0000263	0.0000229	0.0000146
Dump Trucks (4)	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0006266	0.0011251	0.0010287	0.0009892	0.0007510
Truck Tractor for Roll Off Trash Bins	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000916	0.0001306	0.0001193	0.0001138	0.0000825
Fuel Truck	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001037	0.0001532	0.0001400	0.0001337	0.0000956
CAT D8 Dozer	0.000049	0.000041	0.000035	0.000031	0.000027						0.0000011	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000079	0.000062	0.000050	0.000042	0.000038						0.0000012	0.0000000	0.0000000	0.0000000	0.0000006
CAT 14H Grader	0.000054	0.000047	0.000042	0.000037	0.000034						0.0000021	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000176	0.000149	0.000124	0.000100	0.000076						0.0000045	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000035	0.000030	0.000026	0.000024	0.000023						0.0000000	0.0000000	0.0000000	0.0000000	0.0000006
100T Crawler Crane	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000024	0.0000000	0.0000000	0.0000000	0.0000008

175T Crawler Crane	0.000163	0.000147	0.000133	0.000121	0.000109						0.0000130	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.000495	0.000453	0.000402	0.000373	0.000351						0.0000084	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.002124	0.001972	0.001796	0.001588	0.001378						0.0000224	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000163	0.000147	0.000133	0.000121	0.000109						0.0000162	0.0000731	0.0000663	0.0000602	0.0000108
Manitowoc MLC 300 Crawler Crane Breakwater	0.000163	0.000147	0.000133	0.000121	0.000109						0.0000162	0.0000731	0.0000663	0.0000602	0.0000108
Manitowoc MLC 300 Crawler Crane Breakwater	0.000163	0.000147	0.000133	0.000121	0.000109						0.0000162	0.0000731	0.0000663	0.0000602	0.0000108
Manitowoc 999 Crawler Crane Breakwater	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000082	0.0000304	0.0000234	0.0000195	0.0000035
Kobelco 275 Ton Crawler	0.000114	0.000098	0.000077	0.000062	0.000048						0.0000186	0.0000797	0.0000627	0.0000500	0.0000078
60T Hydraulic Crane Assembly Crane	0.000163	0.000147	0.000133	0.000121	0.000109						0.0000100	0.0000090	0.0000082	0.0000074	0.0000067
Cat 988 Loader 1	0.000149	0.000134	0.000121	0.000109	0.000095						0.0000265	0.0000956	0.0000865	0.0000775	0.0000170
Cat 988 Loader 2	0.000149	0.000134	0.000121	0.000109	0.000095						0.0000265	0.0000956	0.0000865	0.0000775	0.0000170
Cat 988 Loader 3	0.000149	0.000134	0.000121	0.000109	0.000095						0.0000265	0.0000956	0.0000865	0.0000775	0.0000170
100T Hydraulic Excavator 1	0.000082	0.000064	0.000051	0.000043	0.000038						0.0000134	0.0000419	0.0000332	0.0000280	0.0000063
100T Hydraulic Excavator 2	0.000082	0.000064	0.000051	0.000043	0.000038						0.0000134	0.0000419	0.0000332	0.0000280	0.0000063
CAT 745 Rock Truck 1	0.000034	0.000029	0.000026	0.000024	0.000023						0.0000047	0.0000163	0.0000147	0.0000135	0.0000032
CAT 745 Rock Truck 2	0.000034	0.000029	0.000026	0.000024	0.000023						0.0000024	0.0000082	0.0000073	0.0000068	0.0000016
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.009254	0.009254	0.009254	0.009254	0.009254						0.0042718	0.0170873	0.0170873	0.0170873	0.0042718
Inner Harbor Tug 1 Generator	0.009254	0.009254	0.009254	0.009254	0.009254						0.0021489	0.0085957	0.0085957	0.0085957	0.0021489
Inner Harbor Tug 2 Engine	0.009254	0.009254	0.009254	0.009254	0.009254						0.0042718	0.0170873	0.0170873	0.0170873	0.0042718
Inner Harbor Tug 2 Generator	0.009254	0.009254	0.009254	0.009254	0.009254						0.0021489	0.0085957	0.0085957	0.0085957	0.0021489
Ocean Going Tug for Armor Stone Transport Engine	0.009254	0.009254	0.009254	0.009254	0.009254						0.0349825	0.0699650	0.0699650	0.0699650	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.009254	0.009254	0.009254	0.009254	0.009254						0.0050142	0.0100283	0.0100283	0.0100283	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000304	0.0001130	0.0001033	0.0000995	0.0000218
Mechanic Truck 1	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001645	0.0002662	0.0002433	0.0002332	0.0001173
Mechanic Truck 2	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0001645	0.0002662	0.0002433	0.0002332	0.0001173
Welding Truck	0.001159	0.001066	0.000962	0.000843	0.000729						0.0000210	0.0000772	0.0000697	0.0000611	0.0000132
Compressor	0.000495	0.000453	0.000402	0.000373	0.000351						0.0000046	0.0000167	0.0000149	0.0000138	0.0000032
Boom Truck	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000365	0.0001356	0.0001240	0.0001194	0.0000261
Water Truck	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000730	0.0002712	0.0002480	0.0002387	0.0000522
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000794	0.0001758	0.0001606	0.0001536	0.0000564
Truck Tractor for Mob/Demob/Various	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000365	0.0001356	0.0001240	0.0001194	0.0000261
6T All Terrain Forklift	0.000030	0.000029	0.000029	0.000029	0.000029						0.0000010	0.0000040	0.0000040	0.0000040	0.0000010
D8 Dozer	0.000049	0.000041	0.000035	0.000031	0.000027						0.0000044	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000035	0.000030	0.000026	0.000024	0.000023						0.0000025	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000047	0.000039	0.000033	0.000029	0.000026						0.0000042	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000093	0.000069	0.000053	0.000044	2.611940					0.000000	0.0000000	0.0000000	0.0000006	0.0000005	0.0000000
Kincho Vibro Hammer/Gen	0.000114	0.000091	0.000071	0.000057	2.611940					0.000000	0.0000000	0.0000000	0.0000002	0.0000001	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000227	0.000190	0.000160	0.000139	2.611940					0.000000	0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
Delmag 30-32 Hammer	0.000114	0.000091	0.000071	0.000057	2.611940					0.000000	0.0000000	0.0000000	0.0000003	0.0000002	0.0000000
65T Rough Terrain Crane	0.000093	0.000069	0.000053	0.000044	2.611940					0.000000	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000684	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0004102	0	0	0	0
Coarse Concrete Aggregate											0.0006153	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000684	0	0	0	0

Armor Stone Bedding											0.0024837	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000185	0.000120	0.000097	0.000083	0.000071	0.000705	0.000398	0.000260	0.000215	0.000206	0.0000000	0.0000000	0.0000004	0.0000003	0.0000000
Passenger car	0.000130	0.000100	0.000091	0.000077	0.000067	0.001138	0.000406	0.000364	0.000304	0.000257	0.0000000	0.0000000	0.0000004	0.0000003	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.000185	0.000120	0.000097	0.000083	0.000071	0.000705	0.000398	0.000260	0.000215	0.000206	0.0000000	0.0000000	0.0000032	0.0000028	0.0000000
185 CFM Compressor	0.000495	0.000453	0.000402	0.000373	0.000351						0.0000000	0.0000000	0.0000133	0.0000123	0.0000000
Miller Welder	0.002313	0.002168	0.002000	0.001802	0.001604						0.0000000	0.0000000	0.0000139	0.0000125	0.0000000
90T Rough Terrain Crane	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000000	0.0000000	0.0000003	0.0000002	0.0000000
175T Crawler Crane	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000000	0.0000000	0.0000025	0.0000020	0.0000000
6T Forklift	0.000030	0.000029	0.000029	0.000029	0.000029						0.0000000	0.0000000	0.0000007	0.0000007	0.0000000
20' Aluminum Crew Boat	0.009254	0.009254	0.009254	0.009254	0.009254						0.0000000	0.0000000	0.0001388	0.0001388	0.0000000
10' Safety Boat	0.009254	0.009254	0.009254	0.009254	0.009254						0.0000000	0.0000000	0.0000044	0.0000044	0.0000000
230T Crawler Crane	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000000	0.0000000	0.0000026	0.0000022	0.0000000
Kincho Vibro Hammer/Gen	0.000114	0.000091	0.000071	0.000057	0.000045						0.0000000	0.0000000	0.0000007	0.0000005	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000227	0.000190	0.000160	0.000139	0.000114						0.0000000	0.0000000	0.0000014	0.0000012	0.0000000
Delmag 30-32 Hammer	0.000114	0.000091	0.000071	0.000057	0.000045						0.0000000	0.0000000	0.0000011	0.0000009	0.0000000
65T Rough Terrain Crane	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Truck Tractor	0.005303	0.004929	0.004507	0.004339	0.003798	0.040590	0.037976	0.034626	0.032329	0.028599	0.0000000	0.0000000	0.0000015	0.0000014	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.009254	0.009254	0.009254	0.009254	0.009254						0.0000000	0.0000000	0.0008215	0.0008215	0.0000000
Inner Harbor Tug Generator	0.009254	0.009254	0.009254	0.009254	0.009254						0.0000000	0.0000000	0.0001648	0.0001648	0.0000000
Concrete Pump	0.000227	0.000190	0.000160	0.000139	0.000114						0.0000000	0.0000000	0.0000005	0.0000004	0.0000000
100T Crawler Crane	0.000093	0.000069	0.000053	0.000044	0.000039						0.0000000	0.0000000	0.0000007	0.0000006	0.0000000
CAT 345 Excavator	0.000035	0.000030	0.000026	0.000024	0.000023						0.0000000	0.0000000	0.0000015	0.0000013	0.0000000
CAT 330 Excavator	0.000035	0.000030	0.000026	0.000024	0.000023						0.0000000	0.0000000	0.0000004	0.0000003	0.0000000
CAT 966 Loader	0.000794	0.000674	0.000592	0.000529	0.000475						0.0000000	0.0000000	0.0000113	0.0000101	0.0000000
CAT 950 Loader	0.000794	0.000674	0.000592	0.000529	0.000475						0.0000000	0.0000000	0.0000051	0.0000045	0.0000000
										Total (ton/yr)	**0.70**	**0.137**	**0.138**	**0.138**	**0.016**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Acetaldehyde Emissions

Equipment	Acetaldehyde Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Acetaldehyde Idling Emission Factor (g/hr for on-road only)					Acetaldehyde Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000951	0.000573	0.000441	0.000364	0.000295	0.003565	0.001786	0.001000	0.000759	0.000725	0.0000126	0.0000076	0.0000058	0.0000048	0.0000039
Passenger car	0.000652	0.000476	0.000424	0.000347	0.000286	0.006219	0.001940	0.001700	0.001363	0.001101	0.0000086	0.0000063	0.0000056	0.0000046	0.0000038
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000951	0.000573	0.000441	0.000364	0.000295	0.003565	0.001786	0.001000	0.000759	0.000725	0.0000252	0.0000227	0.0000175	0.0000144	0.0000059
Passenger Trucks (18), Multiple Staff (18)	0.000951	0.000573	0.000441	0.000364	0.000295	0.003565	0.001786	0.001000	0.000759	0.000725	0.0002264	0.0002046	0.0001574	0.0001298	0.0000527
Coral Translocation															
Excavator	0.000908	0.000811	0.000743	0.000696	0.000667						0.0001063	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.010721	0.009227	0.008356	0.006685	0.007716	0.007935	0.006830	0.006114	0.004886	0.005662	0.0001891	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.002892	0.002892	0.002892	0.002892	0.002892						0.0013692	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.002892	0.002892	0.002892	0.002892	0.002892						0.0013692	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.002892	0.002892	0.002892	0.002892	0.002892						0.0000981	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.002892	0.002892	0.002892	0.002892	0.002892						0.0002013	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.002892	0.002892	0.002892	0.002892	0.002892						0.0000958	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000951	0.000573	0.000441	0.000364	0.000295	0.003565	0.001786	0.001000	0.000759	0.000725	0.0000419	0.0000379	0.0000291	0.0000240	0.0000098
6T All Terrain Forklift 1	0.000703	0.000694	0.000694	0.000694	0.000694						0.0000509	0.0000598	0.0000598	0.0000598	0.0000506
6T All Terrain Forklift 2	0.000703	0.000694	0.000694	0.000694	0.000694						0.0000303	0.0000598	0.0000598	0.0000598	0.0000449
Boom Truck	0.010721	0.009227	0.008356	0.006685	0.007716	0.007935	0.006830	0.006114	0.004886	0.005662	0.0001475	0.0002539	0.0002299	0.0001839	0.0001592
Vacuum Truck/Sweeper	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0002502	0.0004670	0.0004292	0.0004141	0.0002743
Cement Train Tractor 1	0.021173	0.018999	0.016870	0.014701	0.012588						0.0015292	0.0027443	0.0024369	0.0021235	0.0013637
Cement Train Tractor 2	0.021173	0.018999	0.016870	0.014701	0.012588						0.0015292	0.0027443	0.0024369	0.0021235	0.0013637
100T Gantry Crane 1	0.002177	0.001651	0.001306	0.001114	0.001008						0.0004829	0.0007326	0.0005794	0.0004943	0.0003354
100T Gantry Crane 2	0.002177	0.001651	0.001306	0.001114	0.001008						0.0004829	0.0007326	0.0005794	0.0004943	0.0003354
Truck Tractor 1	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006275	0.0010069	0.0009251	0.0008885	0.0006213
Truck Tractor 2	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006275	0.0010069	0.0009251	0.0008885	0.0006213
Skid Steer 1	0.059631	0.057082	0.052761	0.045935	0.038476						0.0009475	0.0018140	0.0016766	0.0014597	0.0009170
Skid Steer 2	0.059631	0.057082	0.052761	0.045935	0.038476						0.0009475	0.0018140	0.0016766	0.0014597	0.0009170
4000 Gal Water Truck	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006005	0.0011207	0.0010300	0.0009939	0.0006582
Cat 966 Loader 1	0.001872	0.001487	0.001227	0.001068	0.000980						0.0003647	0.0005793	0.0004780	0.0004161	0.0002863
Cat 966 Loader 2	0.001872	0.001487	0.001227	0.001068	0.000980						0.0003647	0.0005793	0.0004780	0.0004161	0.0002863
36 Meter Concrete Pump Truck	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0004504	0.0008405	0.0007725	0.0007454	0.0004937
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.003577	0.003072	0.002531	0.001970	0.001548						0.0001247	0.0001071	0.0000882	0.0000687	0.0000540
Ready Mix Concrete Truck 1	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006275	0.0010069	0.0009251	0.0008885	0.0006213
Ready Mix Concrete Truck 2	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006275	0.0010069	0.0009251	0.0008885	0.0006213
Ready Mix Concrete Truck 3	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006275	0.0010069	0.0009251	0.0008885	0.0006213
Ready Mix Concrete Truck 4 (reserve)	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0000627	0.0001007	0.0000925	0.0000888	0.0000621
60' Manlift for Maintenance	0.031822	0.028717	0.025623	0.022283	0.018868						0.0003830	0.0006914	0.0006169	0.0005365	0.0003407
Dump Trucks (4)	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0025793	0.0046491	0.0042727	0.0041185	0.0031543
Truck Tractor for Roll Off Trash Bins	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0003773	0.0005399	0.0004959	0.0004743	0.0003471
Fuel Truck	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0004273	0.0006333	0.0005817	0.0005572	0.0004019
CAT D8 Dozer	0.001196	0.001030	0.000917	0.000828	0.000759						0.0000280	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.001872	0.001487	0.001227	0.001068	0.000980						0.0000278	0.0000000	0.0000000	0.0000000	0.0000145
CAT 14H Grader	0.001240	0.001099	0.000982	0.000880	0.000812						0.0000489	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.004052	0.003424	0.002846	0.002299	0.001758						0.0001028	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000908	0.000811	0.000743	0.000696	0.000667						0.0000000	0.0000000	0.0000000	0.0000000	0.0000166
100T Crawler Crane	0.002177	0.001651	0.001306	0.001114	0.001008						0.0000568	0.0000000	0.0000000	0.0000000	0.0000197

175T Crawler Crane	0.003797	0.003434	0.003125	0.002846	0.002571						0.0003023	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.010188	0.009137	0.007918	0.007217	0.006662						0.0001739	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.052069	0.048280	0.043777	0.038347	0.033080						0.0005496	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.003797	0.003434	0.003125	0.002846	0.002571						0.0003773	0.0017065	0.0015528	0.0014140	0.0002555
Manitowoc MLC 300 Crawler Crane Breakwater	0.003797	0.003434	0.003125	0.002846	0.002571						0.0003773	0.0017065	0.0015528	0.0014140	0.0002555
Manitowoc MLC 300 Crawler Crane Breakwater	0.003797	0.003434	0.003125	0.002846	0.002571						0.0003773	0.0017065	0.0015528	0.0014140	0.0002555
Manitowoc 999 Crawler Crane Breakwater	0.002177	0.001651	0.001306	0.001114	0.001008						0.0001919	0.0007277	0.0005756	0.0004910	0.0000888
Kobelco 275 Ton Crawler	0.002656	0.002315	0.001851	0.001507	0.001210						0.0004312	0.0018791	0.0015025	0.0012228	0.0001964
60T Hydraulic Crane Assembly Crane	0.003797	0.003434	0.003125	0.002846	0.002571						0.0002322	0.0002100	0.0001911	0.0001740	0.0001572
Cat 988 Loader 1	0.003462	0.003132	0.002845	0.002565	0.002277						0.0006168	0.0022320	0.0020271	0.0018282	0.0004056
Cat 988 Loader 2	0.003462	0.003132	0.002845	0.002565	0.002277						0.0006168	0.0022320	0.0020271	0.0018282	0.0004056
Cat 988 Loader 3	0.003462	0.003132	0.002845	0.002565	0.002277						0.0006168	0.0022320	0.0020271	0.0018282	0.0004056
100T Hydraulic Excavator 1	0.001914	0.001531	0.001246	0.001076	0.000982						0.0003137	0.0010037	0.0008169	0.0007054	0.0001609
100T Hydraulic Excavator 2	0.001914	0.001531	0.001246	0.001076	0.000982						0.0003137	0.0010037	0.0008169	0.0007054	0.0001609
CAT 745 Rock Truck 1	0.000879	0.000789	0.000732	0.000690	0.000664						0.0001241	0.0004459	0.0004134	0.0003897	0.0000938
CAT 745 Rock Truck 2	0.000879	0.000789	0.000732	0.000690	0.000664						0.0000621	0.0002230	0.0002067	0.0001949	0.0000469
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.002892	0.002892	0.002892	0.002892	0.002892						0.0013350	0.0053401	0.0053401	0.0053401	0.0013350
Inner Harbor Tug 1 Generator	0.002892	0.002892	0.002892	0.002892	0.002892						0.0006716	0.0026863	0.0026863	0.0026863	0.0006716
Inner Harbor Tug 2 Engine	0.002892	0.002892	0.002892	0.002892	0.002892						0.0013350	0.0053401	0.0053401	0.0053401	0.0013350
Inner Harbor Tug 2 Generator	0.002892	0.002892	0.002892	0.002892	0.002892						0.0006716	0.0026863	0.0026863	0.0026863	0.0006716
Ocean Going Tug for Armor Stone Transport Engine	0.002892	0.002892	0.002892	0.002892	0.002892						0.0109326	0.0218652	0.0218652	0.0218652	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.002892	0.002892	0.002892	0.002892	0.002892						0.0015670	0.0031340	0.0031340	0.0031340	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0001251	0.0004670	0.0004292	0.0004141	0.0000914
Mechanic Truck 1	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006775	0.0011003	0.0010109	0.0009713	0.0004933
Mechanic Truck 2	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0006775	0.0011003	0.0010109	0.0009713	0.0004933
Welding Truck	0.026794	0.024613	0.022195	0.019442	0.016800						0.0004854	0.0017836	0.0016084	0.0014089	0.0003043
Compressor	0.010188	0.009137	0.007918	0.007217	0.006662						0.0000942	0.0003378	0.0002928	0.0002668	0.0000616
Boom Truck	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0001501	0.0005603	0.0005150	0.0004969	0.0001097
Water Truck	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0003003	0.0011207	0.0010300	0.0009939	0.0002194
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0003272	0.0007267	0.0006676	0.0006400	0.0002374
Truck Tractor for Mob/Demob/Various	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0001501	0.0005603	0.0005150	0.0004969	0.0001097
6T All Terrain Forklift	0.000703	0.000694	0.000694	0.000694	0.000694						0.0000242	0.0000957	0.0000957	0.0000957	0.0000239
D8 Dozer	0.001196	0.001030	0.000917	0.000828	0.000759						0.0001069	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000908	0.000811	0.000743	0.000696	0.000667						0.0000664	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.001157	0.000988	0.000881	0.000799	0.000736						0.0001035	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.002177	0.001651	0.001306	0.001114	0.004870						0.0000000	0.0000000	0.0000157	0.0000134	0.0000000
Kincho Vibro Hammer/Gen	0.002641	0.002166	0.001721	0.001401	0.004870						0.0000000	0.0000000	0.0000038	0.0000031	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.005209	0.004374	0.003708	0.003234	0.004873						0.0000000	0.0000000	0.0000077	0.0000067	0.0000000
Delmag 30-32 Hammer	0.002641	0.002166	0.001721	0.001401	0.004870						0.0000000	0.0000000	0.0000067	0.0000055	0.0000000
65T Rough Terrain Crane	0.002177	0.001651	0.001306	0.001114	0.004870						0.0000000	0.0000000	0.0000005	0.0000004	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000214	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0001282	0	0	0	0
Coarse Concrete Aggregate											0.0001923	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000214	0	0	0	0

Armor Stone Bedding											0.0007762	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000951	0.000573	0.000441	0.000364	0.000295	0.003565	0.001786	0.001000	0.000759	0.000725	0.0000000	0.0000000	0.0000017	0.0000014	0.0000000
Passenger car	0.000652	0.000476	0.000424	0.000347	0.000286	0.006219	0.001940	0.001700	0.001363	0.001101	0.0000000	0.0000000	0.0000017	0.0000014	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.000951	0.000573	0.000441	0.000364	0.000295	0.003565	0.001786	0.001000	0.000759	0.000725	0.0000000	0.0000000	0.0000146	0.0000120	0.0000000
185 CFM Compressor	0.010188	0.009137	0.007918	0.007217	0.006662						0.0000000	0.0000000	0.0002618	0.0002386	0.0000000
Miller Welder	0.055685	0.052002	0.047638	0.042377	0.037294						0.0000000	0.0000000	0.0003308	0.0002943	0.0000000
90T Rough Terrain Crane	0.002177	0.001651	0.001306	0.001114	0.001008						0.0000000	0.0000000	0.0000070	0.0000060	0.0000000
175T Crawler Crane	0.002177	0.001651	0.001306	0.001114	0.001008						0.0000000	0.0000000	0.0000602	0.0000513	0.0000000
6T Forklift	0.000703	0.000694	0.000694	0.000694	0.000694						0.0000000	0.0000000	0.0000166	0.0000166	0.0000000
20' Aluminum Crew Boat	0.002892	0.002892	0.002892	0.002892	0.002892						0.0000000	0.0000000	0.0000434	0.0000434	0.0000000
10' Safety Boat	0.002892	0.002892	0.002892	0.002892	0.002892						0.0000000	0.0000000	0.0000014	0.0000014	0.0000000
230T Crawler Crane	0.002177	0.001651	0.001306	0.001114	0.001008						0.0000000	0.0000000	0.0000647	0.0000552	0.0000000
Kincho Vibro Hammer/Gen	0.002641	0.002166	0.001721	0.001401	0.001147						0.0000000	0.0000000	0.0000159	0.0000130	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.005209	0.004374	0.003708	0.003234	0.002654						0.0000000	0.0000000	0.0000330	0.0000288	0.0000000
Delmag 30-32 Hammer	0.002641	0.002166	0.001721	0.001401	0.001147						0.0000000	0.0000000	0.0000274	0.0000223	0.0000000
65T Rough Terrain Crane	0.002177	0.001651	0.001306	0.001114	0.001008						0.0000000	0.0000000	0.0000022	0.0000018	0.0000000
Truck Tractor	0.021827	0.020366	0.018719	0.018061	0.015949	0.167331	0.157222	0.144155	0.135188	0.120634	0.0000000	0.0000000	0.0000062	0.0000060	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.002892	0.002892	0.002892	0.002892	0.002892						0.0000000	0.0000000	0.0002567	0.0002567	0.0000000
Inner Harbor Tug Generator	0.002892	0.002892	0.002892	0.002892	0.002892						0.0000000	0.0000000	0.0000515	0.0000515	0.0000000
Concrete Pump	0.005209	0.004374	0.003708	0.003234	0.002654						0.0000000	0.0000000	0.0000105	0.0000092	0.0000000
100T Crawler Crane	0.002177	0.001651	0.001306	0.001114	0.001008						0.0000000	0.0000000	0.0000167	0.0000143	0.0000000
CAT 345 Excavator	0.000908	0.000811	0.000743	0.000696	0.000667						0.0000000	0.0000000	0.0000413	0.0000387	0.0000000
CAT 330 Excavator	0.000908	0.000811	0.000743	0.000696	0.000667						0.0000000	0.0000000	0.0000101	0.0000095	0.0000000
CAT 966 Loader	0.018731	0.015926	0.013998	0.012531	0.011255						0.0000000	0.0000000	0.0002683	0.0002402	0.0000000
CAT 950 Loader	0.018731	0.015926	0.013998	0.012531	0.011255						0.0000000	0.0000000	0.0001199	0.0001073	0.0000000
										Total (ton/yr)	**0.046**	**0.093**	**0.089**	**0.085**	**0.024**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – 2,2,4-Trimethylpentane Emissions

Equipment	2,2,4-Trimethylpentane Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					2,2,4-Trimethylpentane Idling Emission Factor (g/hr for on-road only)					2,2,4-Trimethylpentane Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.005584	0.004942	0.004666	0.004415	0.004184	0.040712	0.037478	0.035598	0.034534	0.032910	0.0000739	0.0000654	0.0000617	0.0000584	0.0000553
Passenger car	0.005353	0.005054	0.005005	0.004757	0.004628	0.046469	0.039730	0.039472	0.038685	0.037552	0.0000708	0.0000669	0.0000662	0.0000629	0.0000612
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.005584	0.004942	0.004666	0.004415	0.004184	0.040712	0.037478	0.035598	0.034534	0.032910	0.0001477	0.0001961	0.0001852	0.0001752	0.0000830
Passenger Trucks (18), Multiple Staff (18)	0.005584	0.004942	0.004666	0.004415	0.004184	0.040712	0.037478	0.035598	0.034534	0.032910	0.0013295	0.0017649	0.0016664	0.0015768	0.0007471
Coral Translocation															
Excavator	0.000076	0.000068	0.000063	0.000060	0.000058						0.0000089	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.000604	0.000527	0.000482	0.000397	0.000447	0.000454	0.000397	0.000359	0.000295	0.000333	0.0000107	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.002105	0.002105	0.002105	0.002105	0.002105						0.0009965	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.002105	0.002105	0.002105	0.002105	0.002105						0.0009965	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.002105	0.002105	0.002105	0.002105	0.002105						0.0000714	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.002105	0.002105	0.002105	0.002105	0.002105						0.0001465	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.002105	0.002105	0.002105	0.002105	0.002105						0.0000698	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.005584	0.004942	0.004666	0.004415	0.004184	0.040712	0.037478	0.035598	0.034534	0.032910	0.0002462	0.0003268	0.0003086	0.0002920	0.0001383
6T All Terrain Forklift 1	0.000055	0.000054	0.000054	0.000054	0.000054						0.0000040	0.0000047	0.0000047	0.0000047	0.0000039
6T All Terrain Forklift 2	0.000055	0.000054	0.000054	0.000054	0.000054						0.0000024	0.0000047	0.0000047	0.0000047	0.0000035
Boom Truck	0.000604	0.000527	0.000482	0.000397	0.000447	0.000454	0.000397	0.000359	0.000295	0.000333	0.0000083	0.0000145	0.0000133	0.0000109	0.0000092
Vacuum Truck/Sweeper	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000140	0.0000262	0.0000242	0.0000234	0.0000157
Cement Train Tractor 1	0.001826	0.001627	0.001437	0.001247	0.001066						0.0001319	0.0002350	0.0002075	0.0001802	0.0001155
Cement Train Tractor 2	0.001826	0.001627	0.001437	0.001247	0.001066						0.0001319	0.0002350	0.0002075	0.0001802	0.0001155
100T Gantry Crane 1	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000380	0.0000584	0.0000468	0.0000404	0.0000277
100T Gantry Crane 2	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000380	0.0000584	0.0000468	0.0000404	0.0000277
Truck Tractor 1	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000350	0.0000564	0.0000522	0.0000502	0.0000355
Truck Tractor 2	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000350	0.0000564	0.0000522	0.0000502	0.0000355
Skid Steer 1	0.005151	0.004909	0.004509	0.003885	0.003232						0.0000818	0.0001560	0.0001433	0.0001235	0.0000770
Skid Steer 2	0.005151	0.004909	0.004509	0.003885	0.003232						0.0000818	0.0001560	0.0001433	0.0001235	0.0000770
4000 Gal Water Truck	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000335	0.0000628	0.0000581	0.0000561	0.0000376
Cat 966 Loader 1	0.000148	0.000119	0.000100	0.000088	0.000081						0.0000288	0.0000464	0.0000388	0.0000342	0.0000237
Cat 966 Loader 2	0.000148	0.000119	0.000100	0.000088	0.000081						0.0000288	0.0000464	0.0000388	0.0000342	0.0000237
36 Meter Concrete Pump Truck	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000251	0.0000471	0.0000436	0.0000421	0.0000282
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000282	0.000243	0.000200	0.000157	0.000124						0.0000098	0.0000085	0.0000070	0.0000055	0.0000043
Ready Mix Concrete Truck 1	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000350	0.0000564	0.0000522	0.0000502	0.0000355
Ready Mix Concrete Truck 2	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000350	0.0000564	0.0000522	0.0000502	0.0000355
Ready Mix Concrete Truck 3	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000350	0.0000564	0.0000522	0.0000502	0.0000355
Ready Mix Concrete Truck 4 (reserve)	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000035	0.0000056	0.0000052	0.0000050	0.0000036
60' Manlift for Maintenance	0.002710	0.002428	0.002152	0.001863	0.001575						0.0000326	0.0000585	0.0000518	0.0000448	0.0000284
Dump Trucks (4)	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0001440	0.0002606	0.0002410	0.0002326	0.0001803
Truck Tractor for Roll Off Trash Bins	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000210	0.0000302	0.0000280	0.0000268	0.0000198
Fuel Truck	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000238	0.0000355	0.0000328	0.0000315	0.0000230
CAT D8 Dozer	0.000097	0.000085	0.000076	0.000070	0.000064						0.0000023	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000148	0.000119	0.000100	0.000088	0.000081						0.0000022	0.0000000	0.0000000	0.0000000	0.0000012
CAT 14H Grader	0.000096	0.000086	0.000077	0.000069	0.000064						0.0000038	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000315	0.000265	0.000220	0.000177	0.000136						0.0000080	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000076	0.000068	0.000063	0.000060	0.000058						0.0000000	0.0000000	0.0000000	0.0000000	0.0000014
100T Crawler Crane	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000045	0.0000000	0.0000000	0.0000000	0.0000016

175T Crawler Crane	0.000299	0.000270	0.000245	0.000224	0.000202						0.0000238	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.000793	0.000710	0.000615	0.000559	0.000515						0.0000135	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.004573	0.004215	0.003797	0.003299	0.002830						0.0000483	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000299	0.000270	0.000245	0.000224	0.000202						0.0000297	0.0001341	0.0001219	0.0001111	0.0000201
Manitowoc MLC 300 Crawler Crane Breakwater	0.000299	0.000270	0.000245	0.000224	0.000202						0.0000297	0.0001341	0.0001219	0.0001111	0.0000201
Manitowoc MLC 300 Crawler Crane Breakwater	0.000299	0.000270	0.000245	0.000224	0.000202						0.0000297	0.0001341	0.0001219	0.0001111	0.0000201
Manitowoc 999 Crawler Crane Breakwater	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000151	0.0000580	0.0000465	0.0000401	0.0000073
Kobelco 275 Ton Crawler	0.000208	0.000182	0.000147	0.000121	0.000098						0.0000338	0.0001477	0.0001192	0.0000980	0.0000160
60T Hydraulic Crane Assembly Crane	0.000299	0.000270	0.000245	0.000224	0.000202						0.0000183	0.0000165	0.0000150	0.0000137	0.0000124
Cat 988 Loader 1	0.000272	0.000246	0.000224	0.000202	0.000180						0.0000484	0.0001752	0.0001593	0.0001440	0.0000321
Cat 988 Loader 2	0.000272	0.000246	0.000224	0.000202	0.000180						0.0000484	0.0001752	0.0001593	0.0001440	0.0000321
Cat 988 Loader 3	0.000272	0.000246	0.000224	0.000202	0.000180						0.0000484	0.0001752	0.0001593	0.0001440	0.0000321
100T Hydraulic Excavator 1	0.000151	0.000122	0.000101	0.000088	0.000081						0.0000248	0.0000803	0.0000662	0.0000579	0.0000133
100T Hydraulic Excavator 2	0.000151	0.000122	0.000101	0.000088	0.000081						0.0000248	0.0000803	0.0000662	0.0000579	0.0000133
CAT 745 Rock Truck 1	0.000074	0.000067	0.000062	0.000059	0.000057						0.0000104	0.0000377	0.0000353	0.0000335	0.0000081
CAT 745 Rock Truck 2	0.000074	0.000067	0.000062	0.000059	0.000057						0.0000052	0.0000189	0.0000176	0.0000168	0.0000041
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.002105	0.002105	0.002105	0.002105	0.002105						0.0009716	0.0038865	0.0038865	0.0038865	0.0009716
Inner Harbor Tug 1 Generator	0.002105	0.002105	0.002105	0.002105	0.002105						0.0004888	0.0019551	0.0019551	0.0019551	0.0004888
Inner Harbor Tug 2 Engine	0.002105	0.002105	0.002105	0.002105	0.002105						0.0009716	0.0038865	0.0038865	0.0038865	0.0009716
Inner Harbor Tug 2 Generator	0.002105	0.002105	0.002105	0.002105	0.002105						0.0004888	0.0019551	0.0019551	0.0019551	0.0004888
Ocean Going Tug for Armor Stone Transport Engine	0.002105	0.002105	0.002105	0.002105	0.002105						0.0079567	0.0159133	0.0159133	0.0159133	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.002105	0.002105	0.002105	0.002105	0.002105						0.0011405	0.0022809	0.0022809	0.0022809	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000070	0.0000262	0.0000242	0.0000234	0.0000052
Mechanic Truck 1	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000378	0.0000617	0.0000570	0.0000549	0.0000282
Mechanic Truck 2	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000378	0.0000617	0.0000570	0.0000549	0.0000282
Welding Truck	0.002320	0.002113	0.001894	0.001653	0.001425						0.0000420	0.0001531	0.0001372	0.0001198	0.0000258
Compressor	0.000793	0.000710	0.000615	0.000559	0.000515						0.0000073	0.0000262	0.0000227	0.0000207	0.0000048
Boom Truck	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000084	0.0000314	0.0000291	0.0000281	0.0000063
Water Truck	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000168	0.0000628	0.0000581	0.0000561	0.0000125
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000182	0.0000407	0.0000376	0.0000362	0.0000136
Truck Tractor for Mob/Demob/Various	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000084	0.0000314	0.0000291	0.0000281	0.0000063
6T All Terrain Forklift	0.000055	0.000054	0.000054	0.000054	0.000054						0.0000019	0.0000075	0.0000075	0.0000075	0.0000019
D8 Dozer	0.000097	0.000085	0.000076	0.000070	0.000064						0.0000087	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000076	0.000068	0.000063	0.000060	0.000058						0.0000055	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000094	0.000082	0.000074	0.000067	0.000063						0.0000084	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000171	0.000132	0.000106	0.000091	0.149254						0.0000000	0.0000000	0.0000013	0.0000011	0.0000000
Kincho Vibro Hammer/Gen	0.000208	0.000171	0.000137	0.000113	0.149254						0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000420	0.000352	0.000298	0.000259	0.149254						0.0000000	0.0000000	0.0000006	0.0000005	0.0000000
Delmag 30-32 Hammer	0.000208	0.000171	0.000137	0.000113	0.149254						0.0000000	0.0000000	0.0000005	0.0000004	0.0000000
65T Rough Terrain Crane	0.000171	0.000132	0.000106	0.000091	0.149254						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000155	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000933	0	0	0	0
Coarse Concrete Aggregate											0.0001399	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000155	0	0	0	0

Armor Stone Bedding											0.0005649	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.005584	0.004942	0.004666	0.004415	0.004184	0.040712	0.037478	0.035598	0.034534	0.032910	0.0000000	0.0000000	0.0000185	0.0000175	0.0000000
Passenger car	0.005353	0.005054	0.005005	0.004757	0.004628	0.046469	0.039730	0.039472	0.038685	0.037552	0.0000000	0.0000000	0.0000199	0.0000189	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.005584	0.004942	0.004666	0.004415	0.004184	0.040712	0.037478	0.035598	0.034534	0.032910	0.0000000	0.0000000	0.0001543	0.0001460	0.0000000
185 CFM Compressor	0.000793	0.000710	0.000615	0.000559	0.000515						0.0000000	0.0000000	0.0000203	0.0000185	0.0000000
Miller Welder	0.004850	0.004500	0.004093	0.003608	0.003153						0.0000000	0.0000000	0.0000284	0.0000251	0.0000000
90T Rough Terrain Crane	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000000	0.0000000	0.0000006	0.0000005	0.0000000
175T Crawler Crane	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000000	0.0000000	0.0000049	0.0000042	0.0000000
6T Forklift	0.000055	0.000054	0.000054	0.000054	0.000054						0.0000000	0.0000000	0.0000013	0.0000013	0.0000000
20' Aluminum Crew Boat	0.002105	0.002105	0.002105	0.002105	0.002105						0.0000000	0.0000000	0.0000316	0.0000316	0.0000000
10' Safety Boat	0.002105	0.002105	0.002105	0.002105	0.002105						0.0000000	0.0000000	0.0000010	0.0000010	0.0000000
230T Crawler Crane	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000000	0.0000000	0.0000052	0.0000045	0.0000000
Kincho Vibro Hammer/Gen	0.000208	0.000171	0.000137	0.000113	0.000094						0.0000000	0.0000000	0.0000013	0.0000010	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000420	0.000352	0.000298	0.000259	0.000213						0.0000000	0.0000000	0.0000027	0.0000023	0.0000000
Delmag 30-32 Hammer	0.000208	0.000171	0.000137	0.000113	0.000094						0.0000000	0.0000000	0.0000022	0.0000018	0.0000000
65T Rough Terrain Crane	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
Truck Tractor	0.001219	0.001142	0.001056	0.001020	0.000911	0.009317	0.008791	0.008112	0.007640	0.006889	0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.002105	0.002105	0.002105	0.002105	0.002105						0.0000000	0.0000000	0.0001868	0.0001868	0.0000000
Inner Harbor Tug Generator	0.002105	0.002105	0.002105	0.002105	0.002105						0.0000000	0.0000000	0.0000375	0.0000375	0.0000000
Concrete Pump	0.000420	0.000352	0.000298	0.000259	0.000213						0.0000000	0.0000000	0.0000008	0.0000007	0.0000000
100T Crawler Crane	0.000171	0.000132	0.000106	0.000091	0.000083						0.0000000	0.0000000	0.0000014	0.0000012	0.0000000
CAT 345 Excavator	0.000076	0.000068	0.000063	0.000060	0.000058						0.0000000	0.0000000	0.0000035	0.0000033	0.0000000
CAT 330 Excavator	0.000076	0.000068	0.000063	0.000060	0.000058						0.0000000	0.0000000	0.0000009	0.0000008	0.0000000
CAT 966 Loader	0.001512	0.001284	0.001125	0.001005	0.000899						0.0000000	0.0000000	0.0000216	0.0000193	0.0000000
CAT 950 Loader	0.001512	0.001284	0.001125	0.001005	0.000899						0.0000000	0.0000000	0.0000096	0.0000086	0.0000000
										Total (ton/yr)	**0.019**	**0.036**	**0.036**	**0.036**	**0.005**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Benzene Emissions

Equipment	Benzene Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Benzene Idling Emission Factor (g/hr for on-road only)					Benzene Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.003747	0.002679	0.002287	0.002034	0.001820	0.016081	0.011027	0.008694	0.007846	0.007503	0.0000496	0.0000354	0.0000303	0.0000269	0.0000241
Passenger car	0.002832	0.002335	0.002186	0.001933	0.001751	0.022960	0.011137	0.010428	0.009389	0.008519	0.0000375	0.0000309	0.0000289	0.0000256	0.0000232
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.003747	0.002679	0.002287	0.002034	0.001820	0.016081	0.011027	0.008694	0.007846	0.007503	0.0000991	0.0001063	0.0000908	0.0000807	0.0000361
Passenger Trucks (18), Multiple Staff (18)	0.003747	0.002679	0.002287	0.002034	0.001820	0.016081	0.011027	0.008694	0.007846	0.007503	0.0008921	0.0009567	0.0008168	0.0007264	0.0003250
Coral Translocation															
Excavator	0.000356	0.000305	0.000269	0.000245	0.000229						0.0000417	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.002195	0.001864	0.001671	0.001297	0.001528	0.001600	0.001357	0.001200	0.000931	0.001104	0.0000387	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.001401	0.001401	0.001401	0.001401	0.001401						0.0006633	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.001401	0.001401	0.001401	0.001401	0.001401						0.0006633	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.001401	0.001401	0.001401	0.001401	0.001401						0.0000475	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.001401	0.001401	0.001401	0.001401	0.001401						0.0000975	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.001401	0.001401	0.001401	0.001401	0.001401						0.0000464	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.003747	0.002679	0.002287	0.002034	0.001820	0.016081	0.011027	0.008694	0.007846	0.007503	0.0001652	0.0001772	0.0001513	0.0001345	0.0000602
6T All Terrain Forklift 1	0.000336	0.000331	0.000331	0.000331	0.000331						0.0000243	0.0000286	0.0000286	0.0000286	0.0000242
6T All Terrain Forklift 2	0.000336	0.000331	0.000331	0.000331	0.000331						0.0000145	0.0000286	0.0000286	0.0000286	0.0000214
Boom Truck	0.002195	0.001864	0.001671	0.001297	0.001528	0.001600	0.001357	0.001200	0.000931	0.001104	0.0000302	0.0000513	0.0000460	0.0000357	0.0000315
Vacuum Truck/Sweeper	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000523	0.0000973	0.0000889	0.0000856	0.0000561
Cement Train Tractor 1	0.008920	0.008103	0.007257	0.006357	0.005454						0.0006442	0.0011705	0.0010483	0.0009183	0.0005908
Cement Train Tractor 2	0.008920	0.008103	0.007257	0.006357	0.005454						0.0006442	0.0011705	0.0010483	0.0009183	0.0005908
100T Gantry Crane 1	0.001018	0.000747	0.000567	0.000466	0.000410						0.0002259	0.0003312	0.0002514	0.0002067	0.0001365
100T Gantry Crane 2	0.001018	0.000747	0.000567	0.000466	0.000410						0.0002259	0.0003312	0.0002514	0.0002067	0.0001365
Truck Tractor 1	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001312	0.0002097	0.0001916	0.0001835	0.0001271
Truck Tractor 2	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001312	0.0002097	0.0001916	0.0001835	0.0001271
Skid Steer 1	0.022772	0.021961	0.020629	0.018549	0.015880						0.0003618	0.0006979	0.0006556	0.0005894	0.0003785
Skid Steer 2	0.022772	0.021961	0.020629	0.018549	0.015880						0.0003618	0.0006979	0.0006556	0.0005894	0.0003785
4000 Gal Water Truck	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001256	0.0002335	0.0002134	0.0002054	0.0001347
Cat 966 Loader 1	0.000863	0.000662	0.000525	0.000442	0.000395						0.0001681	0.0002580	0.0002047	0.0001721	0.0001154
Cat 966 Loader 2	0.000863	0.000662	0.000525	0.000442	0.000395						0.0001681	0.0002580	0.0002047	0.0001721	0.0001154
36 Meter Concrete Pump Truck	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000942	0.0001751	0.0001600	0.0001541	0.0001011
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.001665	0.001426	0.001168	0.000892	0.000683						0.0000580	0.0000497	0.0000407	0.0000311	0.0000238
Ready Mix Concrete Truck 1	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001312	0.0002097	0.0001916	0.0001835	0.0001271
Ready Mix Concrete Truck 2	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001312	0.0002097	0.0001916	0.0001835	0.0001271
Ready Mix Concrete Truck 3	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001312	0.0002097	0.0001916	0.0001835	0.0001271
Ready Mix Concrete Truck 4 (reserve)	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000131	0.0000210	0.0000192	0.0000183	0.0000127
60' Manlift for Maintenance	0.013384	0.012246	0.011089	0.009738	0.008265						0.0001611	0.0002948	0.0002670	0.0002344	0.0001492
Dump Trucks (4)	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0005395	0.0009685	0.0008851	0.0008511	0.0006456
Truck Tractor for Roll Off Trash Bins	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000789	0.0001124	0.0001027	0.0000979	0.0000709
Fuel Truck	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000893	0.0001319	0.0001204	0.0001150	0.0000822
CAT D8 Dozer	0.000509	0.000421	0.000362	0.000314	0.000278						0.0000119	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000863	0.000662	0.000525	0.000442	0.000395						0.0000128	0.0000000	0.0000000	0.0000000	0.0000059
CAT 14H Grader	0.000601	0.000527	0.000466	0.000412	0.000377						0.0000237	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.001966	0.001667	0.001393	0.001129	0.000861						0.0000499	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000356	0.000305	0.000269	0.000245	0.000229						0.0000000	0.0000000	0.0000000	0.0000000	0.0000057
100T Crawler Crane	0.001018	0.000747	0.000567	0.000466	0.000410						0.0000265	0.0000000	0.0000000	0.0000000	0.0000080

175T Crawler Crane	0.001791	0.001621	0.001473	0.001337	0.001200						0.0001426	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.004974	0.004487	0.003904	0.003584	0.003330						0.0000849	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.019954	0.018713	0.017242	0.015471	0.013567						0.0002106	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.001791	0.001621	0.001473	0.001337	0.001200						0.0001780	0.0008055	0.0007319	0.0006643	0.0001193
Manitowoc MLC 300 Crawler Crane Breakwater	0.001791	0.001621	0.001473	0.001337	0.001200						0.0001780	0.0008055	0.0007319	0.0006643	0.0001193
Manitowoc MLC 300 Crawler Crane Breakwater	0.001791	0.001621	0.001473	0.001337	0.001200						0.0001780	0.0008055	0.0007319	0.0006643	0.0001193
Manitowoc 999 Crawler Crane Breakwater	0.001018	0.000747	0.000567	0.000466	0.000410						0.0000897	0.0003290	0.0002497	0.0002054	0.0000361
Kobelco 275 Ton Crawler	0.001259	0.001085	0.000846	0.000668	0.000514						0.0002043	0.0008806	0.0006865	0.0005421	0.0000834
60T Hydraulic Crane Assembly Crane	0.001791	0.001621	0.001473	0.001337	0.001200						0.0001095	0.0000991	0.0000901	0.0000818	0.0000734
Cat 988 Loader 1	0.001636	0.001477	0.001336	0.001197	0.001052						0.0002914	0.0010526	0.0009523	0.0008533	0.0001875
Cat 988 Loader 2	0.001636	0.001477	0.001336	0.001197	0.001052						0.0002914	0.0010526	0.0009523	0.0008533	0.0001875
Cat 988 Loader 3	0.001636	0.001477	0.001336	0.001197	0.001052						0.0002914	0.0010526	0.0009523	0.0008533	0.0001875
100T Hydraulic Excavator 1	0.000885	0.000685	0.000536	0.000446	0.000396						0.0001452	0.0004492	0.0003512	0.0002924	0.0000649
100T Hydraulic Excavator 2	0.000885	0.000685	0.000536	0.000446	0.000396						0.0001452	0.0004492	0.0003512	0.0002924	0.0000649
CAT 745 Rock Truck 1	0.000341	0.000294	0.000263	0.000241	0.000228						0.0000482	0.0001660	0.0001488	0.0001363	0.0000321
CAT 745 Rock Truck 2	0.000341	0.000294	0.000263	0.000241	0.000228						0.0000241	0.0000830	0.0000744	0.0000682	0.0000161
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.001401	0.001401	0.001401	0.001401	0.001401						0.0006467	0.0025868	0.0025868	0.0025868	0.0006467
Inner Harbor Tug 1 Generator	0.001401	0.001401	0.001401	0.001401	0.001401						0.0003253	0.0013013	0.0013013	0.0013013	0.0003253
Inner Harbor Tug 2 Engine	0.001401	0.001401	0.001401	0.001401	0.001401						0.0006467	0.0025868	0.0025868	0.0025868	0.0006467
Inner Harbor Tug 2 Generator	0.001401	0.001401	0.001401	0.001401	0.001401						0.0003253	0.0013013	0.0013013	0.0013013	0.0003253
Ocean Going Tug for Armor Stone Transport Engine	0.001401	0.001401	0.001401	0.001401	0.001401						0.0052959	0.0105917	0.0105917	0.0105917	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.001401	0.001401	0.001401	0.001401	0.001401						0.0007591	0.0015182	0.0015182	0.0015182	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000262	0.0000973	0.0000889	0.0000856	0.0000187
Mechanic Truck 1	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001417	0.0002292	0.0002094	0.0002006	0.0001009
Mechanic Truck 2	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0001417	0.0002292	0.0002094	0.0002006	0.0001009
Welding Truck	0.011282	0.010503	0.009565	0.008424	0.007300						0.0002044	0.0000000	0.0006931	0.0006104	0.0001322
Compressor	0.004974	0.004487	0.003904	0.003584	0.003330						0.0000460	0.0000000	0.0001443	0.0001325	0.0000308
Boom Truck	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000314	0.0001167	0.0001067	0.0001027	0.0000225
Water Truck	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000628	0.0002335	0.0002134	0.0002054	0.0000449
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000684	0.0001513	0.0001382	0.0001321	0.0000485
Truck Tractor for Mob/Demob/Various	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000314	0.0001167	0.0001067	0.0001027	0.0000225
6T All Terrain Forklift	0.000336	0.000331	0.000331	0.000331	0.000331						0.0000116	0.0000000	0.0000457	0.0000457	0.0000114
D8 Dozer	0.000509	0.000421	0.000362	0.000314	0.000278						0.0000455	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000356	0.000305	0.000269	0.000245	0.000229						0.0000261	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000488	0.000399	0.000342	0.000299	0.000266						0.0000437	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.001018	0.000747	0.000567	0.000466							0.0000000	0.0000000	0.0000068	0.0000056	0.0000000
Kincho Vibro Hammer/Gen	0.001233	0.000998	0.000773	0.000609							0.0000000	0.0000000	0.0000017	0.0000013	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.002399	0.002010	0.001701	0.001485							0.0000000	0.0000000	0.0000035	0.0000031	0.0000000
Delmag 30-32 Hammer	0.001233	0.000998	0.000773	0.000609							0.0000000	0.0000000	0.0000030	0.0000024	0.0000000
65T Rough Terrain Crane	0.001018	0.000747	0.000567	0.000466							0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000103	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000621	0	0	0	0
Coarse Concrete Aggregate											0.0000931	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000103	0	0	0	0

Armor Stone Bedding											0.0003760	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.003747	0.002679	0.002287	0.002034	0.001820	0.016081	0.011027	0.008694	0.007846	0.007503	0.0000000	0.0000000	0.0000091	0.0000081	0.0000000
Passenger car	0.002832	0.002335	0.002186	0.001933	0.001751	0.022960	0.011137	0.010428	0.009389	0.008519	0.0000000	0.0000000	0.0000087	0.0000077	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.003747	0.002679	0.002287	0.002034	0.001820	0.016081	0.011027	0.008694	0.007846	0.007503	0.0000000	0.0000000	0.0000756	0.0000673	0.0000000
185 CFM Compressor	0.004974	0.004487	0.003904	0.003584	0.003330						0.0000000	0.0000000	0.0001291	0.0001185	0.0000000
Miller Welder	0.021800	0.020611	0.019210	0.017524	0.015711						0.0000000	0.0000000	0.0001334	0.0001217	0.0000000
90T Rough Terrain Crane	0.001018	0.000747	0.000567	0.000466	0.000410						0.0000000	0.0000000	0.0000030	0.0000025	0.0000000
175T Crawler Crane	0.001018	0.000747	0.000567	0.000466	0.000410						0.0000000	0.0000000	0.0000261	0.0000215	0.0000000
6T Forklift	0.000336	0.000331	0.000331	0.000331	0.000331						0.0000000	0.0000000	0.0000079	0.0000079	0.0000000
20' Aluminum Crew Boat	0.001401	0.001401	0.001401	0.001401	0.001401						0.0000000	0.0000000	0.0000210	0.0000210	0.0000000
10' Safety Boat	0.001401	0.001401	0.001401	0.001401	0.001401						0.0000000	0.0000000	0.0000007	0.0000007	0.0000000
230T Crawler Crane	0.001018	0.000747	0.000567	0.000466	0.000410						0.0000000	0.0000000	0.0000281	0.0000231	0.0000000
Kincho Vibro Hammer/Gen	0.001233	0.000998	0.000773	0.000609	0.000479						0.0000000	0.0000000	0.0000072	0.0000056	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.002399	0.002010	0.001701	0.001485	0.001205						0.0000000	0.0000000	0.0000152	0.0000132	0.0000000
Delmag 30-32 Hammer	0.001233	0.000998	0.000773	0.000609	0.000479						0.0000000	0.0000000	0.0000123	0.0000097	0.0000000
65T Rough Terrain Crane	0.001018	0.000747	0.000567	0.000466	0.000410						0.0000000	0.0000000	0.0000009	0.0000008	0.0000000
Truck Tractor	0.004566	0.004243	0.003878	0.003733	0.003265	0.034957	0.032698	0.029801	0.027816	0.024590	0.0000000	0.0000000	0.0000013	0.0000012	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.001401	0.001401	0.001401	0.001401	0.001401						0.0000000	0.0000000	0.0001244	0.0001244	0.0000000
Inner Harbor Tug Generator	0.001401	0.001401	0.001401	0.001401	0.001401						0.0000000	0.0000000	0.0000250	0.0000250	0.0000000
Concrete Pump	0.002399	0.002010	0.001701	0.001485	0.001205						0.0000000	0.0000000	0.0000048	0.0000042	0.0000000
100T Crawler Crane	0.001018	0.000747	0.000567	0.000466	0.000410						0.0000000	0.0000000	0.0000073	0.0000060	0.0000000
CAT 345 Excavator	0.000356	0.000305	0.000269	0.000245	0.000229						0.0000000	0.0000000	0.0000150	0.0000136	0.0000000
CAT 330 Excavator	0.000356	0.000305	0.000269	0.000245	0.000229						0.0000000	0.0000000	0.0000037	0.0000033	0.0000000
CAT 966 Loader	0.008498	0.007222	0.006368	0.005714	0.005155						0.0000000	0.0000000	0.0001221	0.0001095	0.0000000
CAT 950 Loader	0.008498	0.007222	0.006368	0.005714	0.005155						0.0000000	0.0000000	0.0000545	0.0000489	0.0000000
										Total (ton/yr)	**0.020**	**0.039**	**0.038**	**0.036**	**0.009**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Hexane Emissions

Equipment	Hexane Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Hexane Idling Emission Factor (g/hr for on-road only)					Hexane Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.005768	0.005085	0.004742	0.004284	0.004029	0.034032	0.031089	0.029379	0.028227	0.026876	0.0000763	0.0000673	0.0000627	0.0000567	0.0000533
Passenger car	0.005729	0.005332	0.005186	0.004606	0.004400	0.038848	0.032839	0.032467	0.031400	0.030358	0.0000758	0.0000705	0.0000686	0.0000609	0.0000582
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.005768	0.005085	0.004742	0.004284	0.004029	0.034032	0.031089	0.029379	0.028227	0.026876	0.0001526	0.0002018	0.0001882	0.0001700	0.0000799
Passenger Trucks (18), Multiple Staff (18)	0.005768	0.005085	0.004742	0.004284	0.004029	0.034032	0.031089	0.029379	0.028227	0.026876	0.0013732	0.0018160	0.0016937	0.0015301	0.0007195
Coral Translocation															
Excavator	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000006	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.000577	0.000493	0.000444	0.000350	0.000406	0.000423	0.000361	0.000321	0.000253	0.000296	0.0000102	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.000825	0.000825	0.000825	0.000825	0.000825						0.0003905	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.000825	0.000825	0.000825	0.000825	0.000825						0.0003905	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.000825	0.000825	0.000825	0.000825	0.000825						0.0000280	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.000825	0.000825	0.000825	0.000825	0.000825						0.0000574	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.000825	0.000825	0.000825	0.000825	0.000825						0.0000273	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.005768	0.005085	0.004742	0.004284	0.004029	0.034032	0.031089	0.029379	0.028227	0.026876	0.0002543	0.0003363	0.0003137	0.0002834	0.0001332
6T All Terrain Forklift 1	0.000001	0.000001	0.000001	0.000001	0.000001						0.0000001	0.0000001	0.0000001	0.0000001	0.0000001
6T All Terrain Forklift 2	0.000001	0.000001	0.000001	0.000001	0.000001						0.0000001	0.0000001	0.0000001	0.0000001	0.0000001
Boom Truck	0.000577	0.000493	0.000444	0.000350	0.000406	0.000423	0.000361	0.000321	0.000253	0.000296	0.0000079	0.0000136	0.0000122	0.0000096	0.0000084
Vacuum Truck/Sweeper	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000137	0.0000255	0.0000234	0.0000225	0.0000149
Cement Train Tractor 1	0.000264	0.000223	0.000189	0.000159	0.000134						0.0000190	0.0000322	0.0000273	0.0000230	0.0000145
Cement Train Tractor 2	0.000264	0.000223	0.000189	0.000159	0.000134						0.0000190	0.0000322	0.0000273	0.0000230	0.0000145
100T Gantry Crane 1	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000014	0.0000025	0.0000023	0.0000023	0.0000017
100T Gantry Crane 2	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000014	0.0000025	0.0000023	0.0000023	0.0000017
Truck Tractor 1	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000344	0.0000550	0.0000504	0.0000483	0.0000336
Truck Tractor 2	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000344	0.0000550	0.0000504	0.0000483	0.0000336
Skid Steer 1	0.001209	0.001138	0.001006	0.000788	0.000609						0.0000192	0.0000362	0.0000320	0.0000250	0.0000145
Skid Steer 2	0.001209	0.001138	0.001006	0.000788	0.000609						0.0000192	0.0000362	0.0000320	0.0000250	0.0000145
4000 Gal Water Truck	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000329	0.0000613	0.0000562	0.0000541	0.0000357
Cat 966 Loader 1	0.000006	0.000005	0.000005	0.000005	0.000005						0.0000011	0.0000021	0.0000020	0.0000020	0.0000015
Cat 966 Loader 2	0.000006	0.000005	0.000005	0.000005	0.000005						0.0000011	0.0000021	0.0000020	0.0000020	0.0000015
36 Meter Concrete Pump Truck	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000247	0.0000459	0.0000421	0.0000406	0.0000267
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000020	0.000015	0.000011	0.000008	0.000006						0.0000007	0.0000005	0.0000004	0.0000003	0.0000002
Ready Mix Concrete Truck 1	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000344	0.0000550	0.0000504	0.0000483	0.0000336
Ready Mix Concrete Truck 2	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000344	0.0000550	0.0000504	0.0000483	0.0000336
Ready Mix Concrete Truck 3	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000344	0.0000550	0.0000504	0.0000483	0.0000336
Ready Mix Concrete Truck 4 (reserve)	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000034	0.0000055	0.0000050	0.0000048	0.0000034
60' Manlift for Maintenance	0.000427	0.000362	0.000300	0.000247	0.000206						0.0000051	0.0000087	0.0000072	0.0000060	0.0000037
Dump Trucks (4)	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0001413	0.0002541	0.0002329	0.0002240	0.0001709
Truck Tractor for Roll Off Trash Bins	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000206	0.0000295	0.0000270	0.0000258	0.0000188
Fuel Truck	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000234	0.0000346	0.0000317	0.0000303	0.0000217
CAT D8 Dozer	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000001	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000006	0.000005	0.000005	0.000005	0.000005						0.0000001	0.0000000	0.0000000	0.0000000	0.0000001
CAT 14H Grader	0.000002	0.000002	0.000002	0.000002	0.000002						0.0000001	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000018	0.000014	0.000009	0.000006	0.000004						0.0000005	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000000	0.0000000	0.0000000	0.0000000	0.0000001
100T Crawler Crane	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000002	0.0000000	0.0000000	0.0000000	0.0000001

175T Crawler Crane	0.000017	0.000015	0.000013	0.000011	0.000010						0.0000014	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.000057	0.000048	0.000041	0.000034	0.000028						0.0000010	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.000995	0.000896	0.000774	0.000623	0.000504						0.0000105	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000017	0.000015	0.000013	0.000011	0.000010						0.0000017	0.0000073	0.0000063	0.0000055	0.0000010
Manitowoc MLC 300 Crawler Crane Breakwater	0.000017	0.000015	0.000013	0.000011	0.000010						0.0000017	0.0000073	0.0000063	0.0000055	0.0000010
Manitowoc MLC 300 Crawler Crane Breakwater	0.000017	0.000015	0.000013	0.000011	0.000010						0.0000017	0.0000073	0.0000063	0.0000055	0.0000010
Manitowoc 999 Crawler Crane Breakwater	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000006	0.0000025	0.0000023	0.0000023	0.0000004
Kobelco 275 Ton Crawler	0.000008	0.000007	0.000006	0.000006	0.000005						0.0000014	0.0000059	0.0000051	0.0000046	0.0000009
60T Hydraulic Crane Assembly Crane	0.000017	0.000015	0.000013	0.000011	0.000010						0.0000011	0.0000009	0.0000008	0.0000007	0.0000006
Cat 988 Loader 1	0.000015	0.000013	0.000011	0.000010	0.000009						0.0000027	0.0000091	0.0000080	0.0000071	0.0000016
Cat 988 Loader 2	0.000015	0.000013	0.000011	0.000010	0.000009						0.0000027	0.0000091	0.0000080	0.0000071	0.0000016
Cat 988 Loader 3	0.000015	0.000013	0.000011	0.000010	0.000009						0.0000027	0.0000091	0.0000080	0.0000071	0.0000016
100T Hydraulic Excavator 1	0.000006	0.000005	0.000005	0.000005	0.000005						0.0000010	0.0000036	0.0000034	0.0000034	0.0000008
100T Hydraulic Excavator 2	0.000006	0.000005	0.000005	0.000005	0.000005						0.0000010	0.0000036	0.0000034	0.0000034	0.0000008
CAT 745 Rock Truck 1	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000007	0.0000028	0.0000028	0.0000028	0.0000007
CAT 745 Rock Truck 2	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000004	0.0000014	0.0000014	0.0000014	0.0000003
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.000825	0.000825	0.000825	0.000825	0.000825						0.0003807	0.0015229	0.0015229	0.0015229	0.0003807
Inner Harbor Tug 1 Generator	0.000825	0.000825	0.000825	0.000825	0.000825						0.0001915	0.0007661	0.0007661	0.0007661	0.0001915
Inner Harbor Tug 2 Engine	0.000825	0.000825	0.000825	0.000825	0.000825						0.0003807	0.0015229	0.0015229	0.0015229	0.0003807
Inner Harbor Tug 2 Generator	0.000825	0.000825	0.000825	0.000825	0.000825						0.0001915	0.0007661	0.0007661	0.0007661	0.0001915
Ocean Going Tug for Armor Stone Transport Engine	0.000825	0.000825	0.000825	0.000825	0.000825						0.0031178	0.0062357	0.0062357	0.0062357	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.000825	0.000825	0.000825	0.000825	0.000825						0.0004469	0.0008938	0.0008938	0.0008938	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000069	0.0000255	0.0000234	0.0000225	0.0000050
Mechanic Truck 1	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000371	0.0000601	0.0000551	0.0000528	0.0000267
Mechanic Truck 2	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000371	0.0000601	0.0000551	0.0000528	0.0000267
Welding Truck	0.000334	0.000289	0.000248	0.000211	0.000178						0.0000060		0.0000180	0.0000153	0.0000032
Compressor	0.000057	0.000048	0.000041	0.000034	0.000028						0.0000005		0.0000015	0.0000012	0.0000003
Boom Truck	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000082	0.0000306	0.0000281	0.0000270	0.0000059
Water Truck	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000165	0.0000613	0.0000562	0.0000541	0.0000119
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000179	0.0000397	0.0000364	0.0000348	0.0000128
Truck Tractor for Mob/Demob/Various	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000082	0.0000306	0.0000281	0.0000270	0.0000059
6T All Terrain Forklift	0.000001	0.000001	0.000001	0.000001	0.000001						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
D8 Dozer	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000005	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000004	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000005	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000007	0.000006	0.000005	0.000005							0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Kincho Vibro Hammer/Gen	0.000011	0.000008	0.000007	0.000006							0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000035	0.000029	0.000023	0.000019							0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Delmag 30-32 Hammer	0.000011	0.000008	0.000007	0.000006							0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
65T Rough Terrain Crane	0.000007	0.000006	0.000005	0.000005							0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000061	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000366	0	0	0	0
Coarse Concrete Aggregate											0.0000548	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000061	0	0	0	0

Armor Stone Bedding											0.0002214	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.005768	0.005085	0.004742	0.004284	0.004029	0.034032	0.031089	0.029379	0.028227	0.026876	0.0000000	0.0000000	0.0000188	0.0000170	0.0000000
Passenger car	0.005729	0.005332	0.005186	0.004606	0.004400	0.038848	0.032839	0.032467	0.031400	0.030358	0.0000000	0.0000000	0.0000206	0.0000183	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.005768	0.005085	0.004742	0.004284	0.004029	0.034032	0.031089	0.029379	0.028227	0.026876	0.0000000	0.0000000	0.0001568	0.0001417	0.0000000
185 CFM Compressor	0.000057	0.000048	0.000041	0.000034	0.000028						0.0000000		0.0000013	0.0000011	0.0000000
Miller Welder	0.001006	0.000907	0.000786	0.000636	0.000518						0.0000000		0.0000055	0.0000044	0.0000000
90T Rough Terrain Crane	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000000		0.0000000	0.0000000	0.0000000
175T Crawler Crane	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000000		0.0000002	0.0000002	0.0000000
6T Forklift	0.000001	0.000001	0.000001	0.000001	0.000001						0.0000000		0.0000000	0.0000000	0.0000000
20' Aluminum Crew Boat	0.000825	0.000825	0.000825	0.000825	0.000825						0.0000000	0.0000000	0.0000124	0.0000124	0.0000000
10' Safety Boat	0.000825	0.000825	0.000825	0.000825	0.000825						0.0000000	0.0000000	0.0000004	0.0000004	0.0000000
230T Crawler Crane	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000000		0.0000003	0.0000003	0.0000000
Kincho Vibro Hammer/Gen	0.000011	0.000008	0.000007	0.000006	0.000006						0.0000000		0.0000001	0.0000001	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000035	0.000029	0.000023	0.000019	0.000016						0.0000000		0.0000002	0.0000002	0.0000000
Delmag 30-32 Hammer	0.000011	0.000008	0.000007	0.000006	0.000006						0.0000000		0.0000001	0.0000001	0.0000000
65T Rough Terrain Crane	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000000		0.0000000	0.0000000	0.0000000
Truck Tractor	0.001196	0.001113	0.001020	0.000983	0.000864	0.009141	0.008566	0.007829	0.007321	0.006503	0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.000825	0.000825	0.000825	0.000825	0.000825						0.0000000	0.0000000	0.0000732	0.0000732	0.0000000
Inner Harbor Tug Generator	0.000825	0.000825	0.000825	0.000825	0.000825						0.0000000	0.0000000	0.0000147	0.0000147	0.0000000
Concrete Pump	0.000035	0.000029	0.000023	0.000019	0.000016						0.0000000		0.0000001	0.0000001	0.0000000
100T Crawler Crane	0.000007	0.000006	0.000005	0.000005	0.000005						0.0000000		0.0000001	0.0000001	0.0000000
CAT 345 Excavator	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000000		0.0000003	0.0000003	0.0000000
CAT 330 Excavator	0.000005	0.000005	0.000005	0.000005	0.000005						0.0000000		0.0000001	0.0000001	0.0000000
CAT 966 Loader	0.000171	0.000145	0.000124	0.000109	0.000094						0.0000000		0.0000024	0.0000021	0.0000000
CAT 950 Loader	0.000171	0.000145	0.000124	0.000109	0.000094						0.0000000		0.0000011	0.0000009	0.0000000
										Total (ton/yr)	**0.009**	**0.015**	**0.016**	**0.016**	**0.003**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Toluene Emissions

Equipment	Toluene Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Toluene Idling Emission Factor (g/hr for on-road only)					Toluene Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.024793	0.021814	0.020553	0.019437	0.018405	0.024793	0.162779	0.154217	0.149489	0.142489	0.0003280	0.0002885	0.0002719	0.0002571	0.0002435
Passenger car	0.023567	0.022189	0.021947	0.020852	0.020263	0.023567	0.172314	0.171045	0.167458	0.162415	0.0003117	0.0002935	0.0002903	0.0002758	0.0002680
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.024793	0.021814	0.020553	0.019437	0.018405	0.024793	0.162779	0.154217	0.149489	0.142489	0.0006559	0.0008656	0.0008156	0.0007713	0.0003652
Passenger Trucks (18), Multiple Staff (18)	0.024793	0.021814	0.020553	0.019437	0.018405	0.024793	0.162779	0.154217	0.149489	0.142489	0.0059033	0.0077907	0.0073404	0.0069419	0.0032867
Coral Translocation															
Excavator															
Flat Bed Truck	0.000347	0.000312	0.000287	0.000270	0.000259	0.000347					0.0000406	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.001625	0.001437	0.001325	0.001127	0.001240	0.001625	0.001099	0.001004	0.000847	0.000934	0.0000287	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.000602	0.000602	0.000602	0.000602	0.000602						0.0002848	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.000602	0.000602	0.000602	0.000602	0.000602						0.0002848	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.000602	0.000602	0.000602	0.000602	0.000602						0.0000204	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.000602	0.000602	0.000602	0.000602	0.000602						0.0000419	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.024793	0.021814	0.020553	0.019437	0.018405	0.024793	0.162779	0.154217	0.149489	0.142489	0.0010932	0.0014427	0.0013593	0.0012855	0.0006087
6T All Terrain Forklift 1	0.000260	0.000256	0.000256	0.000256	0.000256	0.000260					0.0000188	0.0000221	0.0000221	0.0000221	0.0000187
6T All Terrain Forklift 2	0.000260	0.000256	0.000256	0.000256	0.000256	0.000260					0.0000112	0.0000221	0.0000221	0.0000221	0.0000166
Boom Truck	0.001625	0.001437	0.001325	0.001127	0.001240	0.001625	0.001099	0.001004	0.000847	0.000934	0.0000223	0.0000395	0.0000365	0.0000310	0.0000256
Vacuum Truck/Sweeper	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000371	0.0000698	0.0000650	0.0000629	0.0000426
Cement Train Tractor 1	0.006339	0.005764	0.005173	0.004544	0.003913	0.006339					0.0004578	0.0008326	0.0007472	0.0006563	0.0004239
Cement Train Tractor 2	0.006339	0.005764	0.005173	0.004544	0.003913	0.006339					0.0004578	0.0008326	0.0007472	0.0006563	0.0004239
100T Gantry Crane 1	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0001781	0.0002728	0.0002177	0.0001870	0.0001274
100T Gantry Crane 2	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0001781	0.0002728	0.0002177	0.0001870	0.0001274
Truck Tractor 1	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000702	0.0001504	0.0001400	0.0001349	0.0000966
Truck Tractor 2	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000702	0.0001504	0.0001400	0.0001349	0.0000966
Skid Steer 1	0.017871	0.017241	0.016109	0.014270	0.012094	0.017871					0.0002840	0.0005479	0.0005119	0.0004535	0.0002883
Skid Steer 2	0.017871	0.017241	0.016109	0.014270	0.012094	0.017871					0.0002840	0.0005479	0.0005119	0.0004535	0.0002883
4000 Gal Water Truck	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000890	0.0001676	0.0001560	0.0001509	0.0001023
Cat 966 Loader 1	0.000695	0.000556	0.000462	0.000405	0.000373	0.000695					0.0001353	0.0002167	0.0001801	0.0001577	0.0001089
Cat 966 Loader 2	0.000695	0.000556	0.000462	0.000405	0.000373	0.000695					0.0001353	0.0002167	0.0001801	0.0001577	0.0001089
36 Meter Concrete Pump Truck	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000668	0.0001257	0.0001170	0.0001132	0.0000767
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.001279	0.001106	0.000919	0.000723	0.000575	0.001279					0.0000446	0.0000385	0.0000320	0.0000252	0.0000201
Ready Mix Concrete Truck 1	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000702	0.0001504	0.0001400	0.0001349	0.0000966
Ready Mix Concrete Truck 2	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000702	0.0001504	0.0001400	0.0001349	0.0000966
Ready Mix Concrete Truck 3	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000702	0.0001504	0.0001400	0.0001349	0.0000966
Ready Mix Concrete Truck 4 (reserve)	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000070	0.0000150	0.0000140	0.0000135	0.0000097
60' Manlift for Maintenance	0.009713	0.008868	0.008004	0.007015	0.005955	0.009713					0.0001169	0.0002135	0.0001927	0.0001689	0.0001075
Dump Trucks (4)	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0003595	0.0006950	0.0006470	0.0006254	0.0004903
Truck Tractor for Roll Off Trash Bins	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000331	0.0000806	0.0000750	0.0000721	0.0000539
Fuel Truck	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000405	0.0000946	0.0000880	0.0000846	0.0000625
CAT D8 Dozer	0.000451	0.000391	0.000350	0.000318	0.000293	0.000451					0.0000106	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000695	0.000556	0.000462	0.000405	0.000373	0.000695					0.0000103	0.0000000	0.0000000	0.0000000	0.0000055
CAT 14H Grader	0.000457	0.000406	0.000364	0.000327	0.000302	0.000457					0.0000180	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.001439	0.001222	0.001023	0.000832	0.000641	0.001439					0.0000365	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000347	0.000312	0.000287	0.000270	0.000259	0.000347					0.0000000	0.0000000	0.0000000	0.0000000	0.0000065
100T Crawler Crane	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0000209	0.0000000	0.0000000	0.0000000	0.0000075

175T Crawler Crane	0.001353	0.001234	0.001129	0.001033	0.000937	0.001353					0.0001077	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.003630	0.003273	0.002852	0.002614	0.002427	0.003630					0.0000619	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.015081	0.014135	0.012967	0.011516	0.010026	0.015081					0.0001592	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.001353	0.001234	0.001129	0.001033	0.000937	0.001353					0.0001344	0.0006129	0.0005612	0.0005135	0.0000931
Manitowoc MLC 300 Crawler Crane Breakwater	0.001353	0.001234	0.001129	0.001033	0.000937	0.001353					0.0001344	0.0006129	0.0005612	0.0005135	0.0000931
Manitowoc MLC 300 Crawler Crane Breakwater	0.001353	0.001234	0.001129	0.001033	0.000937	0.001353					0.0001344	0.0006129	0.0005612	0.0005135	0.0000931
Manitowoc 999 Crawler Crane Breakwater	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0000708	0.0002710	0.0002162	0.0001857	0.0000338
Kobelco 275 Ton Crawler	0.000972	0.000851	0.000685	0.000562	0.000455	0.000972					0.0001578	0.0006905	0.0005559	0.0004559	0.0000739
60T Hydraulic Crane Assembly Crane	0.001353	0.001234	0.001129	0.001033	0.000937	0.001353					0.0000827	0.0000754	0.0000691	0.0000632	0.0000573
Cat 988 Loader 1	0.001244	0.001133	0.001033	0.000935	0.000833	0.001244					0.0002217	0.0008071	0.0007362	0.0006663	0.0001484
Cat 988 Loader 2	0.001244	0.001133	0.001033	0.000935	0.000833	0.001244					0.0002217	0.0008071	0.0007362	0.0006663	0.0001484
Cat 988 Loader 3	0.001244	0.001133	0.001033	0.000935	0.000833	0.001244					0.0002217	0.0008071	0.0007362	0.0006663	0.0001484
100T Hydraulic Excavator 1	0.000709	0.000572	0.000469	0.000408	0.000373	0.000709					0.0001163	0.0003749	0.0003076	0.0002673	0.0000612
100T Hydraulic Excavator 2	0.000709	0.000572	0.000469	0.000408	0.000373	0.000709					0.0001163	0.0003749	0.0003076	0.0002673	0.0000612
CAT 745 Rock Truck 1	0.000336	0.000304	0.000283	0.000268	0.000258	0.000336					0.0000475	0.0001717	0.0001599	0.0001513	0.0000365
CAT 745 Rock Truck 2	0.000336	0.000304	0.000283	0.000268	0.000258	0.000336					0.0000237	0.0000858	0.0000799	0.0000756	0.0000182
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.000602	0.000602	0.000602	0.000602	0.000602						0.0002777	0.0011108	0.0011108	0.0011108	0.0002777
Inner Harbor Tug 1 Generator	0.000602	0.000602	0.000602	0.000602	0.000602						0.0001397	0.0005588	0.0005588	0.0005588	0.0001397
Inner Harbor Tug 2 Engine	0.000602	0.000602	0.000602	0.000602	0.000602						0.0002777	0.0011108	0.0011108	0.0011108	0.0002777
Inner Harbor Tug 2 Generator	0.000602	0.000602	0.000602	0.000602	0.000602						0.0001397	0.0005588	0.0005588	0.0005588	0.0001397
Ocean Going Tug for Armor Stone Transport Engine	0.000602	0.000602	0.000602	0.000602	0.000602						0.0022741	0.0045483	0.0045483	0.0045483	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.000602	0.000602	0.000602	0.000602	0.000602						0.0003260	0.0006519	0.0006519	0.0006519	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000185	0.0000698	0.0000650	0.0000629	0.0000142
Mechanic Truck 1	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000776	0.0001644	0.0001530	0.0001475	0.0000767
Mechanic Truck 2	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000776	0.0001644	0.0001530	0.0001475	0.0000767
Welding Truck	0.007950	0.007414	0.006764	0.005970	0.005188	0.007950					0.0001440	0.0005372	0.0004901	0.0004326	0.0000940
Compressor	0.003630	0.003273	0.002852	0.002614	0.002427	0.003630					0.0000336	0.0001210	0.0001054	0.0000967	0.0000224
Boom Truck	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000223	0.0000838	0.0000780	0.0000755	0.0000171
Water Truck	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000445	0.0001676	0.0001560	0.0001509	0.0000341
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000257	0.0001085	0.0001010	0.0000972	0.0000369
Truck Tractor for Mob/Demob/Various	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000223	0.0000838	0.0000780	0.0000755	0.0000171
6T All Terrain Forklift	0.000260	0.000256	0.000256	0.000256	0.000256	0.000260					0.0000090	0.0000354	0.0000354	0.0000354	0.0000088
D8 Dozer	0.000451	0.000391	0.000350	0.000318	0.000293	0.000451					0.0000403	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000347	0.000312	0.000287	0.000270	0.000259	0.000347					0.0000254	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000437	0.000376	0.000337	0.000307	0.000285	0.000437					0.0000391	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000803	0.000615	0.000491	0.000421	0.149254	0.000803					0.0000000	0.0000000	0.0000059	0.0000051	0.0000000
Kincho Vibro Hammer/Gen	0.000961	0.000795	0.000637	0.000523	0.149254	0.000961					0.0000000	0.0000000	0.0000014	0.0000012	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001775	0.001505	0.001290	0.001139	0.149254	0.001775					0.0000000	0.0000000	0.0000027	0.0000024	0.0000000
Delmag 30-32 Hammer	0.000961	0.000795	0.000637	0.000523	0.149254	0.000961					0.0000000	0.0000000	0.0000025	0.0000020	0.0000000
65T Rough Terrain Crane	0.000803	0.000615	0.000491	0.000421	0.149254	0.000803					0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000044	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000267	0	0	0	0
Coarse Concrete Aggregate											0.0000400	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000044	0	0	0	0

Armor Stone Bedding											0.0001615	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.024793	0.021814	0.020553	0.019437	0.018405	0.024793	0.162779	0.154217	0.149489	0.142489	0.0000000	0.0000000	0.0000816	0.0000771	0.0000000
Passenger car	0.023567	0.022189	0.021947	0.020852	0.020263	0.023567	0.172314	0.171045	0.167458	0.162415	0.0000000	0.0000000	0.0000871	0.0000827	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.024793	0.021814	0.020553	0.019437	0.018405	0.024793	0.162779	0.154217	0.149489	0.142489	0.0000000	0.0000000	0.0006797	0.0006428	0.0000000
185 CFM Compressor	0.003630	0.003273	0.002852	0.002614	0.002427	0.003630					0.0000000	0.0000000	0.0000943	0.0000864	0.0000000
Miller Welder	0.016404	0.015496	0.014380	0.012991	0.011568	0.016404					0.0000000	0.0000000	0.0000999	0.0000902	0.0000000
90T Rough Terrain Crane	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0000000	0.0000000	0.0000026	0.0000023	0.0000000
175T Crawler Crane	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0000000	0.0000000	0.0000226	0.0000194	0.0000000
6T Forklift	0.000260	0.000256	0.000256	0.000256	0.000256	0.000260					0.0000000	0.0000000	0.0000061	0.0000061	0.0000000
20' Aluminum Crew Boat	0.000602	0.000602	0.000602	0.000602	0.000602						0.0000000	0.0000000	0.0000090	0.0000090	0.0000000
10' Safety Boat	0.000602	0.000602	0.000602	0.000602	0.000602						0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
230T Crawler Crane	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0000000	0.0000000	0.0000243	0.0000209	0.0000000
Kincho Vibro Hammer/Gen	0.000961	0.000795	0.000637	0.000523	0.000432	0.000961					0.0000000	0.0000000	0.0000059	0.0000048	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001775	0.001505	0.001290	0.001139	0.000944	0.001775					0.0000000	0.0000000	0.0000115	0.0000102	0.0000000
Delmag 30-32 Hammer	0.000961	0.000795	0.000637	0.000523	0.000432	0.000961					0.0000000	0.0000000	0.0000102	0.0000083	0.0000000
65T Rough Terrain Crane	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0000000	0.0000000	0.0000008	0.0000007	0.0000000
Truck Tractor	0.003235	0.003045	0.002835	0.002742	0.002479	0.003235	0.023398	0.021738	0.020567	0.018744	0.0000000	0.0000000	0.0000009	0.0000009	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.000602	0.000602	0.000602	0.000602	0.000602						0.0000000	0.0000000	0.0000534	0.0000534	0.0000000
Inner Harbor Tug Generator	0.000602	0.000602	0.000602	0.000602	0.000602						0.0000000	0.0000000	0.0000107	0.0000107	0.0000000
Concrete Pump	0.001775	0.001505	0.001290	0.001139	0.000944	0.001775					0.0000000	0.0000000	0.0000037	0.0000032	0.0000000
100T Crawler Crane	0.000803	0.000615	0.000491	0.000421	0.000383	0.000803					0.0000000	0.0000000	0.0000063	0.0000054	0.0000000
CAT 345 Excavator	0.000347	0.000312	0.000287	0.000270	0.000259	0.000347					0.0000000	0.0000000	0.0000160	0.0000150	0.0000000
CAT 330 Excavator	0.000347	0.000312	0.000287	0.000270	0.000259	0.000347					0.0000000	0.0000000	0.0000039	0.0000037	0.0000000
CAT 966 Loader	0.006259	0.005340	0.004721	0.004249	0.003841	0.006259					0.0000000	0.0000000	0.0000905	0.0000814	0.0000000
CAT 950 Loader	0.006259	0.005340	0.004721	0.004249	0.003841	0.006259					0.0000000	0.0000000	0.0000404	0.0000364	0.0000000
										Total (ton/yr)	**0.019**	**0.033**	**0.032**	**0.031**	**0.010**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Acrolein Emissions

Equipment	Acrolein Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Acrolein Idling Emission Factor (g/hr for on-road only)					Acrolein Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000060	0.000040	0.000033	0.000028	0.000025	0.000228	0.000134	0.000092	0.000078	0.000075	0.0000008	0.0000005	0.0000004	0.0000004	0.0000003
Passenger car	0.000042	0.000033	0.000030	0.000026	0.000023	0.000357	0.000134	0.000121	0.000103	0.000088	0.0000006	0.0000004	0.0000004	0.0000003	0.0000003
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000060	0.000040	0.000033	0.000028	0.000025	0.000228	0.000134	0.000092	0.000078	0.000075	0.0000016	0.0000016	0.0000013	0.0000011	0.0000005
Passenger Trucks (18), Multiple Staff (18)	0.000060	0.000040	0.000033	0.000028	0.000025	0.000228	0.000134	0.000092	0.000078	0.000075	0.0000142	0.0000142	0.0000117	0.0000102	0.0000044
Coral Translocation															
Excavator	0.000143	0.000125	0.000113	0.000104	0.000099						0.0000167	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.001913	0.001635	0.001473	0.001159	0.001353	0.001404	0.001199	0.001067	0.000839	0.000985	0.0000337	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.000546	0.000546	0.000546	0.000546	0.000546						0.0002586	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.000546	0.000546	0.000546	0.000546	0.000546						0.0002586	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.000546	0.000546	0.000546	0.000546	0.000546						0.0000185	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.000546	0.000546	0.000546	0.000546	0.000546						0.0000380	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.000546	0.000546	0.000546	0.000546	0.000546						0.0000181	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000060	0.000040	0.000033	0.000028	0.000025	0.000228	0.000134	0.000092	0.000078	0.000075	0.0000026	0.0000026	0.0000022	0.0000019	0.0000008
6T All Terrain Forklift 1	0.000121	0.000119	0.000119	0.000119	0.000119						0.0000088	0.0000103	0.0000103	0.0000103	0.0000087
6T All Terrain Forklift 2	0.000121	0.000119	0.000119	0.000119	0.000119						0.0000052	0.0000103	0.0000103	0.0000103	0.0000077
Boom Truck	0.001913	0.001635	0.001473	0.001159	0.001353	0.001404	0.001199	0.001067	0.000839	0.000985	0.0000263	0.0000450	0.0000405	0.0000319	0.0000279
Vacuum Truck/Sweeper	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000451	0.0000839	0.0000769	0.0000741	0.0000488
Cement Train Tractor 1	0.005166	0.004560	0.003992	0.003440	0.002922						0.0003731	0.0006586	0.0005766	0.0004969	0.0003166
Cement Train Tractor 2	0.005166	0.004560	0.003992	0.003440	0.002922						0.0003731	0.0006586	0.0005766	0.0004969	0.0003166
100T Gantry Crane 1	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000829	0.0001233	0.0000954	0.0000799	0.0000535
100T Gantry Crane 2	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000829	0.0001233	0.0000954	0.0000799	0.0000535
Truck Tractor 1	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001130	0.0001809	0.0001657	0.0001590	0.0001106
Truck Tractor 2	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001130	0.0001809	0.0001657	0.0001590	0.0001106
Skid Steer 1	0.012911	0.012208	0.011165	0.009632	0.008027						0.0002052	0.0003880	0.0003548	0.0003061	0.0001913
Skid Steer 2	0.012911	0.012208	0.011165	0.009632	0.008027						0.0002052	0.0003880	0.0003548	0.0003061	0.0001913
4000 Gal Water Truck	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001082	0.0002014	0.0001845	0.0001779	0.0001172
Cat 966 Loader 1	0.000318	0.000248	0.000201	0.000172	0.000156						0.0000620	0.0000966	0.0000781	0.0000669	0.0000455
Cat 966 Loader 2	0.000318	0.000248	0.000201	0.000172	0.000156						0.0000620	0.0000966	0.0000781	0.0000669	0.0000455
36 Meter Concrete Pump Truck	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000811	0.0001511	0.0001384	0.0001334	0.0000879
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000635	0.000541	0.000441	0.000337	0.000259						0.0000221	0.0000189	0.0000154	0.0000117	0.0000090
Ready Mix Concrete Truck 1	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001130	0.0001809	0.0001657	0.0001590	0.0001106
Ready Mix Concrete Truck 2	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001130	0.0001809	0.0001657	0.0001590	0.0001106
Ready Mix Concrete Truck 3	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001130	0.0001809	0.0001657	0.0001590	0.0001106
Ready Mix Concrete Truck 4 (reserve)	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000113	0.0000181	0.0000166	0.0000159	0.0000111
60' Manlift for Maintenance	0.007329	0.006524	0.005748	0.004960	0.004187						0.0000882	0.0001571	0.0001384	0.0001194	0.0000756
Dump Trucks (4)	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0004646	0.0008355	0.0007655	0.0007371	0.0005614
Truck Tractor for Roll Off Trash Bins	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000679	0.0000970	0.0000888	0.0000849	0.0000617
Fuel Truck	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000770	0.0001138	0.0001042	0.0000997	0.0000715
CAT D8 Dozer	0.000195	0.000165	0.000144	0.000128	0.000115						0.0000046	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000318	0.000248	0.000201	0.000172	0.000156						0.0000047	0.0000000	0.0000000	0.0000000	0.0000023
CAT 14H Grader	0.000215	0.000190	0.000169	0.000150	0.000138						0.0000085	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000733	0.000617	0.000509	0.000409	0.000310						0.0000186	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000143	0.000125	0.000113	0.000104	0.000099						0.0000000	0.0000000	0.0000000	0.0000000	0.0000025
100T Crawler Crane	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000097	0.0000000	0.0000000	0.0000000	0.0000031

175T Crawler Crane	0.000690	0.000614	0.000552	0.000498	0.000447						0.0000549	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.001848	0.001652	0.001426	0.001295	0.001191						0.0000315	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.012310	0.011255	0.010090	0.008768	0.007529						0.0001299	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000690	0.000614	0.000552	0.000498	0.000447						0.0000686	0.0003051	0.0002742	0.0002474	0.0000445
Manitowoc MLC 300 Crawler Crane Breakwater	0.000690	0.000614	0.000552	0.000498	0.000447						0.0000686	0.0003051	0.0002742	0.0002474	0.0000445
Manitowoc MLC 300 Crawler Crane Breakwater	0.000690	0.000614	0.000552	0.000498	0.000447						0.0000686	0.0003051	0.0002742	0.0002474	0.0000445
Manitowoc 999 Crawler Crane Breakwater	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000330	0.0001225	0.0000948	0.0000794	0.0000142
Kobelco 275 Ton Crawler	0.000462	0.000399	0.000315	0.000252	0.000198						0.0000750	0.0003243	0.0002554	0.0002043	0.0000321
60T Hydraulic Crane Assembly Crane	0.000690	0.000614	0.000552	0.000498	0.000447						0.0000422	0.0000375	0.0000337	0.0000305	0.0000274
Cat 988 Loader 1	0.000618	0.000552	0.000498	0.000446	0.000393						0.0001100	0.0003935	0.0003547	0.0003181	0.0000701
Cat 988 Loader 2	0.000618	0.000552	0.000498	0.000446	0.000393						0.0001100	0.0003935	0.0003547	0.0003181	0.0000701
Cat 988 Loader 3	0.000618	0.000552	0.000498	0.000446	0.000393						0.0001100	0.0003935	0.0003547	0.0003181	0.0000701
100T Hydraulic Excavator 1	0.000326	0.000256	0.000204	0.000173	0.000156						0.0000534	0.0001679	0.0001338	0.0001136	0.0000256
100T Hydraulic Excavator 2	0.000326	0.000256	0.000204	0.000173	0.000156						0.0000534	0.0001679	0.0001338	0.0001136	0.0000256
CAT 745 Rock Truck 1	0.000137	0.000121	0.000111	0.000103	0.000098						0.0000194	0.0000684	0.0000625	0.0000581	0.0000139
CAT 745 Rock Truck 2	0.000137	0.000121	0.000111	0.000103	0.000098						0.0000097	0.0000342	0.0000312	0.0000291	0.0000069
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.000546	0.000546	0.000546	0.000546	0.000546						0.0002522	0.0010087	0.0010087	0.0010087	0.0002522
Inner Harbor Tug 1 Generator	0.000546	0.000546	0.000546	0.000546	0.000546						0.0001269	0.0005074	0.0005074	0.0005074	0.0001269
Inner Harbor Tug 2 Engine	0.000546	0.000546	0.000546	0.000546	0.000546						0.0002522	0.0010087	0.0010087	0.0010087	0.0002522
Inner Harbor Tug 2 Generator	0.000546	0.000546	0.000546	0.000546	0.000546						0.0001269	0.0005074	0.0005074	0.0005074	0.0001269
Ocean Going Tug for Armor Stone Transport Engine	0.000546	0.000546	0.000546	0.000546	0.000546						0.0020652	0.0041303	0.0041303	0.0041303	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.000546	0.000546	0.000546	0.000546	0.000546						0.0002960	0.0005920	0.0005920	0.0005920	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000225	0.0000839	0.0000769	0.0000741	0.0000163
Mechanic Truck 1	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001220	0.0001977	0.0001811	0.0001738	0.0000878
Mechanic Truck 2	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0001220	0.0001977	0.0001811	0.0001738	0.0000878
Welding Truck	0.006651	0.005990	0.005317	0.004609	0.003950						0.0001205	0.0000000	0.0003853	0.0003340	0.0000716
Compressor	0.001848	0.001652	0.001426	0.001295	0.001191						0.0000171	0.0000000	0.0000527	0.0000479	0.0000110
Boom Truck	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000270	0.0001007	0.0000923	0.0000889	0.0000195
Water Truck	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000541	0.0002014	0.0001845	0.0001779	0.0000391
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000589	0.0001306	0.0001196	0.0001145	0.0000422
Truck Tractor for Mob/Demob/Various	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000270	0.0001007	0.0000923	0.0000889	0.0000195
6T All Terrain Forklift	0.000121	0.000119	0.000119	0.000119	0.000119						0.0000042	0.0000000	0.0000165	0.0000165	0.0000041
D8 Dozer	0.000195	0.000165	0.000144	0.000128	0.000115						0.0000174	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000143	0.000125	0.000113	0.000104	0.000099						0.0000104	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000188	0.000157	0.000138	0.000123	0.000111						0.0000168	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000374	0.000278	0.000215	0.000180							0.0000000	0.0000000	0.0000026	0.0000022	0.0000000
Kincho Vibro Hammer/Gen	0.000460	0.000373	0.000291	0.000233							0.0000000	0.0000000	0.0000006	0.0000005	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001035	0.000854	0.000708	0.000602							0.0000000	0.0000000	0.0000015	0.0000013	0.0000000
Delmag 30-32 Hammer	0.000460	0.000373	0.000291	0.000233							0.0000000	0.0000000	0.0000011	0.0000009	0.0000000
65T Rough Terrain Crane	0.000374	0.000278	0.000215	0.000180							0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000040	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000242	0	0	0	0
Coarse Concrete Aggregate											0.0000363	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000040	0	0	0	0

Armor Stone Bedding											0.0001466	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000060	0.000040	0.000033	0.000028	0.000025	0.000228	0.000134	0.000092	0.000078	0.000075	0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Passenger car	0.000042	0.000033	0.000030	0.000026	0.000023	0.000357	0.000134	0.000121	0.000103	0.000088	0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.000060	0.000040	0.000033	0.000028	0.000025	0.000228	0.000134	0.000092	0.000078	0.000075	0.0000000	0.0000000	0.0000011	0.0000009	0.0000000
185 CFM Compressor	0.001848	0.001652	0.001426	0.001295	0.001191						0.0000000		0.0000472	0.0000428	0.0000000
Miller Welder	0.012957	0.011921	0.010780	0.009489	0.008283						0.0000000		0.0000749	0.0000659	0.0000000
90T Rough Terrain Crane	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000000		0.0000011	0.0000010	0.0000000
175T Crawler Crane	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000000		0.0000099	0.0000083	0.0000000
6T Forklift	0.000121	0.000119	0.000119	0.000119	0.000119						0.0000000		0.0000029	0.0000029	0.0000000
20' Aluminum Crew Boat	0.000546	0.000546	0.000546	0.000546	0.000546						0.0000000	0.0000000	0.0000082	0.0000082	0.0000000
10' Safety Boat	0.000546	0.000546	0.000546	0.000546	0.000546						0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
230T Crawler Crane	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000000		0.0000107	0.0000089	0.0000000
Kincho Vibro Hammer/Gen	0.000460	0.000373	0.000291	0.000233	0.000186						0.0000000		0.0000027	0.0000022	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001035	0.000854	0.000708	0.000602	0.000483						0.0000000		0.0000063	0.0000054	0.0000000
Delmag 30-32 Hammer	0.000460	0.000373	0.000291	0.000233	0.000186						0.0000000		0.0000046	0.0000037	0.0000000
65T Rough Terrain Crane	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000000		0.0000004	0.0000003	0.0000000
Truck Tractor	0.003931	0.003660	0.003354	0.003232	0.002839	0.030136	0.028249	0.025817	0.024152	0.021441	0.0000000	0.0000000	0.0000011	0.0000011	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.000546	0.000546	0.000546	0.000546	0.000546						0.0000000	0.0000000	0.0000485	0.0000485	0.0000000
Inner Harbor Tug Generator	0.000546	0.000546	0.000546	0.000546	0.000546						0.0000000	0.0000000	0.0000097	0.0000097	0.0000000
Concrete Pump	0.001035	0.000854	0.000708	0.000602	0.000483						0.0000000		0.0000020	0.0000017	0.0000000
100T Crawler Crane	0.000374	0.000278	0.000215	0.000180	0.000161						0.0000000		0.0000028	0.0000023	0.0000000
CAT 345 Excavator	0.000143	0.000125	0.000113	0.000104	0.000099						0.0000000		0.0000063	0.0000058	0.0000000
CAT 330 Excavator	0.000143	0.000125	0.000113	0.000104	0.000099						0.0000000		0.0000015	0.0000014	0.0000000
CAT 966 Loader	0.003706	0.003125	0.002718	0.002406	0.002136						0.0000000		0.0000521	0.0000461	0.0000000
CAT 950 Loader	0.003706	0.003125	0.002718	0.002406	0.002136						0.0000000		0.0000233	0.0000206	0.0000000
										Total (ton/yr)	**0.009**	**0.017**	**0.017**	**0.016**	**0.005**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Propionaldehyde Emissions

Equipment	Propionaldehyde Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Propionaldehyde Idling Emission Factor (g/hr for on-road only)					Propionaldehyde Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000071	0.000044	0.000034	0.000028	0.000023	0.000266	0.000139	0.000083	0.000065	0.000062	0.0000009	0.0000006	0.0000005	0.0000004	0.0000003
Passenger car	0.000048	0.000036	0.000032	0.000026	0.000022	0.000449	0.000146	0.000128	0.000104	0.000085	0.0000006	0.0000005	0.0000004	0.0000003	0.0000003
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000071	0.000044	0.000034	0.000028	0.000023	0.000266	0.000139	0.000083	0.000065	0.000062	0.0000009	0.0000006	0.0000005	0.0000004	0.0000003
Passenger Trucks (18), Multiple Staff (18)	0.000048	0.000036	0.000032	0.000026	0.000022	0.000449	0.000146	0.000128	0.000104	0.000085	0.0000006	0.0000005	0.0000004	0.0000003	0.0000003
Coral Translocation															
Excavator	0.000160	0.000139	0.000125	0.000115	0.000109						0.0000187	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.001341	0.001146	0.001033	0.000813	0.000952	0.000984	0.000841	0.000749	0.000590	0.000694	0.0000236	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.000448	0.000448	0.000448	0.000448	0.000448						0.0002123	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.000448	0.000448	0.000448	0.000448	0.000448						0.0002123	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.000448	0.000448	0.000448	0.000448	0.000448						0.0000152	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.000448	0.000448	0.000448	0.000448	0.000448						0.0000312	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.000448	0.000448	0.000448	0.000448	0.000448						0.0000149	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000071	0.000044	0.000034	0.000028	0.000023	0.000266	0.000139	0.000083	0.000065	0.000062	0.0000031	0.0000029	0.0000023	0.0000019	0.0000008
6T All Terrain Forklift 1	0.000141	0.000139	0.000139	0.000139	0.000139						0.0000102	0.0000120	0.0000120	0.0000120	0.0000101
6T All Terrain Forklift 2	0.000141	0.000139	0.000139	0.000139	0.000139						0.0000061	0.0000120	0.0000120	0.0000120	0.0000090
Boom Truck	0.001341	0.001146	0.001033	0.000813	0.000952	0.000984	0.000841	0.000749	0.000590	0.000694	0.0000184	0.0000315	0.0000284	0.0000224	0.0000196
Vacuum Truck/Sweeper	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000314	0.0000584	0.0000535	0.0000516	0.0000340
Cement Train Tractor 1	0.004952	0.004410	0.003902	0.003390	0.002895						0.0003576	0.0006370	0.0005636	0.0004896	0.0003137
Cement Train Tractor 2	0.004952	0.004410	0.003902	0.003390	0.002895						0.0003576	0.0006370	0.0005636	0.0004896	0.0003137
100T Gantry Crane 1	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000982	0.0001434	0.0001093	0.0000908	0.0000604
100T Gantry Crane 2	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000982	0.0001434	0.0001093	0.0000908	0.0000604
Truck Tractor 1	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000787	0.0001261	0.0001154	0.0001108	0.0000770
Truck Tractor 2	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000787	0.0001261	0.0001154	0.0001108	0.0000770
Skid Steer 1	0.020251	0.019407	0.017664	0.014684	0.011857						0.0003218	0.0006167	0.0005613	0.0004666	0.0002826
Skid Steer 2	0.020251	0.019407	0.017664	0.014684	0.011857						0.0003218	0.0006167	0.0005613	0.0004666	0.0002826
4000 Gal Water Truck	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000753	0.0001402	0.0001285	0.0001239	0.0000816
Cat 966 Loader 1	0.000370	0.000285	0.000229	0.000194	0.000176						0.0000721	0.0001110	0.0000890	0.0000757	0.0000513
Cat 966 Loader 2	0.000370	0.000285	0.000229	0.000194	0.000176						0.0000721	0.0001110	0.0000890	0.0000757	0.0000513
36 Meter Concrete Pump Truck	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000565	0.0001052	0.0000964	0.0000929	0.0000612
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000842	0.000703	0.000557	0.000414	0.000308						0.0000294	0.0000245	0.0000194	0.0000144	0.0000107
Ready Mix Concrete Truck 1	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000787	0.0001261	0.0001154	0.0001108	0.0000770
Ready Mix Concrete Truck 2	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000787	0.0001261	0.0001154	0.0001108	0.0000770
Ready Mix Concrete Truck 3	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000787	0.0001261	0.0001154	0.0001108	0.0000770
Ready Mix Concrete Truck 4 (reserve)	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000079	0.0000126	0.0000115	0.0000111	0.0000077
60' Manlift for Maintenance	0.008364	0.007458	0.006542	0.005614	0.004735						0.0001007	0.0001796	0.0001575	0.0001352	0.0000855
Dump Trucks (4)	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0003235	0.0005819	0.0005330	0.0005136	0.0003909
Truck Tractor for Roll Off Trash Bins	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000474	0.0000676	0.0000619	0.0000592	0.0000430
Fuel Truck	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000536	0.0000793	0.0000726	0.0000695	0.0000498
CAT D8 Dozer	0.000221	0.000186	0.000162	0.000143	0.000128						0.0000052	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000370	0.000285	0.000229	0.000194	0.000176						0.0000055	0.0000000	0.0000000	0.0000000	0.0000026
CAT 14H Grader	0.000250	0.000220	0.000195	0.000174	0.000159						0.0000099	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000971	0.000803	0.000647	0.000505	0.000373						0.0000246	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000160	0.000139	0.000125	0.000115	0.000109						0.0000000	0.0000000	0.0000000	0.0000000	0.0000027
100T Crawler Crane	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000115	0.0000000	0.0000000	0.0000000	0.0000036

175T Crawler Crane	0.000857	0.000769	0.000693	0.000623	0.000555						0.0000683	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.002399	0.002098	0.001774	0.001569	0.001407						0.0000409	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.015902	0.014718	0.013154	0.011123	0.009341						0.0001679	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000857	0.000769	0.000693	0.000623	0.000555						0.0000852	0.0003821	0.0003443	0.0003098	0.0000552
Manitowoc MLC 300 Crawler Crane Breakwater	0.000857	0.000769	0.000693	0.000623	0.000555						0.0000852	0.0003821	0.0003443	0.0003098	0.0000552
Manitowoc MLC 300 Crawler Crane Breakwater	0.000857	0.000769	0.000693	0.000623	0.000555						0.0000852	0.0003821	0.0003443	0.0003098	0.0000552
Manitowoc 999 Crawler Crane Breakwater	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000390	0.0001424	0.0001086	0.0000902	0.0000160
Kobelco 275 Ton Crawler	0.000560	0.000480	0.000373	0.000294	0.000228						0.0000909	0.0003894	0.0003031	0.0002390	0.0000370
60T Hydraulic Crane Assembly Crane	0.000857	0.000769	0.000693	0.000623	0.000555						0.0000524	0.0000470	0.0000424	0.0000381	0.0000340
Cat 988 Loader 1	0.000777	0.000695	0.000623	0.000554	0.000484						0.0001385	0.0004955	0.0004441	0.0003947	0.0000862
Cat 988 Loader 2	0.000777	0.000695	0.000623	0.000554	0.000484						0.0001385	0.0004955	0.0004441	0.0003947	0.0000862
Cat 988 Loader 3	0.000777	0.000695	0.000623	0.000554	0.000484						0.0001385	0.0004955	0.0004441	0.0003947	0.0000862
100T Hydraulic Excavator 1	0.000380	0.000295	0.000233	0.000196	0.000176						0.0000623	0.0001936	0.0001526	0.0001286	0.0000289
100T Hydraulic Excavator 2	0.000380	0.000295	0.000233	0.000196	0.000176						0.0000623	0.0001936	0.0001526	0.0001286	0.0000289
CAT 745 Rock Truck 1	0.000154	0.000135	0.000123	0.000114	0.000108						0.0000217	0.0000762	0.0000693	0.0000643	0.0000153
CAT 745 Rock Truck 2	0.000154	0.000135	0.000123	0.000114	0.000108						0.0000109	0.0000381	0.0000347	0.0000321	0.0000076
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.000448	0.000448	0.000448	0.000448	0.000448						0.0002070	0.0008281	0.0008281	0.0008281	0.0002070
Inner Harbor Tug 1 Generator	0.000448	0.000448	0.000448	0.000448	0.000448						0.0001041	0.0004165	0.0004165	0.0004165	0.0001041
Inner Harbor Tug 2 Engine	0.000448	0.000448	0.000448	0.000448	0.000448						0.0002070	0.0008281	0.0008281	0.0008281	0.0002070
Inner Harbor Tug 2 Generator	0.000448	0.000448	0.000448	0.000448	0.000448						0.0001041	0.0004165	0.0004165	0.0004165	0.0001041
Ocean Going Tug for Armor Stone Transport Engine	0.000448	0.000448	0.000448	0.000448	0.000448						0.0016953	0.0033905	0.0033905	0.0033905	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.000448	0.000448	0.000448	0.000448	0.000448						0.0002430	0.0004860	0.0004860	0.0004860	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000157	0.0000584	0.0000535	0.0000516	0.0000113
Mechanic Truck 1	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000850	0.0001377	0.0001261	0.0001211	0.0000611
Mechanic Truck 2	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000850	0.0001377	0.0001261	0.0001211	0.0000611
Welding Truck	0.006141	0.005632	0.005072	0.004433	0.003826						0.0001113	0.0000000	0.0003675	0.0003212	0.0000693
Compressor	0.002399	0.002098	0.001774	0.001569	0.001407						0.0000222	0.0000000	0.0000656	0.0000580	0.0000130
Boom Truck	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000188	0.0000701	0.0000642	0.0000620	0.0000136
Water Truck	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000377	0.0001402	0.0001285	0.0001239	0.0000272
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000411	0.0000910	0.0000833	0.0000798	0.0000294
Truck Tractor for Mob/Demob/Various	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000188	0.0000701	0.0000642	0.0000620	0.0000136
6T All Terrain Forklift	0.000141	0.000139	0.000139	0.000139	0.000139						0.0000048	0.0000000	0.0000191	0.0000191	0.0000048
D8 Dozer	0.000221	0.000186	0.000162	0.000143	0.000128						0.0000198	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000160	0.000139	0.000125	0.000115	0.000109						0.0000117	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000213	0.000177	0.000154	0.000137	0.000124						0.0000190	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000443	0.000323	0.000246	0.000205							0.0000000	0.0000000	0.0000030	0.0000025	0.0000000
Kincho Vibro Hammer/Gen	0.000573	0.000454	0.000348	0.000274							0.0000000	0.0000000	0.0000008	0.0000006	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001191	0.000995	0.000839	0.000725							0.0000000	0.0000000	0.0000017	0.0000015	0.0000000
Delmag 30-32 Hammer	0.000573	0.000454	0.000348	0.000274							0.0000000	0.0000000	0.0000014	0.0000011	0.0000000
65T Rough Terrain Crane	0.000443	0.000323	0.000246	0.000205							0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000033	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000199	0	0	0	0
Coarse Concrete Aggregate											0.0000298	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000033	0	0	0	0

Armor Stone Bedding											0.0001204	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000071	0.000044	0.000034	0.000028	0.000023	0.000266	0.000139	0.000083	0.000065	0.000062	0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Passenger car	0.000048	0.000036	0.000032	0.000026	0.000022	0.000449	0.000146	0.000128	0.000104	0.000085	0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.000071	0.000044	0.000034	0.000028	0.000023	0.000266	0.000139	0.000083	0.000065	0.000062	0.0000000	0.0000000	0.0000011	0.0000009	0.0000000
185 CFM Compressor	0.002399	0.002098	0.001774	0.001569	0.001407						0.0000000		0.0000586	0.0000519	0.0000000
Miller Welder	0.016647	0.015483	0.013947	0.011950	0.010205						0.0000000		0.0000969	0.0000830	0.0000000
90T Rough Terrain Crane	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000000		0.0000013	0.0000011	0.0000000
175T Crawler Crane	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000000		0.0000114	0.0000094	0.0000000
6T Forklift	0.000141	0.000139	0.000139	0.000139	0.000139						0.0000000		0.0000033	0.0000033	0.0000000
20' Aluminum Crew Boat	0.000448	0.000448	0.000448	0.000448	0.000448						0.0000000	0.0000000	0.0000067	0.0000067	0.0000000
10' Safety Boat	0.000448	0.000448	0.000448	0.000448	0.000448						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
230T Crawler Crane	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000000		0.0000122	0.0000101	0.0000000
Kincho Vibro Hammer/Gen	0.000573	0.000454	0.000348	0.000274	0.000216						0.0000000		0.0000032	0.0000025	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001191	0.000995	0.000839	0.000725	0.000589						0.0000000		0.0000075	0.0000065	0.0000000
Delmag 30-32 Hammer	0.000573	0.000454	0.000348	0.000274	0.000216						0.0000000		0.0000055	0.0000044	0.0000000
65T Rough Terrain Crane	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000000		0.0000004	0.0000003	0.0000000
Truck Tractor	0.002737	0.002549	0.002335	0.002252	0.001976	0.021026	0.019716	0.018019	0.016863	0.014965	0.0000000	0.0000000	0.0000008	0.0000007	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.000448	0.000448	0.000448	0.000448	0.000448						0.0000000	0.0000000	0.0000398	0.0000398	0.0000000
Inner Harbor Tug Generator	0.000448	0.000448	0.000448	0.000448	0.000448						0.0000000	0.0000000	0.0000080	0.0000080	0.0000000
Concrete Pump	0.001191	0.000995	0.000839	0.000725	0.000589						0.0000000		0.0000024	0.0000021	0.0000000
100T Crawler Crane	0.000443	0.000323	0.000246	0.000205	0.000182						0.0000000		0.0000032	0.0000026	0.0000000
CAT 345 Excavator	0.000160	0.000139	0.000125	0.000115	0.000109						0.0000000		0.0000070	0.0000064	0.0000000
CAT 330 Excavator	0.000160	0.000139	0.000125	0.000115	0.000109						0.0000000		0.0000017	0.0000016	0.0000000
CAT 966 Loader	0.004952	0.004224	0.003708	0.003322	0.002969						0.0000000		0.0000711	0.0000637	0.0000000
CAT 950 Loader	0.004952	0.004224	0.003708	0.003322	0.002969						0.0000000		0.0000318	0.0000284	0.0000000
										Total (ton/yr)	**0.008**	**0.016**	**0.016**	**0.014**	**0.004**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Xylene Emissions

Equipment	Xylenes Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Xylenes Idling Emission Factor (g/hr for on-road only)					Xylenes Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.013100	0.010872	0.010036	0.009515	0.008919	0.089205	0.077957	0.072124	0.069532	0.066325	0.0001733	0.0001438	0.0001328	0.0001259	0.0001180
Passenger car	0.011551	0.010581	0.010410	0.009992	0.009639	0.107352	0.082264	0.081136	0.078911	0.076018	0.0001528	0.0001400	0.0001377	0.0001322	0.0001275
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.013100	0.010872	0.010036	0.009515	0.008919	0.089205	0.077957	0.072124	0.069532	0.066325	0.0003466	0.0004314	0.0003983	0.0003776	0.0001770
Passenger Trucks (18), Multiple Staff (18)	0.013100	0.010872	0.010036	0.009515	0.008919	0.089205	0.077957	0.072124	0.069532	0.066325	0.0031192	0.0038830	0.0035845	0.0033981	0.0015926
Coral Translocation															
Excavator	0.000525	0.000519	0.000515	0.000512	0.000509						0.0000614	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.002644	0.002497	0.002409	0.002286	0.002358	0.002178	0.002051	0.001965	0.001819	0.001882	0.0000466	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.000420	0.000420	0.000420	0.000420	0.000420						0.0001990	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.000420	0.000420	0.000420	0.000420	0.000420						0.0001990	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000143	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000293	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000139	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.013100	0.010872	0.010036	0.009515	0.008919	0.089205	0.077957	0.072124	0.069532	0.066325	0.0005776	0.0007191	0.0006638	0.0006293	0.0002949
6T All Terrain Forklift 1	0.000188	0.000187	0.000187	0.000187	0.000187						0.0000136	0.0000161	0.0000161	0.0000161	0.0000136
6T All Terrain Forklift 2	0.000188	0.000187	0.000187	0.000187	0.000187						0.0000081	0.0000161	0.0000161	0.0000161	0.0000121
Boom Truck	0.002644	0.002497	0.002409	0.002286	0.002358	0.002178	0.002051	0.001965	0.001819	0.001882	0.0000364	0.0000687	0.0000663	0.0000629	0.0000487
Vacuum Truck/Sweeper	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000525	0.0001015	0.0000977	0.0000959	0.0000684
Cement Train Tractor 1	0.003943	0.003508	0.003109	0.002730	0.002380						0.0002848	0.0005066	0.0004491	0.0003944	0.0002578
Cement Train Tractor 2	0.003943	0.003508	0.003109	0.002730	0.002380						0.0002848	0.0005066	0.0004491	0.0003944	0.0002578
100T Gantry Crane 1	0.000625	0.000581	0.000553	0.000538	0.000531						0.0001387	0.0002578	0.0002454	0.0002388	0.0001766
100T Gantry Crane 2	0.000625	0.000581	0.000553	0.000538	0.000531						0.0001387	0.0002578	0.0002454	0.0002388	0.0001766
Truck Tractor 1	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001319	0.0002192	0.0002110	0.0002069	0.0001558
Truck Tractor 2	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001319	0.0002192	0.0002110	0.0002069	0.0001558
Skid Steer 1	0.010735	0.010156	0.009219	0.007780	0.006387						0.0001706	0.0003227	0.0002930	0.0002472	0.0001522
Skid Steer 2	0.010735	0.010156	0.009219	0.007780	0.006387						0.0001706	0.0003227	0.0002930	0.0002472	0.0001522
4000 Gal Water Truck	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001259	0.0002435	0.0002344	0.0002302	0.0001641
Cat 966 Loader 1	0.000597	0.000567	0.000547	0.000535	0.000529						0.0001162	0.0002208	0.0002132	0.0002085	0.0001547
Cat 966 Loader 2	0.000597	0.000567	0.000547	0.000535	0.000529						0.0001162	0.0002208	0.0002132	0.0002085	0.0001547
36 Meter Concrete Pump Truck	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000944	0.0001827	0.0001758	0.0001727	0.0001231
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000802	0.000747	0.000689	0.000631	0.000588						0.0000280	0.0000260	0.0000240	0.0000220	0.0000205
Ready Mix Concrete Truck 1	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001319	0.0002192	0.0002110	0.0002069	0.0001558
Ready Mix Concrete Truck 2	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001319	0.0002192	0.0002110	0.0002069	0.0001558
Ready Mix Concrete Truck 3	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001319	0.0002192	0.0002110	0.0002069	0.0001558
Ready Mix Concrete Truck 4 (reserve)	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000132	0.0000219	0.0000211	0.0000207	0.0000156
60' Manlift for Maintenance	0.005501	0.004878	0.004277	0.003686	0.003130						0.0000662	0.0001174	0.0001030	0.0000887	0.0000565
Dump Trucks (4)	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0005410	0.0010107	0.0009727	0.0009551	0.0007874
Truck Tractor for Roll Off Trash Bins	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000794	0.0001177	0.0001133	0.0001110	0.0000874
Fuel Truck	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000899	0.0001380	0.0001328	0.0001301	0.0001011
CAT D8 Dozer	0.000543	0.000532	0.000525	0.000520	0.000516						0.0000127	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000597	0.000567	0.000547	0.000535	0.000529						0.0000088	0.0000000	0.0000000	0.0000000	0.0000078
CAT 14H Grader	0.000296	0.000283	0.000273	0.000263	0.000257						0.0000116	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000630	0.000553	0.000483	0.000419	0.000357						0.0000160	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000525	0.000519	0.000515	0.000512	0.000509						0.0000000	0.0000000	0.0000000	0.0000000	0.0000127
100T Crawler Crane	0.000625	0.000581	0.000553	0.000538	0.000531						0.0000163	0.0000000	0.0000000	0.0000000	0.0000104

175T Crawler Crane	0.000813	0.000769	0.000734	0.000705	0.000679						0.0000647	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.001352	0.001213	0.001058	0.000962	0.000886						0.0000231	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.009775	0.008924	0.007948	0.006805	0.005785						0.0001032	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000813	0.000769	0.000734	0.000705	0.000679						0.0000808	0.0003821	0.0003647	0.0003501	0.0000675
Manitowoc MLC 300 Crawler Crane Breakwater	0.000813	0.000769	0.000734	0.000705	0.000679						0.0000808	0.0003821	0.0003647	0.0003501	0.0000675
Manitowoc MLC 300 Crawler Crane Breakwater	0.000813	0.000769	0.000734	0.000705	0.000679						0.0000808	0.0003821	0.0003647	0.0003501	0.0000675
Manitowoc 999 Crawler Crane Breakwater	0.000625	0.000581	0.000553	0.000538	0.000531						0.0000551	0.0002560	0.0002437	0.0002372	0.0000468
Kobelco 275 Ton Crawler	0.000669	0.000642	0.000603	0.000575	0.000550						0.0001087	0.0005208	0.0004892	0.0004663	0.0000893
60T Hydraulic Crane Assembly Crane	0.000813	0.000769	0.000734	0.000705	0.000679						0.0000497	0.0000470	0.0000449	0.0000431	0.0000415
Cat 988 Loader 1	0.000769	0.000732	0.000703	0.000677	0.000652						0.0001370	0.0005219	0.0005010	0.0004825	0.0001162
Cat 988 Loader 2	0.000769	0.000732	0.000703	0.000677	0.000652						0.0001370	0.0005219	0.0005010	0.0004825	0.0001162
Cat 988 Loader 3	0.000769	0.000732	0.000703	0.000677	0.000652						0.0001370	0.0005219	0.0005010	0.0004825	0.0001162
100T Hydraulic Excavator 1	0.000596	0.000568	0.000547	0.000534	0.000528						0.0000977	0.0003725	0.0003587	0.0003504	0.0000866
100T Hydraulic Excavator 2	0.000596	0.000568	0.000547	0.000534	0.000528						0.0000977	0.0003725	0.0003587	0.0003504	0.0000866
CAT 745 Rock Truck 1	0.000522	0.000517	0.000514	0.000511	0.000509						0.0000737	0.0002921	0.0002903	0.0002887	0.0000719
CAT 745 Rock Truck 2	0.000522	0.000517	0.000514	0.000511	0.000509						0.0000369	0.0001460	0.0001451	0.0001443	0.0000359
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.000420	0.000420	0.000420	0.000420	0.000420						0.0001941	0.0007762	0.0007762	0.0007762	0.0001941
Inner Harbor Tug 1 Generator	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000976	0.0003905	0.0003905	0.0003905	0.0000976
Inner Harbor Tug 2 Engine	0.000420	0.000420	0.000420	0.000420	0.000420						0.0001941	0.0007762	0.0007762	0.0007762	0.0001941
Inner Harbor Tug 2 Generator	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000976	0.0003905	0.0003905	0.0003905	0.0000976
Ocean Going Tug for Armor Stone Transport Engine	0.000420	0.000420	0.000420	0.000420	0.000420						0.0015891	0.0031782	0.0031782	0.0031782	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.000420	0.000420	0.000420	0.000420	0.000420						0.0002278	0.0004555	0.0004555	0.0004555	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000262	0.0001015	0.0000977	0.0000959	0.0000228
Mechanic Truck 1	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001424	0.0002395	0.0002305	0.0002261	0.0001239
Mechanic Truck 2	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0001424	0.0002395	0.0002305	0.0002261	0.0001239
Welding Truck	0.004936	0.004459	0.003985	0.003500	0.003054						0.0000894	0.0003231	0.0002888	0.0002536	0.0000553
Compressor	0.001352	0.001213	0.001058	0.000962	0.000886						0.0000125	0.0000448	0.0000391	0.0000356	0.0000082
Boom Truck	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000315	0.0001218	0.0001172	0.0001151	0.0000274
Water Truck	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000629	0.0002435	0.0002344	0.0002302	0.0000547
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000689	0.0001583	0.0001524	0.0001493	0.0000601
Truck Tractor for Mob/Demob/Various	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000315	0.0001218	0.0001172	0.0001151	0.0000274
6T All Terrain Forklift	0.000188	0.000187	0.000187	0.000187	0.000187						0.0000065	0.0000258	0.0000258	0.0000258	0.0000064
D8 Dozer	0.000543	0.000532	0.000525	0.000520	0.000516						0.0000486	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000525	0.000519	0.000515	0.000512	0.000509						0.0000384	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000541	0.000529	0.000523	0.000518	0.000514						0.0000484	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000625	0.000581	0.000553	0.000538	0.246269						0.0000000	0.0000000	0.0000066	0.0000065	0.0000000
Kincho Vibro Hammer/Gen	0.000684	0.000640	0.000599	0.000570	0.246269						0.0000000	0.0000000	0.0000013	0.0000013	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001024	0.000918	0.000833	0.000770	0.238806						0.0000000	0.0000000	0.0000017	0.0000016	0.0000000
Delmag 30-32 Hammer	0.000684	0.000640	0.000599	0.000570	0.246269						0.0000000	0.0000000	0.0000023	0.0000022	0.0000000
65T Rough Terrain Crane	0.000625	0.000581	0.000553	0.000538	0.246269						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000031	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000186	0	0	0	0
Coarse Concrete Aggregate											0.0000280	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000031	0	0	0	0

Armor Stone Bedding											0.0001128	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.013100	0.010872	0.010036	0.009515	0.008919	0.089205	0.077957	0.072124	0.069532	0.066325	0.0000000	0.0000000	0.0000398	0.0000378	0.0000000
Passenger car	0.011551	0.010581	0.010410	0.009992	0.009639	0.107352	0.082264	0.081136	0.078911	0.076018	0.0000000	0.0000000	0.0000413	0.0000397	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.013100	0.010872	0.010036	0.009515	0.008919	0.089205	0.077957	0.072124	0.069532	0.066325	0.0000000	0.0000000	0.0003319	0.0003146	0.0000000
185 CFM Compressor	0.001352	0.001213	0.001058	0.000962	0.000886						0.0000000	0.0000000	0.0000350	0.0000318	0.0000000
Miller Welder	0.010198	0.009359	0.008399	0.007276	0.006277						0.0000000	0.0000000	0.0000583	0.0000505	0.0000000
90T Rough Terrain Crane	0.000625	0.000581	0.000553	0.000538	0.000531						0.0000000	0.0000000	0.0000030	0.0000029	0.0000000
175T Crawler Crane	0.000625	0.000581	0.000553	0.000538	0.000531						0.0000000	0.0000000	0.0000255	0.0000248	0.0000000
6T Forklift	0.000188	0.000187	0.000187	0.000187	0.000187						0.0000000	0.0000000	0.0000045	0.0000045	0.0000000
20' Aluminum Crew Boat	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000000	0.0000000	0.0000063	0.0000063	0.0000000
10' Safety Boat	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
230T Crawler Crane	0.000625	0.000581	0.000553	0.000538	0.000531						0.0000000	0.0000000	0.0000274	0.0000267	0.0000000
Kincho Vibro Hammer/Gen	0.000684	0.000640	0.000599	0.000570	0.000547						0.0000000	0.0000000	0.0000055	0.0000053	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.001024	0.000918	0.000833	0.000770	0.000704						0.0000000	0.0000000	0.0000074	0.0000069	0.0000000
Delmag 30-32 Hammer	0.000684	0.000640	0.000599	0.000570	0.000547						0.0000000	0.0000000	0.0000095	0.0000091	0.0000000
65T Rough Terrain Crane	0.000625	0.000581	0.000553	0.000538	0.000531						0.0000000	0.0000000	0.0000009	0.0000009	0.0000000
Truck Tractor	0.004576	0.004426	0.004259	0.004184	0.003977	0.035396	0.034547	0.033256	0.032331	0.030911	0.0000000	0.0000000	0.0000014	0.0000014	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000000	0.0000000	0.0000373	0.0000373	0.0000000
Inner Harbor Tug Generator	0.000420	0.000420	0.000420	0.000420	0.000420						0.0000000	0.0000000	0.0000075	0.0000075	0.0000000
Concrete Pump	0.001024	0.000918	0.000833	0.000770	0.000704						0.0000000	0.0000000	0.0000024	0.0000022	0.0000000
100T Crawler Crane	0.000625	0.000581	0.000553	0.000538	0.000531						0.0000000	0.0000000	0.0000071	0.0000069	0.0000000
CAT 345 Excavator	0.000525	0.000519	0.000515	0.000512	0.000509						0.0000000	0.0000000	0.0000286	0.0000285	0.0000000
CAT 330 Excavator	0.000525	0.000519	0.000515	0.000512	0.000509						0.0000000	0.0000000	0.0000070	0.0000070	0.0000000
CAT 966 Loader	0.002985	0.002587	0.002301	0.002084	0.001893						0.0000000	0.0000000	0.0000441	0.0000399	0.0000000
CAT 950 Loader	0.002985	0.002587	0.002301	0.002084	0.001893						0.0000000	0.0000000	0.0000197	0.0000178	0.0000000
										Total (ton/yr)	**0.013**	**0.023**	**0.023**	**0.022**	**0.008**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – Phenanthrene Emissions

Equipment	Phenanthrene Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					Phenanthrene Idling Emission Factor (g/hr for on-road only)					Phenanthrene Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000019	0.000012	0.000010	0.000009	0.000007	0.000073	0.000041	0.000027	0.000022	0.000021	0.0000003	0.0000002	0.0000001	0.0000001	0.0000001
Passenger car	0.000013	0.000010	0.000009	0.000008	0.000007	0.000118	0.000042	0.000038	0.000032	0.000027	0.0000002	0.0000001	0.0000001	0.0000001	0.0000001
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000019	0.000012	0.000010	0.000009	0.000007	0.000073	0.000041	0.000027	0.000022	0.000021	0.0000005	0.0000005	0.0000004	0.0000003	0.0000001
Passenger Trucks (18), Multiple Staff (18)	0.000019	0.000012	0.000010	0.000009	0.000007	0.000073	0.000041	0.000027	0.000022	0.000021	0.0000046	0.0000044	0.0000036	0.0000031	0.0000013
Coral Translocation															
Excavator	0.000009	0.000008	0.000007	0.000006	0.000006						0.0000011	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.000199	0.000169	0.000152	0.000118	0.000139	0.000145	0.000123	0.000109	0.000085	0.000101	0.0000035	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.000401	0.000401	0.000401	0.000401	0.000401						0.0001898	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.000401	0.000401	0.000401	0.000401	0.000401						0.0001898	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000136	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000279	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000133	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000019	0.000012	0.000010	0.000009	0.000007	0.000073	0.000041	0.000027	0.000022	0.000021	0.0000008	0.0000008	0.0000007	0.0000006	0.0000002
6T All Terrain Forklift 1	0.000008	0.000008	0.000008	0.000008	0.000008						0.0000006	0.0000007	0.0000007	0.0000007	0.0000006
6T All Terrain Forklift 2	0.000008	0.000008	0.000008	0.000008	0.000008						0.0000003	0.0000007	0.0000007	0.0000007	0.0000005
Boom Truck	0.000199	0.000169	0.000152	0.000118	0.000139	0.000145	0.000123	0.000109	0.000085	0.000101	0.0000027	0.0000046	0.0000042	0.0000032	0.0000029
Vacuum Truck/Sweeper	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000047	0.0000088	0.0000080	0.0000077	0.0000051
Cement Train Tractor 1	0.000312	0.000277	0.000243	0.000210	0.000179						0.0000225	0.0000399	0.0000351	0.0000304	0.0000194
Cement Train Tractor 2	0.000312	0.000277	0.000243	0.000210	0.000179						0.0000225	0.0000399	0.0000351	0.0000304	0.0000194
100T Gantry Crane 1	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000055	0.0000081	0.0000062	0.0000051	0.0000034
100T Gantry Crane 2	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000055	0.0000081	0.0000062	0.0000051	0.0000034
Truck Tractor 1	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000118	0.0000189	0.0000173	0.0000165	0.0000115
Truck Tractor 2	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000118	0.0000189	0.0000173	0.0000165	0.0000115
Skid Steer 1	0.000815	0.000775	0.000712	0.000616	0.000515						0.0000130	0.0000246	0.0000226	0.0000196	0.0000123
Skid Steer 2	0.000815	0.000775	0.000712	0.000616	0.000515						0.0000130	0.0000246	0.0000226	0.0000196	0.0000123
4000 Gal Water Truck	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000113	0.0000210	0.0000192	0.0000185	0.0000122
Cat 966 Loader 1	0.000021	0.000016	0.000013	0.000011	0.000010						0.0000041	0.0000063	0.0000051	0.0000043	0.0000029
Cat 966 Loader 2	0.000021	0.000016	0.000013	0.000011	0.000010						0.0000041	0.0000063	0.0000051	0.0000043	0.0000029
36 Meter Concrete Pump Truck	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000085	0.0000158	0.0000144	0.0000139	0.0000091
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000043	0.000036	0.000029	0.000022	0.000017						0.0000015	0.0000013	0.0000010	0.0000008	0.0000006
Ready Mix Concrete Truck 1	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000118	0.0000189	0.0000173	0.0000165	0.0000115
Ready Mix Concrete Truck 2	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000118	0.0000189	0.0000173	0.0000165	0.0000115
Ready Mix Concrete Truck 3	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000118	0.0000189	0.0000173	0.0000165	0.0000115
Ready Mix Concrete Truck 4 (reserve)	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000012	0.0000019	0.0000017	0.0000017	0.0000011
60' Manlift for Maintenance	0.000452	0.000405	0.000358	0.000310	0.000262						0.0000054	0.0000097	0.0000086	0.0000075	0.0000047
Dump Trucks (4)	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000486	0.0000872	0.0000798	0.0000767	0.0000582
Truck Tractor for Roll Off Trash Bins	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000071	0.0000101	0.0000093	0.0000088	0.0000064
Fuel Truck	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000080	0.0000119	0.0000109	0.0000104	0.0000074
CAT D8 Dozer	0.000013	0.000011	0.000009	0.000008	0.000007						0.0000003	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000021	0.000016	0.000013	0.000011	0.000010						0.0000003	0.0000000	0.0000000	0.0000000	0.0000001
CAT 14H Grader	0.000014	0.000013	0.000011	0.000010	0.000009						0.0000006	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000050	0.000042	0.000034	0.000028	0.000021						0.0000013	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000009	0.000008	0.000007	0.000006	0.000006						0.0000000	0.0000000	0.0000000	0.0000000	0.0000001
100T Crawler Crane	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000006	0.0000000	0.0000000	0.0000000	0.0000002

175T Crawler Crane	0.000046	0.000041	0.000037	0.000033	0.000030						0.0000037	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.000126	0.000113	0.000098	0.000089	0.000082						0.0000022	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.000752	0.000691	0.000622	0.000542	0.000467						0.0000079	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000046	0.000041	0.000037	0.000033	0.000030						0.0000046	0.0000203	0.0000183	0.0000165	0.0000030
Manitowoc MLC 300 Crawler Crane Breakwater	0.000046	0.000041	0.000037	0.000033	0.000030						0.0000046	0.0000203	0.0000183	0.0000165	0.0000030
Manitowoc MLC 300 Crawler Crane Breakwater	0.000046	0.000041	0.000037	0.000033	0.000030						0.0000046	0.0000203	0.0000183	0.0000165	0.0000030
Manitowoc 999 Crawler Crane Breakwater	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000022	0.0000081	0.0000062	0.0000051	0.0000009
Kobelco 275 Ton Crawler	0.000031	0.000027	0.000021	0.000016	0.000013						0.0000050	0.0000216	0.0000169	0.0000134	0.0000021
60T Hydraulic Crane Assembly Crane	0.000046	0.000041	0.000037	0.000033	0.000030						0.0000028	0.0000025	0.0000023	0.0000020	0.0000018
Cat 988 Loader 1	0.000041	0.000037	0.000033	0.000030	0.000026						0.0000073	0.0000263	0.0000237	0.0000212	0.0000047
Cat 988 Loader 2	0.000041	0.000037	0.000033	0.000030	0.000026						0.0000073	0.0000263	0.0000237	0.0000212	0.0000047
Cat 988 Loader 3	0.000041	0.000037	0.000033	0.000030	0.000026						0.0000073	0.0000263	0.0000237	0.0000212	0.0000047
100T Hydraulic Excavator 1	0.000022	0.000017	0.000013	0.000011	0.000010						0.0000035	0.0000110	0.0000087	0.0000073	0.0000016
100T Hydraulic Excavator 2	0.000022	0.000017	0.000013	0.000011	0.000010						0.0000035	0.0000110	0.0000087	0.0000073	0.0000016
CAT 745 Rock Truck 1	0.000009	0.000007	0.000007	0.000006	0.000006						0.0000012	0.0000042	0.0000038	0.0000035	0.0000008
CAT 745 Rock Truck 2	0.000009	0.000007	0.000007	0.000006	0.000006						0.0000006	0.0000021	0.0000019	0.0000018	0.0000004
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.000401	0.000401	0.000401	0.000401	0.000401						0.0001850	0.0007402	0.0007402	0.0007402	0.0001850
Inner Harbor Tug 1 Generator	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000931	0.0003723	0.0003723	0.0003723	0.0000931
Inner Harbor Tug 2 Engine	0.000401	0.000401	0.000401	0.000401	0.000401						0.0001850	0.0007402	0.0007402	0.0007402	0.0001850
Inner Harbor Tug 2 Generator	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000931	0.0003723	0.0003723	0.0003723	0.0000931
Ocean Going Tug for Armor Stone Transport Engine	0.000401	0.000401	0.000401	0.000401	0.000401						0.0015153	0.0030307	0.0030307	0.0030307	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.000401	0.000401	0.000401	0.000401	0.000401						0.0002172	0.0004344	0.0004344	0.0004344	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000024	0.0000088	0.0000080	0.0000077	0.0000017
Mechanic Truck 1	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000128	0.0000206	0.0000189	0.0000181	0.0000091
Mechanic Truck 2	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000128	0.0000206	0.0000189	0.0000181	0.0000091
Welding Truck	0.000399	0.000362	0.000323	0.000281	0.000241						0.0000072	0.0000262	0.0000234	0.0000204	0.0000044
Compressor	0.000126	0.000113	0.000098	0.000089	0.000082						0.0000012	0.0000042	0.0000036	0.0000033	0.0000008
Boom Truck	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000028	0.0000105	0.0000096	0.0000093	0.0000020
Water Truck	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000057	0.0000210	0.0000192	0.0000185	0.0000041
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000062	0.0000136	0.0000125	0.0000119	0.0000044
Truck Tractor for Mob/Demob/Various	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000028	0.0000105	0.0000096	0.0000093	0.0000020
6T All Terrain Forklift	0.000008	0.000008	0.000008	0.000008	0.000008						0.0000003	0.0000011	0.0000011	0.0000011	0.0000003
D8 Dozer	0.000013	0.000011	0.000009	0.000008	0.000007						0.0000011	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000009	0.000008	0.000007	0.000006	0.000006						0.0000007	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000012	0.000010	0.000009	0.000008	0.000007						0.0000011	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000025	0.000018	0.000014	0.000012	0.000000						0.0000000	0.0000000	0.0000002	0.0000001	0.0000000
Kincho Vibro Hammer/Gen	0.000031	0.000025	0.000019	0.000015	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000067	0.000055	0.000046	0.000039	0.000000						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Delmag 30-32 Hammer	0.000031	0.000025	0.000019	0.000015	0.000000						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
65T Rough Terrain Crane	0.000025	0.000018	0.000014	0.000012	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000030	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000178	0	0	0	0
Coarse Concrete Aggregate											0.0000267	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000030	0	0	0	0

Armor Stone Bedding											0.0001076	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000019	0.000012	0.000010	0.000009	0.000007	0.000073	0.000041	0.000027	0.000022	0.000021	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Passenger car	0.000013	0.000010	0.000009	0.000008	0.000007	0.000118	0.000042	0.000038	0.000032	0.000027	0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.000019	0.000012	0.000010	0.000009	0.000007	0.000073	0.000041	0.000027	0.000022	0.000021	0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
185 CFM Compressor	0.000126	0.000113	0.000098	0.000089	0.000082						0.0000000	0.0000000	0.0000032	0.0000029	0.0000000
Miller Welder	0.000796	0.000737	0.000670	0.000592	0.000519						0.0000000	0.0000000	0.0000047	0.0000041	0.0000000
90T Rough Terrain Crane	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
175T Crawler Crane	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000000	0.0000000	0.0000006	0.0000005	0.0000000
6T Forklift	0.000008	0.000008	0.000008	0.000008	0.000008						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
20' Aluminum Crew Boat	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000000	0.0000000	0.0000060	0.0000060	0.0000000
10' Safety Boat	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
230T Crawler Crane	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000000	0.0000000	0.0000007	0.0000006	0.0000000
Kincho Vibro Hammer/Gen	0.000031	0.000025	0.000019	0.000015	0.000012						0.0000000	0.0000000	0.0000002	0.0000001	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000067	0.000055	0.000046	0.000039	0.000032						0.0000000	0.0000000	0.0000004	0.0000004	0.0000000
Delmag 30-32 Hammer	0.000031	0.000025	0.000019	0.000015	0.000012						0.0000000	0.0000000	0.0000003	0.0000002	0.0000000
65T Rough Terrain Crane	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Truck Tractor	0.000411	0.000382	0.000349	0.000337	0.000294	0.003151	0.002949	0.002689	0.002512	0.002222	0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000000	0.0000000	0.0000356	0.0000356	0.0000000
Inner Harbor Tug Generator	0.000401	0.000401	0.000401	0.000401	0.000401						0.0000000	0.0000000	0.0000071	0.0000071	0.0000000
Concrete Pump	0.000067	0.000055	0.000046	0.000039	0.000032						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
100T Crawler Crane	0.000025	0.000018	0.000014	0.000012	0.000010						0.0000000	0.0000000	0.0000002	0.0000001	0.0000000
CAT 345 Excavator	0.000009	0.000008	0.000007	0.000006	0.000006						0.0000000	0.0000000	0.0000004	0.0000004	0.0000000
CAT 330 Excavator	0.000009	0.000008	0.000007	0.000006	0.000006						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
CAT 966 Loader	0.000242	0.000205	0.000179	0.000159	0.000141						0.0000000	0.0000000	0.0000034	0.0000030	0.0000000
CAT 950 Loader	0.000242	0.000205	0.000179	0.000159	0.000141						0.0000000	0.0000000	0.0000015	0.0000014	0.0000000
										Total (ton/yr)	**0.003**	**0.006**	**0.006**	**0.006**	**0.001**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Naval Base Guam - Apra Harbor Breakwater Repair – 1,3-Butadiene Emissions

Equipment	1,3-Butadiene Emission Factor (g/hp-hr for off-road; g/mi for on-road; g/kWh for harbor craft)					1,3-Butadiene Idling Emission Factor (g/hr for on-road only)					1,3-Butadiene Emissions (tons/yr)				
	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029	2025	2026	2027	2028	2029
GLASS BREAKWATER REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000350	0.000184	0.000128	0.000095	0.000066	2.517360	2.193846	2.026706	1.952876	1.862834	0.0000046	0.0000024	0.0000017	0.0000013	0.0000009
Passenger car	0.000231	0.000154	0.000131	0.000098	0.000072	3.037552	2.314705	2.281925	2.217948	2.135628	0.0000031	0.0000020	0.0000017	0.0000013	0.0000009
Contractor Breakwater Fleet Vehicles															
Passenger Trucks (3), 3 Eng. Home Office	0.000350	0.000184	0.000128	0.000095	0.000066	2.517360	2.193846	2.026706	1.952876	1.862834	0.0000092	0.0000073	0.0000051	0.0000038	0.0000013
Passenger Trucks (18), Multiple Staff (18)	0.000350	0.000184	0.000128	0.000095	0.000066	2.517360	2.193846	2.026706	1.952876	1.862834	0.0000832	0.0000659	0.0000457	0.0000340	0.0000118
Coral Translocation															
Excavator	0.000012	0.000011	0.000009	0.000008	0.000008						0.0000014	0.0000000	0.0000000	0.0000000	0.0000000
Flat Bed Truck	0.000800	0.000679	0.000608	0.000470	0.000557	0.100390	0.090923	0.084679	0.074018	0.080033	0.0000141	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Primary Engine)	0.000299	0.000299	0.000299	0.000299	0.000299						0.0001418	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Bow Thrusters)	0.000299	0.000299	0.000299	0.000299	0.000299						0.0001418	0.0000000	0.0000000	0.0000000	0.0000000
Tugboat (Generator)	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000102	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Large Dive Boat (2 engines, total hp)	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000208	0.0000000	0.0000000	0.0000000	0.0000000
Twin Engine Small Dive Boat (2 engines, total hp)	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000099	0.0000000	0.0000000	0.0000000	0.0000000
Contractor Casting Yard Fleet Vehicles and Equipment															
Passenger Trucks (5) Casting Yard, Multiple Staff (5)	0.000350	0.000184	0.000128	0.000095	0.000066	2.517360	2.193846	2.026706	1.952876	1.862834	0.0000154	0.0000122	0.0000085	0.0000063	0.0000022
6T All Terrain Forklift 1	0.000012	0.000011	0.000011	0.000011	0.000011						0.0000008	0.0000010	0.0000010	0.0000010	0.0000008
6T All Terrain Forklift 2	0.000012	0.000011	0.000011	0.000011	0.000011						0.0000005	0.0000010	0.0000010	0.0000010	0.0000007
Boom Truck	0.000800	0.000679	0.000608	0.000470	0.000557	0.100390	0.090923	0.084679	0.074018	0.080033	0.0000110	0.0000187	0.0000167	0.0000129	0.0000115
Vacuum Truck/Sweeper	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000189	0.0000351	0.0000321	0.0000309	0.0000202
Cement Train Tractor 1	0.000431	0.000383	0.000338	0.000292	0.000249						0.0000311	0.0000553	0.0000488	0.0000422	0.0000270
Cement Train Tractor 2	0.000431	0.000383	0.000338	0.000292	0.000249						0.0000311	0.0000553	0.0000488	0.0000422	0.0000270
100T Gantry Crane 1	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000079	0.0000115	0.0000087	0.0000071	0.0000047
100T Gantry Crane 2	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000079	0.0000115	0.0000087	0.0000071	0.0000047
Truck Tractor 1	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019888	0.0019348	0.0018164	0.0017358	0.0015912
Truck Tractor 2	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019888	0.0019348	0.0018164	0.0017358	0.0015912
Skid Steer 1	0.001276	0.001217	0.001116	0.000956	0.000791						0.0000203	0.0000387	0.0000355	0.0000304	0.0000189
Skid Steer 2	0.001276	0.001217	0.001116	0.000956	0.000791						0.0000203	0.0000387	0.0000355	0.0000304	0.0000189
4000 Gal Water Truck	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000454	0.0000844	0.0000770	0.0000742	0.0000486
Cat 966 Loader 1	0.000030	0.000023	0.000018	0.000015	0.000014						0.0000058	0.0000089	0.0000071	0.0000059	0.0000040
Cat 966 Loader 2	0.000030	0.000023	0.000018	0.000015	0.000014						0.0000058	0.0000089	0.0000071	0.0000059	0.0000040
36 Meter Concrete Pump Truck	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000341	0.0000633	0.0000578	0.0000557	0.0000364
Central Mix Batch Plant Erie Strayer-120CP w 150 T air cooled water chiller															
100 KW Generators Backup Power (2)	0.000063	0.000053	0.000043	0.000032	0.000024						0.0000022	0.0000019	0.0000015	0.0000011	0.0000008
Ready Mix Concrete Truck 1	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019888	0.0019348	0.0018164	0.0017358	0.0015912
Ready Mix Concrete Truck 2	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019888	0.0019348	0.0018164	0.0017358	0.0015912
Ready Mix Concrete Truck 3	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019888	0.0019348	0.0018164	0.0017358	0.0015912
Ready Mix Concrete Truck 4 (reserve)	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0001989	0.0001935	0.0001816	0.0001736	0.0001591
60' Manlift for Maintenance	0.000651	0.000583	0.000516	0.000446	0.000376						0.0000078	0.0000140	0.0000124	0.0000107	0.0000068
Dump Trucks (4)	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0021364	0.0022090	0.0020667	0.0019770	0.0017780
Truck Tractor for Roll Off Trash Bins	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019699	0.0018997	0.0017843	0.0017049	0.0015709
Fuel Truck	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019737	0.0019067	0.0017907	0.0017111	0.0015750
CAT D8 Dozer	0.000018	0.000015	0.000012	0.000011	0.000010						0.0000004	0.0000000	0.0000000	0.0000000	0.0000000
CAT 950 Loader	0.000030	0.000023	0.000018	0.000015	0.000014						0.0000004	0.0000000	0.0000000	0.0000000	0.0000002
CAT 14H Grader	0.000021	0.000018	0.000016	0.000014	0.000013						0.0000008	0.0000000	0.0000000	0.0000000	0.0000000
25T Vibratory Compactor	0.000074	0.000062	0.000051	0.000040	0.000030						0.0000019	0.0000000	0.0000000	0.0000000	0.0000000
CAT 345 Excavator	0.000012	0.000011	0.000009	0.000008	0.000008						0.0000000	0.0000000	0.0000000	0.0000000	0.0000002
100T Crawler Crane	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000009	0.0000000	0.0000000	0.0000000	0.0000003

175T Crawler Crane	0.000067	0.000060	0.000054	0.000048	0.000043						0.0000053	0.0000000	0.0000000	0.0000000	0.0000000
185 CFM Compressor	0.000187	0.000166	0.000143	0.000129	0.000118						0.0000032	0.0000000	0.0000000	0.0000000	0.0000000
Miller Welder 400Amps	0.001116	0.001029	0.000926	0.000802	0.000686						0.0000118	0.0000000	0.0000000	0.0000000	0.0000000
Construction															
Liebherr LR1300 Crawler Crane Hotel Wharf	0.000067	0.000060	0.000054	0.000048	0.000043						0.0000067	0.0000297	0.0000267	0.0000241	0.0000043
Manitowoc MLC 300 Crawler Crane Breakwater	0.000067	0.000060	0.000054	0.000048	0.000043						0.0000067	0.0000297	0.0000267	0.0000241	0.0000043
Manitowoc MLC 300 Crawler Crane Breakwater	0.000067	0.000060	0.000054	0.000048	0.000043						0.0000067	0.0000297	0.0000267	0.0000241	0.0000043
Manitowoc 999 Crawler Crane Breakwater	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000031	0.0000114	0.0000086	0.0000071	0.0000012
Kobelco 275 Ton Crawler	0.000045	0.000038	0.000030	0.000023	0.000018						0.0000072	0.0000311	0.0000241	0.0000189	0.0000029
60T Hydraulic Crane Assembly Crane	0.000067	0.000060	0.000054	0.000048	0.000043						0.0000041	0.0000037	0.0000033	0.0000030	0.0000026
Cat 988 Loader 1	0.000060	0.000054	0.000048	0.000043	0.000038						0.0000107	0.0000384	0.0000345	0.0000308	0.0000067
Cat 988 Loader 2	0.000060	0.000054	0.000048	0.000043	0.000038						0.0000107	0.0000384	0.0000345	0.0000308	0.0000067
Cat 988 Loader 3	0.000060	0.000054	0.000048	0.000043	0.000038						0.0000107	0.0000384	0.0000345	0.0000308	0.0000067
100T Hydraulic Excavator 1	0.000031	0.000024	0.000018	0.000015	0.000014						0.0000050	0.0000155	0.0000121	0.0000101	0.0000022
100T Hydraulic Excavator 2	0.000031	0.000024	0.000018	0.000015	0.000014						0.0000050	0.0000155	0.0000121	0.0000101	0.0000022
CAT 745 Rock Truck 1	0.000012	0.000010	0.000009	0.000008	0.000008						0.0000017	0.0000057	0.0000051	0.0000047	0.0000011
CAT 745 Rock Truck 2	0.000012	0.000010	0.000009	0.000008	0.000008						0.0000008	0.0000029	0.0000026	0.0000023	0.0000006
8000 DWT Staging Platform															
2000 DWT Transfer Shuttle Barge															
Spud Barge															
16000 DWT Barge for Armor Stone Transport															
Inner Harbor Tug 1 Engine	0.000299	0.000299	0.000299	0.000299	0.000299						0.0001382	0.0005529	0.0005529	0.0005529	0.0001382
Inner Harbor Tug 1 Generator	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000695	0.0002782	0.0002782	0.0002782	0.0000695
Inner Harbor Tug 2 Engine	0.000299	0.000299	0.000299	0.000299	0.000299						0.0001382	0.0005529	0.0005529	0.0005529	0.0001382
Inner Harbor Tug 2 Generator	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000695	0.0002782	0.0002782	0.0002782	0.0000695
Ocean Going Tug for Armor Stone Transport Engine	0.000299	0.000299	0.000299	0.000299	0.000299						0.0011320	0.0022641	0.0022641	0.0022641	0.0000000
Ocean Going Tug for Armor Stone Transport Generator	0.000299	0.000299	0.000299	0.000299	0.000299						0.0001623	0.0003245	0.0003245	0.0003245	0.0000000
20' Aluminum Crew Boat	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 1	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
10' Safety Boat 2	0.000000	0.000000	0.000000	0.000000	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Fuel Truck	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000095	0.0000351	0.0000321	0.0000309	0.0000067
Mechanic Truck 1	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019926	0.0019418	0.0018228	0.0017420	0.0015817
Mechanic Truck 2	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019926	0.0019418	0.0018228	0.0017420	0.0015817
Welding Truck	0.000547	0.000498	0.000446	0.000389	0.000334						0.0000099	0.0000361	0.0000323	0.0000282	0.0000061
Compressor	0.000187	0.000166	0.000143	0.000129	0.000118						0.0000017	0.0000061	0.0000053	0.0000048	0.0000011
Boom Truck	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000114	0.0000422	0.0000385	0.0000371	0.0000081
Water Truck	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000227	0.0000844	0.0000770	0.0000742	0.0000162
Truck Tractor for Roll Off Trash Bins Stage at Hotel	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0019661	0.0019137	0.0017971	0.0017173	0.0015628
Truck Tractor for Mob/Demob/Various	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000114	0.0000422	0.0000385	0.0000371	0.0000081
6T All Terrain Forklift	0.000012	0.000011	0.000011	0.000011	0.000011						0.0000004	0.0000016	0.0000016	0.0000016	0.0000004
D8 Dozer	0.000018	0.000015	0.000012	0.000011	0.000010						0.0000016	0.0000000	0.0000000	0.0000000	0.0000000
CAT 330 Excavator	0.000012	0.000011	0.000009	0.000008	0.000008						0.0000009	0.0000000	0.0000000	0.0000000	0.0000000
CAT 14H Grader	0.000017	0.000014	0.000012	0.000010	0.000009						0.0000015	0.0000000	0.0000000	0.0000000	0.0000000
230T Crawler Crane	0.000036	0.000026	0.000020	0.000016	0.000000						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
Kincho Vibro Hammer/Gen	0.000045	0.000036	0.000027	0.000021	0.000000						0.0000000	0.0000000	0.0000001	0.0000000	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000096	0.000080	0.000066	0.000057	0.000000						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
Delmag 30-32 Hammer	0.000045	0.000036	0.000027	0.000021	0.000000						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
65T Rough Terrain Crane	0.000036	0.000026	0.000020	0.000016	0.000000						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Ocean Going Vessels (Product List)															
ADVA 140 m 58oz/CY (Concrete Additive)	See table note (8)										0.0000022	0	0	0	0
DARREX1 1AEA 63oz/CY (Concrete Additive)															
WRDA-HA 43 oz/CY (Concrete Additive)															
Concrete Sand C-33											0.0000133	0	0	0	0
Coarse Concrete Aggregate											0.0000199	0	0	0	0
Cement 504#/CY (4)											0.0000000	0	0	0	0
Fly Ash 215 lb/CY											0.0000022	0	0	0	0

Armor Stone Bedding											0.0000804	0	0	0	0
SUMAY COVE REPAIRS															
Government Fleet Vehicles															
Passenger truck	0.000350	0.000184	0.000128	0.000095	0.000066	2.517360	2.193846	2.026706	1.952876	1.862834	0.0000000	0.0000000	0.0000005	0.0000004	0.0000000
Passenger car	0.000231	0.000154	0.000131	0.000098	0.000072	3.037552	2.314705	2.281925	2.217948	2.135628	0.0000000	0.0000000	0.0000005	0.0000004	0.0000000
Contractor Sumay Cove Vehicles															
Passenger trucks (5), Multiple Staff (5)	0.000350	0.000184	0.000128	0.000095	0.000066	2.517360	2.193846	2.026706	1.952876	1.862834	0.0000000	0.0000000	0.0000042	0.0000032	0.0000000
185 CFM Compressor	0.000187	0.000166	0.000143	0.000129	0.000118						0.0000000	0.0000000	0.0000047	0.0000043	0.0000000
Miller Welder	0.001181	0.001095	0.000995	0.000873	0.000760						0.0000000	0.0000000	0.0000069	0.0000061	0.0000000
90T Rough Terrain Crane	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
175T Crawler Crane	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000000	0.0000000	0.0000009	0.0000007	0.0000000
6T Forklift	0.000012	0.000011	0.000011	0.000011	0.000011						0.0000000	0.0000000	0.0000003	0.0000003	0.0000000
20' Aluminum Crew Boat	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000000	0.0000000	0.0000045	0.0000045	0.0000000
10' Safety Boat	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
230T Crawler Crane	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000000	0.0000000	0.0000010	0.0000008	0.0000000
Kincho Vibro Hammer/Gen	0.000045	0.000036	0.000027	0.000021	0.000017						0.0000000	0.0000000	0.0000003	0.0000002	0.0000000
HPSI 260Hammer w/400HP Powerpack	0.000096	0.000080	0.000066	0.000057	0.000046						0.0000000	0.0000000	0.0000006	0.0000005	0.0000000
Delmag 30-32 Hammer	0.000045	0.000036	0.000027	0.000021	0.000017						0.0000000	0.0000000	0.0000004	0.0000003	0.0000000
65T Rough Terrain Crane	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000000	0.0000000	0.0000000	0.0000000	0.0000000
Truck Tractor	0.001650	0.001533	0.001400	0.001349	0.001176	1.847219	1.768578	1.661850	1.587744	1.469210	0.0000000	0.0000000	0.0000005	0.0000004	0.0000000
Spud Barge															
Inner Harbor Tug Engine	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000000	0.0000000	0.0000266	0.0000266	0.0000000
Inner Harbor Tug Generator	0.000299	0.000299	0.000299	0.000299	0.000299						0.0000000	0.0000000	0.0000053	0.0000053	0.0000000
Concrete Pump	0.000096	0.000080	0.000066	0.000057	0.000046						0.0000000	0.0000000	0.0000002	0.0000002	0.0000000
100T Crawler Crane	0.000036	0.000026	0.000020	0.000016	0.000014						0.0000000	0.0000000	0.0000003	0.0000002	0.0000000
CAT 345 Excavator	0.000012	0.000011	0.000009	0.000008	0.000008						0.0000000	0.0000000	0.0000005	0.0000005	0.0000000
CAT 330 Excavator	0.000012	0.000011	0.000009	0.000008	0.000008						0.0000000	0.0000000	0.0000001	0.0000001	0.0000000
CAT 966 Loader	0.000362	0.000307	0.000268	0.000239	0.000213						0.0000000	0.0000000	0.0000051	0.0000046	0.0000000
CAT 950 Loader	0.000362	0.000307	0.000268	0.000239	0.000213						0.0000000	0.0000000	0.0000023	0.0000020	0.0000000
										Total (ton/yr)	**0.025**	**0.027**	**0.026**	**0.025**	**0.019**

Notes:
N/A = not applicable
(1) Assume coral translocation occurs just in 2025.
(2) Assume no activity in 2030.
(3) Assume that all barges and the staging platform do not have engines as they are moved by tugs and do not have auxiliary engines.
(4) Passenger cars and passenger trucks are not allowed to run idle.
(5) Idling hours for off-road equipment is added to operating hours to get the total hours. The default MOVES load factor is used to account for times when the equipment is idling then. Idling emissions are not calculated separately for off-road equipment.
(6) Assume all engines are USEPA Tier 2 engines operating on ultra-low sulfur diesel. Tier II emission factors were used for criteria air pollutant emissions from off-road equipment.
(7) See RONA tables for equipment inputs.
(8) For HAPs, Appendix D - HAP SPECIATION PROFILES FOR COMMERCIAL MARINE ENGINES within the Port Emission Inventory guidance document above were used and multiplied by the VOC EF to obtain specific HAP EFs. Only calculated the most significant HAP emissions based on a HAP speciation fraction of equal to or greater than 1.0E-03.

Pollutant	Pollutant Code	Basis	Fraction
1,3-Butadiene	106990	VOC	1.01E-03
2,2,4-Trimethylpentane	540841	VOC	7.12E-03
Acetaldehyde	75070	VOC	9.78E-03
Acrolein	107028	VOC	1.85E-03
Benzene	71432	VOC	4.74E-03
Formaldehyde	50000	VOC	4.27E-02
Naphthalene	91203	VOC	3.13E-02
Hexane	110543	VOC	2.79E-03
Phenanthrene	85018	VOC	1.36E-03
Propionaldehyde	123386	VOC	1.52E-03
Toluene	108883	VOC	2.04E-03
Xylenes (Mixed Isomers)	1330207	VOC	1.42E-03

Appendix C: ESA and MSA Consultation Documentation

NOTE: For security purposes, email addresses and phone numbers are redacted from correspondences in the Appendices.

MSA EFH: Navy/NMFS Early Coordination/Consultation Initiation Correspondence

From: Steven McKagan - NOAA Federal
To: Jacobs, Kaitlyn P CIV (USA)
Cc: Sean Hanser - NOAA Federal; Lino, Kevin C CIV USN NAVFAC PAC PEARL HI (USA); Bejder, Michelle M CIV USN NAVFAC PAC PEARL HI (USA); Perez, Anjelica Claire U CIV USN NAVFAC MARIANAS GU (USA); Cruz, Jesse T CIV USN NAVFAC MARIANAS GU (USA); Moon, Edward E CIV USN NAVFAC MARIANAS GU (USA); Santos, Maria L (MarLo) CIV USN NAVFAC MARIANAS GU (USA)
Subject: Re: [Non-DoD Source] Re: Request for EFH Consultation: Apra Harbor Waterfront Repairs
Date: Monday, April 14, 2025 9:58:00 AM

Hi Kaitlyn,

Thanks for reaching back out. We are currently working on the consultation letter. My leadership approved the deferred detailed mitigation plan and abbreviated consultation timeline in early April, so would it be okay to list Friday May 2nd as the official due date for our response letter?

-Steve

On Tue, Apr 15, 2025 at 5:36 AM Jacobs, Kaitlyn P CIV (USA) [redacted] wrote:

> Good morning Steve,
>
> I wanted to check in and see where NMFS is at with initiation of this consultation. The Navy appreciated the opportunity to submit two drafts along with responses to NMFS' comments in hopes of expediting this process, considering the urgent nature of the Glass breakwater repairs. Two weeks seems an adequate amount of time to deem the consultation package complete and start the clock, and the Navy would appreciate a timeline of when to expect CRs.
>
> Thank you,
>
> Kaitlyn
>
> **From:** Steven McKagan - NOAA Federal [redacted]
> **Sent:** Thursday, March 27, 2025 2:18 PM
> **To:** Moon, Edward E CIV USN NAVFAC MARIANAS GU (USA) [redacted]
> **Cc:** Jacobs, Kaitlyn P CIV (USA) <[redacted]Sean Hanser - NOAA Federal [redacted] Lino, Kevin C CIV USN NAVFAC PAC PEARL HI (USA) [redacted]; Bejder, Michelle M CIV USN NAVFAC PAC PEARL HI (USA) [redacted]Perez, Anjelica Claire U CIV USN NAVFAC MARIANAS GU (USA) <[redacted]; Cruz, Jesse T CIV USN NAVFAC MARIANAS GU (USA) [redacted], Maria L (MarLo) CIV USN NAVFAC MARIANAS GU (USA) [redacted]

Subject: [Non-DoD Source] Re: Request for EFH Consultation: Apra Harbor Waterfront Repairs

Hafa Adai Ed and Kaitlyn,

I have received the request letter and EFHA ,and I will lead the EFH consultation for this action. Thanks again for all of your early coordination efforts.

-Steve

On Fri, Mar 28, 2025 at 10:11 AM 'Moon, Edward E CIV USN NAVFAC MARIANAS GU (USA)' via _NMFS PIR ESHESA <efhesaconsult@noaa.gov> wrote:

> ALCON,
>
> I'm not sure why the unsigned letter of transmittal was included. Signed letter is attached.
>
> v/r
>
> Ed Moon
> Installation Environmental Program Director.
> Public Works Department, Naval Base Guam.
> [redacted]
>
> -----Original Message-----
> From: Jacobs, Kaitlyn P CIV (USA) [redacted]
> Sent: Friday, March 28, 2025 9:51 AM
> To: efhesaconsult@noaa.gov; Mckagan, Steven C CIV (USA) [redacted]; Sean Hanser - NOAA Federal [redacted]
> Cc: Lino, Kevin C CIV USN NAVFAC PAC PEARL HI (USA) [redacted]; Beider, Michelle M CIV USN NAVFAC PAC PEARL HI (USA) [redacted]; Perez, Anjelica Claire U CIV USN NAVFAC MARIANAS GU (USA) [redacted] Cruz, Jesse T CIV USN NAVFAC MARIANAS GU (USA) [redacted] Moon, Edward E CIV USN NAVFAC MARIANAS GU (USA) [redacted]; Santos, Maria L (MarLo) CIV USN NAVFAC MARIANAS GU (USA) [redacted]
> Subject: Request for EFH Consultation: Apra Harbor Waterfront Repairs
>
> Aloha NMFS colleagues,

NAVFAC Pacific is submitting an EFH consultation package on behalf of the Action Proponents for the Navy's proposed Apra Harbor Waterfront Repairs at Naval Base Guam, in Apra Harbor, Guam.

The following is attached in this email:

* NOAA 'Request to Initiate Consultation' cover letter
* Essential Fish Habitat Assessment (EFHA)

We appreciate NMFS's guidance and assistance during all of the pre-consultation meetings and correspondence on drafts, and look forward to answering any questions that may arise. If you have any questions or concerns, please feel free to contact me by phone or email.

Thank you,

Kaitlyn Jacobs, MSc.

Marine Resources Management Specialist

NAVFAC Pacific

[redacted]

NBG MSA EFHA Consultation Initiation Letter to NMFS

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 153
FPO AP 96540-0001

5090
Ser EV/ 043
March 26, 2025

Gerry Davis
Assistant Regional Administrator
Habitat Conservation Division
Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Blvd., Bldg. 176
Honolulu, HI 96818

Subject: REQUEST FOR CONSULTATION ON THE EFFECTS FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Dear Mr. Davis,

This letter requests your review and conservation recommendations to fulfill the Navy's requirements to consider the impacts of its actions on Essential Fish Habitat (EFH) as required by the Magnuson-Stevens Fishery Conservation and Management Act (16 USC§ 1801 et seq.).

The Navy proposes to repair waterfront structures that were severely damaged by Typhoon Mawar (e.g., Sumay Marina, Sumay Point and the Admiral Glass Breakwater). The Proposed Action includes the installation and removal of piles at the marina, along with the transport and installation of concrete armor units at the breakwater. The action will impact seafloor habitat, benthic organisms colonizing current breakwater boulders and fouling organism colonizing piles at Sumay Marina. The Project is anticipated to begin in September 2025 and the installation will involve some vessel and barge traffic within the harbor. The in-water actions will be undertaken in daylight hours only and will require approximately 5 years to complete.

The Navy determined that the Proposed Action will adversely affect the quality and quantity of EFH at outer and inner breakwater but most of the effects will be managed and minimized with the incorporation of Best Management Practices (BMP). Potential adverse effects that are likely to occur to EFH are based on exposure to the following stressors: physical removal; direct physical contact; increased turbidity and suspended sediments; elevated underwater noise levels; waste and discharge; aquatic invasive species; chemical contaminants and hypoxia. Removal of the marine invertebrate community in the action area will be permanent and the Navy is proposing avoidance, minimization and offset mitigation measures to compensate for the unavoidable loss of ecosystem functions and services. The remaining effects will primarily be temporary, restricted to the action area and rendered minimal by the implementation of BMPs.

Subject: REQUEST FOR CONSULTATION ON THE EFFECTS FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Thank you for consideration of our request and we look forward to your review and concurrence. Should you have any questions or concerns, please contact Kaitlyn Jacobs at NAVFAC Pacific at [redacted]

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosure: 1. Essential Fish Habitat Assessment: Consultation for the Apra Harbor Waterfront Repairs, Apra Harbor, U.S. Naval Base Guam

2

MSA EFH: NMFS Consultation Response Letter to Navy

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
(808) 725-5000 · Fax: (808) 725-5215

Edward Moon
Installation Environmental Program Director
Naval Base Guam
PSC 455 Box 195
FPO AP 96540-2937

April 30, 2025

Dear Mr. Moon,

The National Marine Fisheries Service, Pacific Islands Regional Office (NMFS), received Naval Base Guam (the Navy) essential fish habitat (EFH) consultation request and EFH Assessment (EFHA) for an emergency repair of the Glass Breakwater on March 27, 2025. We have reviewed the final EFHA and agree that there will be unavoidable and substantial adverse effects due to the proposed action including impacts to 511,878 square feet (ft2) of benthic EFH. NMFS agrees that the mitigation plan put forward by the Navy, which includes avoidance through a range of best management practices (BMPs), minimization through the translocation of corals, and offset via the restoration of seagrass at Dadi Beach and transplantation of crustose coralline algae (CCA) starters, is a viable approach to conserving EFH and replacing lost ecosystem services and functions. We have provided eleven EFH conservation recommendations (CRs) pursuant to the EFH provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA; Section 305(b)(2) as described by 50 CFR 600.920). When implemented, these CRs will help you further avoid and minimize potential adverse effects to EFH.

Consultation History

NMFS consulted previously with the Navy specifically as it relates to impacts adjacent to Glass Breakwater as part of the preliminary emergency repair action (i.e., Emergency Action Phase 1 or EA1) in 2024, which can be found in the NMFS Environmental Consultation Organizer (NMFS 2024). NMFS has continued to coordinate with the Navy through early coordination to discuss this

new comprehensive maintenance and repair action (i.e., Emergency Action Phase 2 or EA2), with a focus on mitigation strategies and accountability.

- On January 15, 2025: NMFS met with the Navy for a pre-consultation meeting to discuss EA2 for the Glass Breakwater, located in Apra Harbor, Guam.
- On February 8, 2025: NMFS received the first draft EA2 EFHA for review.
- On February 19, 2025: NMFS met with the Navy to discuss parameters for the Habitat Equivalency Analysis (HEA). NMFS requested that the coral translocation plan be integrated into the EA2 EFHA for a more comprehensive consultation package and to avoid additional coordination requirements that could cause delays. NMFS also provided the 2022 EFH guidance document to help the Navy ensure they address all of the mandatory components required under MSA in future drafts of the EA2 EFHA.
- On February 25, 2025: NMFS met with the Navy to discuss mitigation offset alternatives given the limited potential of on-site and in-kind restoration projects adjacent to Glass Breakwater, including the possibility of integrating mangrove or seagrass restoration as part of the offset strategy.
- On March 8, 2025: NMFS received the second draft EA2 EFHA for review.
- On March 13, 2025: NMFS provided the Navy a range of questions and recommendations related to the CAU materials and design, boating, silt curtain usage, use of piles, revetment repairs, impacts analysis, and other gaps in the information provided related avoidance BMPs, the coral translocation minimization plan, and the newly added seagrass restoration and CCA transplantation offset plans.
- On March 27, 2025: The Navy responded to NMFS comments to the second draft EA2 EFHA and submitted the final EFH documents to start the consultation process.

Project Description

Outer and Inner Glass Breakwater Repairs

The proposed action is to perform repairs on the north side, the Philippine Sea-side, of the Glass Breakwater, called the 'Outer Breakwater.' The Outer Breakwater was damaged by typhoon Mawar in May 2023 and subsequent storms. Sections of the breakwater are severely eroded and susceptible to imminent breaching from normal wave action. Repairs will occur where 'armor' boulders (large stones placed as riprap to protect shorelines and other structures from erosion) have been displaced or washed away into the ocean. The proposed action will also perform repairs on the 'Inner Breakwater,' facing Apra Harbor. Repairs for the Inner Breakwater include small areas of damage from the crest to toe.

The Outer Breakwater west of Luminao Reef, including the area wrapping around the point at the harbor mouth, is currently defined by structural engineers as being in either poor, serious, or critical condition. The Inner Breakwater is categorized as fair condition with some small areas of damage.

Repair activities will involve excavation and replacement of the existing toe, slope, and crest rock protection, rebuilding of the damaged core and toe sections, placement of a bedding stone under layer where necessary, and installation of concrete armor units (CAUs) along the toe, slope, and crest. Grading will require up to 54,000 cubic yards (cy) of imported quarried aggregate material and bedding rock. Course aggregate and stone will be used with an admixture to construct the CAUs that will be cured prior to placement. The fabricated CAUs are anticipated to vary from 15 to 50 tons, depending on the size required to fill existing holes or depressions in the structure.

The CAUs will be transported via a shuttle and spud barge. The repairs are expected to be carried out with a land-based crane from the top of the Outer Breakwater. To enable the crane to reach out to the toe of the existing structure, the Navy projects that the top 10 ft of the Outer Breakwater may be lowered by removing armor stone, core aggregate, or vegetation. Crane capacity will be a controlling factor in selection of armor stone size and weight. CAUs will be lowered onto the Outer Breakwater one at a time and placed on existing armor. In some cases, smaller armor stones may be inserted to stabilize the foundational armor stones. For damaged foundational areas, the Outer Breakwater's core will be graded and rebuilt to create a stable foundation for the placement of the CAUs.

The Navy has identified multiple staging areas for equipment and materials landside and one holding location for the concrete armor units on the breakwater.

Sumay Point Marina Repairs

The proposed action also includes revetment repairs, pile driving activities, and installation of a wave attenuator at Sumay Point Marina, along the south side of inner Apra Harbor. The wave attenuator and pile driving activities are located in the midwest section of the Sumay Cove Channel.

To protect the floating docks and maintain safe vessel operation within the Sumay Marina, 16 deteriorated piles will be removed from the main dock and standing wave attenuator and disposed of at the local upland landfill. An impact hammer will be used to drill up to 56 concrete or steel piles ranging from 16 to 20-inches (in) in diameter to a depth of approximately 20 ft below the mudline. A vibratory hammer will be used to drill 10 steel piles to build a temporary trestle in Sumay Marina from which the repairs will be completed.

The existing revetment along Sumay Point is a deteriorated steel structure with failing rock fill. The proposed action will remove the steel structure and a 15,000 ft2 area of rock to adjust the slope of the revetment. The rock debris and additional imported bedding material will be reused to backfill

and compact the underlying slope and transported via truck from the breakwater or a quarry. Approximately 500 cy of imported rock salvaged from the breakwater will be placed above and in shallow water to restore the rock revetment. The majority of construction will occur above the mean higher high water.

Schedule

Equipment mobilization and site preparation will begin in August 2025. CAU fabrication will begin earliest in August of 2025 and initial armor placement is anticipated to begin in early 2026 and continue through the middle of 2029. In-water work is anticipated to continue intermittently for the duration of the project and night works is not anticipated, although above-water nighttime work may occur to prepare the site for placement and delivery of CAUs.

Essential Fish Habitat

The marine water column from the surface to a depth of 3,281 ft from the shoreline to the outer boundary of the EEZ (200 nautical miles), and the seafloor from the shoreline out to a depth of 2,296 ft around each of the Mariana Islands, have been designated as EFH. As such, the water column and bottom and all surrounding waters and submerged lands around Apra Harbor are designated as EFH and support various life stages for the management unit species (MUS) identified under the Western Pacific Regional Fishery Management Council's Pelagic and Mariana Archipelago Fishery Ecosystem Plans and amendments (WPFMC 2009a, 2009b, 2018). The MUS and life stages found in these waters include eggs, larvae, juveniles, and adults of Bottomfish and Pelagic MUS. Specific types of habitat considered as EFH within, or adjacent to, the proposed project area include coral reef, patch reefs, hard substrate, artificial substrate, seagrass beds, soft substrate, lagoon, estuarine, surge zone, deep-slope terraces and pelagic/open ocean.

Outer and Inner Breakwater Baseline Condition

The Glass Breakwater is a manmade structure. The Outer Breakwater is exposed to the open ocean, and is a dynamic area that experiences regular and considerable wave energy from storms and typhoons. Divers conducting benthic surveys in February and March 2024 noted that the existing boulders on the Outer Breakwater had shifted considerably due to waves, resulting in rock slides and locations where boulders were dislodged from the above-water structure and washed into the sea. Some boulders have been sheared, scoured each other, and broken into pieces. The northeast section of the Outer Breakwater, nearest the shallow reef flat of Luminao Reef, experiences a strong southwesterly current that flows off the reef flat. The limestone boulders that make up most of the substrate of the Outer Breakwater are covered primarily with light turf algae or are encrusted by CCA. CCA is the dominant bottom cover with an average of 43%.

On the Outer Breakwater, corals are generally low density within 6.6 ft of the shoreline with an average density of 0.12 colony/ft2 and become more abundant, diverse, and larger at approximately the 3 to 4 m (9.9 to 13.1 ft) dept (Kilarski et al. 2024). The highest coral abundance and diversity within 6.6 ft of the shoreline occurs in the northeast section nearest the reef flat at Luminao Reef (Houk et al. 2024). The lowest coral cover is found at the tip of the breakwater, from the water line down to the breakwater toe. Strong current and wave action prevented divers from obtaining fish counts during surveys, but divers did note the presence of surgeon fish, parrot fish, snappers, and trevally's within the area.

On the Inner Breakwater, corals are also low density adjacent to the existing structure (i.e., within 6.6 ft) and become more abundant at 5 ft depth and below (Kilarski et al. 2024). A total of 584 colonies from 26 coral genera were documented during marine surveys along the Inner Breakwater (Houk et al. 2024). Approximately 63% of the coral identified were considered small (i.e., 4 in or less), and approximately 8% of the colonies were considered large (i.e., 48 colonies > 1 ft) including several very large colonies of Porites spp., exceeding 5.25 ft in size (Kilarski et al. 2024). The site adjacent to the channel had the highest species richness and a total of 9 colonies of Acropora globiceps were observed around the inner breakwater boulder habitat (Houk et al. 2024).

Sumay Point Baseline Condition

Sumay point faces outer Apra Harbor and Sumay Cove is an enclosed embayment on the southern shore of Outer Apra Bay. The benthic habitat surrounding Sumay Point is primarily sand and rubble with minimal limestone boulder coverage ranges in depth from 2 to 4.3 ft. Macroalgae is the primary biological cover atop manmade structures, and there is a low number of small corals and sponges in the surrounding area (Kilarski et al. 2024). At the revetment repair area, corals are low density and make up 1% of benthic cover with two colonies of encrusting Leptastrea in the 0.4-2 in size class, and 25 colonies of branching Pocillopora spp. observed over a 164 ft transect. The marina is routinely dredged and divers from a survey in 2024 have primarily observed Chlororus spilurus and Ctenochaetus striatus (i.e., bullethead parrotfish and brown tang).

Adverse Effects

Physical Damage/Removal (physical stressor): Repairing armor stones on the Breakwater could result in the temporary alteration of EFH substrate and the direct unavoidable loss of benthic organisms, such as corals, macroalgae, filter feeders (e.g. sponges and bryzoans), and fish and mobile invertebrates that inhabit spaces between rocks. Direct impacts to substrate and organisms will occur during the removal of existing material and deployment of new CAUs into the water. The majority of construction activities will occur above the water's surface and tidal influence but construction at the tow of the breakwater (i.e., within 6.6 ft of seawater) is expected to impact colonizing corals, algae, crabs, bivalves and other species that can live in the interdidal zone.

Corals occur at low density around the areas where breakwater repairs will take place. The survey report attached to the EFHA indicated that branching *Pocillopora spp.* and *Acropora spp.* colonies make up much of the three-dimensional reef habitat on top of boulders on the outer Breakwater. A total of 10 colonies of the ESA-listed coral species, *Acropora globiceps*, were observed across the outer breakwater boulder habitat (Houk et al. 2024).

Sumay Marina pile-driving activities, and the installation of a wave attenuator will occur primarily in-water and are expected to disturb the benthic community in the action area. Physical damage to organisms, including corals, from construction often results in breakage, dislocation, or mortality, but can also result in sub-lethal tissue abrasion. Corals are particularly vulnerable to physical damage because their slow-growing carbonate skeleton is relatively brittle and their polyps are easily damaged. In general, lobate, encrusting, and other massive colony morphologies tend to withstand breakage better than foliose, table, plating, and branching morphologies; more fragile forms tend to have higher growth rates (Rützler 2001).

Unintentional physical damage could occur during in-water actions at the Sumay Marina and revetment. The majority of Sumay revetment repairs will occur above the mean higher high water and constructed at the same location as the existing revetment. Corals are low density at the revetment area and make up 1% of the benthic cover. Direct physical contact to the hardbottom by equipment and materials and installation activities could lead to the unavoidable loss of corals and other benthic organisms.

Sedimentation (water quality stressor): The use of heavy equipment to reset and replace stones in the harbor structures and relocate rock debris for revetment repairs will increase loose substrate in the project area, potentially leading to a temporary increase of sediment being introduced to the marine environment during construction and rain events. In-water work, including vibratory and impact hammer pile driving, pile removal, and other construction activities at the Sumay Marina and Breakwater may also increase suspended sediments in the water column. Suspended sediment can elicit short- and long-term responses from aquatic organisms depending on the quantity, quality, and duration of suspended sediment exposure (Kjelland et al. 2015). Coral reef organisms are easily smothered by sediment and can experience both physiological and lethal responses to concentrations below 10 milligrams (mg)/cm^2/day and 10 mg/Liter (L) (Tuttle and Donahue 2022). Adverse effects from deposited sediment can occur as low as 1 mg/cm^2/day for larvae and 4.9 mg/cm^2/day for adult tissue (Tuttle and Donahue 2022). Suspended sediment levels of 10 mg/L can lead to reduced growth rates and levels of 3.2 mg/L can cause bleaching and tissue mortality (Tuttle and Donahue 2022), although corals show considerable interspecific variability. Increased turbidity can cause changes in fish behavior, including altered predator-prey relationships (Higham et al. 2015).

Impacts to water quality from sedimentation associated with this project would be short-term and temporary, lasting only as long as the breakwater and revetment repair activities last and the time it

takes for the substrate under the armor stones and rock fill to stabilize. The persistent wave action on the Outer Breakwater can wash sediment into the ocean and temporarily increase sedimentation, but the active movement of the water has the potential to clear away cloudy water quickly and move suspended sediment away from organisms growing on the Breakwater. The effects of sedimentation can also be minimized by implementing appropriate erosion control BMPs including silt curtains along the Inner Breakwater.

Chemical Contamination (water quality stressor): The use of heavy equipment increases risk of chemicals being introduced to the marine environment from spills or releases. Pollutants may enter the marine environment via runoff, wind, spillage, or drainage systems. The implementation of BMPs is essential to avoiding and managing chemical contamination. Contaminants can have a variety of lethal and sublethal effects on habitat-forming marine organisms, including alteration of growth, interference with reproduction, disruption of metabolic processes, and changes in behavior. These adverse effects can cascade through ecosystems, altering species composition and ecosystem functions and services. Some pollutants are environmentally persistent and can take years or even decades to biodegrade, and others can bioaccumulate or biomagnify through the food chain, eventually posing a direct threat to human health. Contaminant concentrations in fishes are linked to locations with increased urbanization and military history (Nalley et al.2021; 2023).

Land-based runoff and discharges can subject nearshore benthic communities to adverse exposures and potential degradation of conditions. When not properly maintained, equipment could release contaminants (e.g., oil, fuel) into the marine environment. Impacts from contaminants in the marine environment are dependent on how long chemical compounds persist and their tendency to bio-accumulate in the food web (van Dam et al. 2011). An increase in nutrients, pollutants, and contaminants in the marine environment can reduce fitness and cause mortality of exposed organisms. Some pollutants are environmentally persistent and can take years or even decades to biodegrade (Minton 2017). Nearshore species may spend a portion of their lives in coral reefs, but many of these fish and invertebrates are pelagic spawners (Colin 2011) or broadcastspawners (see, for example, Padilla-Gamiño and Gates 2012; Birdet al. 2011). Eggs and larvae are sensitive to water quality changes and can uptake contaminants (Von Westernhagen 1988). The eggs and larvae of pelagic and broadcast spawners spend time in the plankton community where they can be mobilized far off shore (Lobel and Robinson 1988; Cowen and Sponaugle 2009) and bring nutrients and accumulated contaminants to pelagic and benthic communities, including bottomfish and pelagic MUS.

Noise (environmental stressor): Use of heavy equipment will cause increased noise in the construction areas and may expose individual habitat-forming marine organisms to sound and vibratory stressors. Behavioral changes can occur as a response to noise, resulting in animals leaving feeding or reproduction on grounds (Slabbekoornet al. 2012) or becoming more susceptible to mortality through decreased predator-avoidance responses (Simpson et al. 2016). Although not likely to kill organisms, chronic noise can mask biologically important sounds and alter the natural

soundscape, cause hearing loss, and/or have an adverse effect on an organism's stress levels and immune system. Sound that has its source on land, either in air or in the ground, does not propagate well into the aquatic environment compared to sound sources actually occurring in the marine environment (Richardson et al. 2013). The difference in density and other physical properties between mediums such as air and water or water and land limit the propagation of sound. For the repair of the Outer and Inner Breakwater, noise occurring in the water will be limited, because the majority of the repair work is occurring above the waterline and no equipment will be operating or staged in the water or on vessels. Construction equipment may reach into the water to move or place rocks.

At Sumay Point, the use of an impact hammer for concrete pile-driving will occur for a maximum of 10 minutes per day. A vibratory hammer will also be used intermittently for the installation and removal of piles. Pile installation activities can reduce habitat quality temporarily. Studies evaluating how fish detect particle motion components of sound indicate that exposure levels associated with continuous sound, such as vibratory pile driving, do not produce tissue damage (Hastings 2014; Hawkins and Popper 2018, 2018b). Research has shown that stress from noise is greater from intermittent sounds (impulsive) than for continuous sounds (non-impulsive; Popper et al. 2014). Noise from impulse sources such as impact pile driving can have significant effects on fish, especially in cases of over-exposure, where dead or stunned fish float to the surface soon after an acoustic event (Popper et al. 2014). Vibratory pile driving (non-impulsive) would possibly elicit behavioral reactions from fish such as temporary avoidance of the area but is less likely to cause injuries to fish or have persistent effects on local fish populations.

Nutrient Loading (water quality stressor): Nutrient loading may occur from nutrient laden runoff and sediment coming from construction activities, stockpiles that are uncovered or not stabilized, and exposed ground that may erode. The action of removing, resetting, and replacing stones may expose the underlayer of finer sediment and organic content that has accumulated in the interest in all spaces of the stones. Movement of this fine sediment into the marine environment may degrade water quality in the project area. Changes in the drainage profile both during and after repair of the Breakwater may increase the flow of stormwater to the nearshore environment permanently. Coral reef ecosystems thrive in oligotrophic, or nutrient-poor, waters,and nutrient enrichment has been shown to negatively affect coral reef ecosystems directly and indirectly(Nalley et al. 2023b). Growth rates of macroalgae are constrained by nutrient limitation and herbivore grazing, thereby preventing algae from overgrowing and killing corals under normal conditions (Carpenter 1986; Littler et al. 2006). Exposure to elevated nutrients can cause a shift to an assemblage dominated by algae (Lapointe 1997; Dudgeon et al. 2010). Nutrient enrichment can also lead to increased abundances of invasive algae that outcompete native algae in areas with nutrient pollution (Dulai et al. 2023).

The persistent wave action on the Outer Breakwater can increase erosion and wash organic matter into the ocean. The active movement of the water will not allow nutrients concentrated in the water by the face of the Outer Breakwater to remain concentrated for long. Organic input will be moved

away from organisms growing on the Breakwater. Limiting the effects of nutrient loading can be accomplished through controlling erosion, managing stormwater and runoff, and being prepared for securing the project site during inclement weather.

Invasive Species (biological stressor): Bringing equipment to the project site from other parts of Guam or from off island has an increased risk of spreading invasive species. Introduced species are organisms that have been moved, intentionally or unintentionally, into areas where they do not naturally occur. Invasive species rapidly increase in abundance to the point that they come to dominate their new environment, creating adverse ecological effects to other species of the ecosystem and the functions and services it may provide (Goldberg and Wilkinson 2004). Invasive species can decrease species diversity, change trophic structure, and diminish physical structure, but adverse effects are highly variable and species-specific. The shipping and transportation of construction material and CAU staging have the potential to introduce aquatic invasive species (AIS). The Inner and Outer Breakwater planned activities and revetment repairs will include little to no in-water work, so the risk of spreading invasive species in the marine environment appears minimal from these activities but would increase if/when divers and small boats are participating in the construction or mitigation actions.. The pile driving and wave attenuator activities require in-water work and also pose an increased risk of spreading AIS.

Extreme Weather Events (combined stressor): Extreme weather in the Pacific is becoming more frequent and intense because of global climate change (e.g., see Hu et al. 2021 and Cai et al. 2014). Breakwater repairs, CAU staging areas, and mitigation activities could be affected by extreme winds, high runoff, waves, and elevated sea level events. NMFS is encouraging the Navy to consider the potential effects of extreme weather events on the project and to continue to develop contingency plans for all phases of the proposed action. Typhoon season in the Pacific is considered to be from June 1 to November 30, however tropical storms can and do occur year round in the Marianas.

Navy-proposed BMPs

To avoid and minimize potential adverse effects to EFH, the following BMPs and minimization measures will be implemented:

Physical Impacts to Benthic and Water Column Communities

- For all in-water activities that require staging materials in the marine environment and/or be supported by divers (e.g. coral translocation, seagrass restoration), the Navy will ensure that these activities avoid any unnecessary contact with marine organisms.
- Equipment (e.g., moorings, anchors, chains) will be placed in soft sediment only, and selection of anchor locations will take into consideration damage that could occur from the anchor chain if the vessel swings due to currents or tides. If practicable, all intertidal work will be conducted at low and/or slack tides..

- Where applicable, divers will check anchor deployment and shift anchors to another location, if needed, to ensure that they are not a threat to corals or seagrass.
- While in water depths where the draft of the vessel provides less than a 2 m (6 ft) clearance, all vessels should operate at "no wake/idle" speeds at all times and should preferentially follow deep-water routes (e.g., marked channels) whenever possible. If operating in shallow water, all vessels should have a crewmember serve as a dedicated lookout to assist the pilot with avoiding large coral colonies and other benthic organisms that might extend up from the bottom.
- Work platforms and barges will be oriented to minimize shading to the most reasonable extent practicable. The Navy will attempt to position vessels so that the path of the sun will cross perpendicular to the length of the platform to reduce the duration of shading, and thereby allowing light into areas under barges and work platforms.
- A large swell, inclement weather, and typhoon contingency plan has been developed that includes specific conditions (Guam Condition Level III) that will require work to stop, and the removal or securing of equipment 48 hours ahead of any potential storms.
- While in water depths where the draft of the vessel provides less than a 2-m clearance, all vessels will operate at "no wake/idle" speeds at all times and should preferentially follow deep-water routes (e.g., marked channels) whenever possible. If operating in shallow water, all vessels should employ a dedicated "lookout" to assist the pilot with avoiding coral colonies and other benthic organisms that might extend up from the bottom.
- Divers and any other in-water workers will avoid trampling, ripping, and other harm of areas with healthy seagrass or other corals and benthic organisms.

Increase in Sedimentation and/or Turbidity

- Full-length silt curtains will be installed immediately adjacent to and around the area of active work within outer Apra Harbor (i.e., the inner wall of Glass Breakwater and Sumay Marina), at all times to isolate and contain the in-water work area and prevent turbid water from flowing outside the Project area. Silt curtains will completely enclose the area of active inner Breakwater repair actions to the maximum extent practicable to reduce effects on water quality. Silt curtains will not be used along the outer wall of Glass Breakwater due to rough environmental conditions that do not allow for their safe and effective deployment (Table 3).
- If a visible plume is observed outside the silt curtains, construction activity will be suspended and evaluated, and corrective measures will be taken.
- Coral translocation and all in-water activities will cease during the primary Guam coral spawning events each year for hard (scleractinian) corals. The coral spawning period is estimated to be 21 days total, including 8 days prior to the full moon in July and 14 days after for most corals.
- A Storm Water Pollution Prevention Plan (SWPPP) will be developed by the construction contractor once selected to reduce on-site erosion and off-site sedimentation.
- Vessels will follow established transportation channels whenever practicable.

Increase in Contaminants

- All Project-related debris and other waste will be contained and will not enter or remain in the marine environment.
- An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout construction of the proposed action.
- Oil or other hazardous substances will be prevented from seeping into the ground or entering any drainage inlet or local bodies of water. A hydrophobic boom will be used inside the silt curtains for any potential surface oil spills.
- 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.
- Fueling of proposed action-related vehicles and equipment will take place at least 46 m (150 ft.) 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.
- Lubricants and excess oil will be disposed of in accordance with applicable federal, territory, and local regulations, laws, ordinances, and permits.
- Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.
- All proposed action-related materials and equipment placed in the water will be free of pollutants.
- 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.
- The Navy will ensure that dive activities avoid exposing corals directly or indirectly to toxicopathological agents (which includes sunscreens with harmful chemicals like oxybenzone, avobenzone, and oxycrylene).

Increase in Invasive Species

- The portions of the equipment that enter the water will be clean and free of pollutants, including AIS. All vessels and equipment (including barges, dry docks, and dredging equipment) will be free from fouling organisms before entering Guam's coastal waters (3 nm offshore).
- Vessels will be free of AIS in accordance with Guam Executive Order 91-37 and will follow proper Navy ballast water procedures stated in the OPNAV 5090.1. There will be no discharge of oils, fuels, or chemicals to surface waters; fuel hoses, transfer valves, etc. will be checked regularly for leaks.

Navy-proposed Minimization

The Navy is proposing to translocate 902 coral colonies including 84 *Acropora globiceps* and another 844 colonies from other species which fall within the preferred size, morphology, and health requirements. The corals identified for translocation include:

- All *Leptastrea purpurea, Pavona cactus, Pectinia paeonia, Astreopora spp.*, and *Porites spp.* massive colonies that are 8 cm or greater, healthy, and accessible
- All *Pachyseris speciosa, Porites cylindrical, Stylocoeniella armata, Galaxea spp, Lobophyllia spp.*, and *Pavona varians spp. Pocillopora acuta, Fungia spp, and Herpolitha spp.* of any size, that are healthy, and accessible

The corals identified as inappropriate for translocation include:

- All corals that are undergoing bleaching, are stressed/diseased, have encrusting or boring sponge cover, or are otherwise unhealthy
- All flat-encrusting growth forms
- All coral colonies from the *Porites rus* complex (due to challenges associated with previous mitigation efforts within Apra Harbor)

The coral translocation site has not yet been identified. The Navy plans to finalize a translocation site and develop comprehensive habitat management and monitoring protocols as part of the pending coral translocation plan.

NMFS considers the translocation of corals a minimization measure because the corals that survive translocation are not unavoidably lost and do not require direct offset. Based on the previous performance of similar outplanting efforts within Apra Harbor, the Navy expects a minimum of 540 coral colonies (60%) to survive the translocation effort.

Navy-proposed Offset

The Navy worked with NMFS through early coordination, and leveraged previous mitigation efforts in Apra Harbor (NMFS 2019a, 2019b), to generate parameters (e.g. expected injury, service levels, discount rate, and years to recover) in development of a Habitat Equivalency Analysis (HEA). The HEA model is designed to quantify the interim loss of ecosystem services and function associated with the adverse effects of this proposed action, and developed a quantifiable mitigation strategy focusing on EFH area replacement. The Navy built in several conservative assumptions into the HEA parameters to account for ecosystem service levels and discount rates, resulting in an estimated replacement habitat requirement of 321,723 ft^2 from the breakwater construction, 7.5 ft^2 from the Sumay marina replacement, and 191 ft^2 from the Sumay revetment repairs (total 315,461 ft^2).

The Navy has proposed to offset the majority of the 315,461 ft^2 of lost EFH through out-of-kind and off-site mitigation by restoring and improving seagrass habitat at Dadi Beach on Guam. The

Navy has also proposed a pilot study to transplant CCA starters to enhance the potential for coral settlement of the shallow-water habitats adjacent to the breakwater.

The seagrass restoration plan and the CCA transplantation pilot study, which will include details regarding seagrass and algae sources, grow out processes, transplantation methods, monitoring protocols, and metrics to identify successful recovery, will be developed after the Navy has identified an expert contractor to manage each project.

NMFS Concerns

NMFS is concerned that the proposed activity will cause physical damage to EFH resources, including the unavoidable loss of corals and non-coral invertebrates, turbidity and sedimentation leading to degradation of coral condition, and the potential introduction of invasive species. NMFS is also concerned that the proposed coral translocation, seagrass restoration, and CCA transplantation projects could fail to meet the minimization and offset levels required to compensate for the ecosystem services and functions lost due to this action. These concerns will result in the permanent loss of corals, non-coral invertebrates, and their ecosystem services and function.

The Navy reduced the overall construction footprint to avoid approximately 584,244 ft2 of direct impacts along the Outer Breakwater, but the activities associated with this action will still directly impact an estimated 511,878 ft2 of EFH, predominantly associated with the deployment of 20,100 CAUs along the breakwater, each weighing as much as 50 tons.

Minimization measures are expected to protect approximately 902 coral colonies proposed for translocation, leaving the majority of the coral colonies, which fail to meet the proposed translocation criteria, unavoidably lost. The Navy should plan to translocate all corals that meet the proposed translocation criteria and/or that the translocation team is confident in moving, even if the final number of colonies exceeds the estimated 902 (i.e., the Navy should not stop translocating corals just because they have reached 902 colonies and they should expand the criteria once they have a better understanding of the capabilities of their coral translocation team).

As much as 1,000,000 tons of material will be transported, fabricated, staged, and deployed as part of this action, resulting in multiple vectors for AIS introductions during each phase of this project. The Navy has opted not to include some of the foundational reef building coral communities (e.g., the Porites rus complex) within the translocation plan due to the complexities of working with those species. The overall robustness of Porites spp. is proving to be important for the future of reefs in the Marianas and additional steps should be taken to protect these coral colonies even if they are not being fully translocated.

The mitigation projects proposed as minimization and offset have the potential to adversely affect EFH through vessel (e.g. physical damage and chemical contamination risks) and diver interactions

(e.g. physical damage, introduction of toxicopathological agents, and invasive species risks) associated with the surveying, coral translocation, seagrass and algae transplanting, and monitoring activities.

The Navy has put forward a realistic mitigation strategy to offset for lost EFH, which has the potential to increase overall habitat area over time if the seagrass restoration at Dadi Beach is successful. If the proposed seagrass restoration fails to improve the habitat quality with quantifiable results at Dadi Beach, effective offset of EFH will have failed. The HEA has proven to be an effective tool in developing the theoretical offset, but should be supported by long-term monitoring and adaptive management to ensure that the expected level of recovery occurs.

EFH Determination

NMFS agrees with the Navy's determination that the proposed action will adversely affect EFH and result in unavoidable loss. Furthermore, NMFS determines that even with the avoidance, minimization, and offset measures proposed by the Navy, the proposed action could still have long-term to permanent adverse effects to EFH associated with the implementation of the proposed mitigation strategies, unexpectedly low survivorship for translocated corals, or resulting from complications that may delay the successful transplantation of CCA starters at the breakwater or the success of seagrass restoration at Dadi beach.

Conservation Recommendations

NMFS provides the following EFH conservation recommendations in accordance with the EFH provisions of the Magnuson-Stevens Act (305(b)(4)(A)) to help the Navy ensure that adverse effects to EFH including corals are avoided, minimized, offset for, or otherwise mitigated.

> *Conservation Recommendation #1:* The Navy should develop conservation specific evaluation criteria (i.e., risks to benthic organisms from spills, increased turbidity, direct physical impacts, corridor interactions, etc.) for all ten of the proposed fabrication and staging locations and only use those locations that pose the smallest risk.
>
> *Conservation Recommendation #2:* To ensure that AIS are not introduced at any stage of the project (e.g., shipping of materials, boating, deployment of CAU's, etc.), the Navy should coordinate with and follow the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP). The JRM INRMP contains comprehensive objectives and actions that define and implement invasive species management, which begins through prevention, then addresses early detection and monitoring, and finally control and eradication.
>
> *Conservation Recommendation #3:* To minimize the impact of diver operations, the Navy should familiarize divers, dive support, and vessel crew with underwater terrain features

including shallow areas where there is a potential for vessel hull, propellers and divers to be in contact with the shallow reef areas such as near the trench walls.

Conservation Recommendation #4: To minimize the risk of additional coral tissue loss, disease, or predation, the Navy should close injuries to any large *Porites sp.* corals (e.g., damage sustained to *Porites rus* during anchoring, staging, or deployment activities) with coral safe epoxy or clay.

Conservation Recommendation #5: The Navy should not start any in-water construction activities until NMFS has approved the final mitigation plans (e.g., coral translocation plan, seagrass restoration plan, and CCA transplantation plan). NMFS should be given the opportunity to advise and/or provide additional CRs specific to the mitigation plans, including but not limited to recommendations related to seagrass and CCA collection, transplantation/translocation methods, monitoring, offset evaluation sufficiency (i.e., survivorship and/or demonstrated ecosystem recovery), and comprehensive impact avoidance measures (i.e., BMPs) that address all phases of the proposed restoration action.

Conservation Recommendation #6: Coral translocation, seagrass and algae transplantation, and marine monitoring all require a high level of expertise and should only be performed by experts (i.e., led by a PhD or team lead with similar experience) using well documented and replicable methods (i.e., following guidance from recent literature and focusing on work previously performed within the Pacific region). Any planned deviation from the minimization or offset approach outlined within the EFHA or changes to the future mitigation planning documents should be socialized with NMFS before work begins.

Conservation Recommendation #7: The Navy should attempt to translocate and document all corals that meet the translocation criteria defined within the EFHA. That is likely to mean that coral colonies beyond the estimated 902 colonies may be identified.

Conservation Recommendation #8: To ensure that the translocation of coral colonies is meeting early survivorship targets, the Navy should work with NMFS to develop appropriate monitoring schedules and protocols and provide a monitoring report to NMFS after each monitoring event. Each report should clearly document the performance between coral morphology types, colony sizes, and translocation location (i.e. if the corals are not all translocated to the same location). If survivorship of translocated corals does not meet the 60% survivorship target (as compared to control sites) at the end of the survey period, the Navy should coordinate with NMFS to discuss the potential need for additional offset.

Conservation Recommendation #9: The Navy needs to decide whether the development of a coral nursery is going to be part of the mitigation package for this action and if/how the development of a nursery will be factored into reaching the offset requirements.

Development of a new coral nursery will also require an additional consultation with NMFS and coordination with the U.S. Army Corps of Engineers as it will require the installation of new structures within the navigable waters of the United States. Methods/procedures for tracking the amount of coral that comes into the nursery and the amount of coral that is outplanted from the nursery to the environment will need to be developed and recorded. The goal will be to track and report when the nursery's output exceeds the input from received corals. Corals that are growing in the nursery are not creditable until they are outplanted and survive for a period of time in the natural environment.

Conservation Recommendation #10: To ensure that the proposed offset from the HEA is effective, the Navy should develop a plan for implementation that would quantify seagrass restoration success at Dadi Beach. This data could then be integrated into a follow-up modelling effort to determine if recovery is matching rates and targets used within the original HEA, and that ecosystem function is being effectively offset. To support this effort, the Navy should consider coordinating this monitoring plan with the actions listed within the 2024 JRM INRMP, Marine Habitat Management section. If the 2024 JRM INMRP is not prescriptive enough to meet the needs of this specific consultation, then the Navy should consider including Dadi Beach seagrass surveys within the next update to the JRM INRMP.

Conservation Recommendation #11: Should the proposed mitigation strategies fall short of conservation targets at any time (i.e., whether during initial execution, after early monitoring, or following a future HEA analysis), the Navy should coordinate with NMFS and develop a contingency plan/project to ensure all lost ecosystem services and functions are accounted for before mitigation is considered final.

Conclusion

Upon review of the consultation documents for the proposed repairs at Glass Breakwater, Sumay marina, and the Sumay revetment in Apra Harbor, Guam, NMFS determines that there will be unavoidable loss and substantial adverse effects to sensitive and hard-to-replace EFH. NMFS expects that many adverse effects to EFH from these project activities can be avoided and/or minimized if all of the proposed BMPs and mitigation strategies are fully implemented, and coral translocation achieves the targeted success levels. Additionally, NMFS believes that full offset can be realized as long as the Navy follows the EFH conservation recommendations provided by NMFS and continues to coordinate with NMFS throughout the development of the coral translocation, seagrass restoration, and CCA translocation mitigation plans. NMFS provides the EFH conservation recommendations as described above to help the Navy ensure that adverse effects to EFH including coral reef resources are avoided, minimized, offset for, or otherwise mitigated.

Please be advised that regulations (Section 305(b)(4)(B)) to implement the EFH provisions of the Magnuson-Stevens Act requires that federal agencies provide a written response to this letter within

30 days of its receipt, but a preliminary response is acceptable if more time is needed. The final response must include a description of measures to be required or actions to be taken to address the CRs. If either CR cannot be adopted, an explanation of the reason for not implementing it with scientific support for the rationale must be provided at least 10 days prior to final approval of the activities. Please don't hesitate to contact Steve McKagan at [redacted] and/or [redacted] should you have any questions, comments, or require additional technical assistance require additional technical assistance.

Sincerely,

Gerry Davis
Assistant Regional Administrator
Habitat Conservation Division

CC by email:

Edward Moon - [redacted]
Kevin Lino - [redacted]
Michelle Bejder [redacted]
Anjelica Perez - [redacted]
Jesse Cruz - [redacted]
Kaitlyn Jacobs [redacted]
Maria Santos [redacted]
Dawn Golden [redacted]
David Delaney - [redacted]

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MSA EFH: NBG Consultation Response Letter to NMFS

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
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Gerry Davis
Assistant Regional Administrator
Habitat Conservation Division
Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Blvd., Building 176
Honolulu, HI 96818

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

In accordance with the Essential Fish Habitat (EFH) provisions of the *Magnuson-Stevens Fishery Conservation and Management Act* (MSA; 6 U.S.C. § 1801 et seq.), the Navy is providing this letter as a response to the National Marine Fisheries Service (NMFS) conservation recommendations letter dated April 30, 2025. The EFH consultation is for proposed repairs to the Admiral Glass Breakwater and Sumay Marina in Outer Apra Harbor, U.S. Naval Base Guam. Many of the effects from the project can be avoided and minimized through the implementation of the Best Management Practices (BMPs) that were described in the Navy's EFH assessment that was submitted to NMFS on March 28, 2025. The Navy understands that conservation recommendations from NMFS are intended to enhance, or to be in addition to BMPs, and the Navy provides its responses to the conservation recommendations below.

NMFS Conservation Recommendation #1: The Navy should develop conservation specific evaluation criteria (i.e., risks to benthic organisms from spills, increased turbidity, direct physical impacts, corridor interactions, etc.) for all ten of the proposed fabrication and staging locations and only use those locations that pose the smallest risk.

Navy Response to Conservation Recommendation #1:

The Navy agrees with this recommendation and will use only the fabrication and staging locations that pose the smallest risk to benthic organisms from spills, increased turbidity, direct physical impacts and corridor interactions. The conservation specific criteria will be detailed in the contractor's environmental protection submittals (i.e., Environmental Protection Plan, Stormwater Pollution Prevention Plan, Spill Prevention Control and Countermeasures Plan, etc.).

NMFS Conservation Recommendation #2: To ensure that AIS are not introduced at any stage of the project (e.g., shipping of materials, boating, deployment of CAU's, etc.), the Navy should coordinate with and follow the Joint Region Marianas (JRM) Integrated Natural Resources Management Plan (INRMP). The JRM INRMP contains comprehensive objectives and actions

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that define and implement invasive species management, which begins through prevention, then addresses early detection and monitoring, and finally control and eradication.

Navy Response to Conservation Recommendation #2:

The Navy agrees with this recommendation and will follow the JRM INRMP as it relates to avoiding any Aquatic Invasive Species (AIS) introductions and BMPs. In Section 5.4.2.2, the INRMP outlines specific recommendations and projects identified to manage invasive species risks, including strategies to implement applicable measures in the U.S. DOD Biosecurity Recommendations, Volume I, Attachment M, which would avoid and minimize new incursions or transfer of AIS. The Navy intends to comply with all that are applicable, as well as the related BMPs included in the consultation document.

NMFS Conservation Recommendation #3: To minimize the impact of diver operations, the Navy should familiarize divers, dive support, and vessel crew with underwater terrain features including shallow areas where there is a potential for vessel hull, propellers and divers to be in contact with the shallow reef areas such as near the trench walls.

Navy Response to Conservation Recommendation #3:

The Navy agrees with this recommendation and will affirm that all divers and vessel crew are aware of any shallow reef or areas with the potential for contact, as stated in the consultation BMPs.

NMFS Conservation Recommendation #4: To minimize the risk of additional coral tissue loss, disease, or predation, the Navy should close injuries to any large Porites sp. corals (e.g., damage sustained to Porites rus during anchoring, staging, or deployment activities) with coral safe epoxy or clay.

Navy Response to Conservation Recommendation #4:

The Navy agrees with this recommendation and does not anticipate additional coral tissue loss, disease, or predation via damage sustained to *Porites rus* during anchoring, staging, or deployment activities, as there will be no anchoring or staging of material on corals as listed in the BMPs G-1 in section 2.5.2 of the consultation document. The Navy understands that any damage that were to occur to *Porites rus* outside the impacts analysis of this consultation would require additional consultation and mitigation. The Navy will recommend use of coral safe epoxy or clay within the coral translocation plan for divers to utilize during the coral translocation if damage were to occur in that process.

NMFS Conservation Recommendation #5: The Navy should not start any in-water construction activities until NMFS has approved the final mitigation plans (e.g., coral translocation plan, seagrass restoration plan, and CCA transplantation plan). NMFS should be given the opportunity to advise and/or provide additional CRs specific to the mitigation plans, including but not limited to recommendations related to seagrass and CCA collection, transplantation/translocation

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

methods, monitoring, offset evaluation sufficiency (i.e., survivorship and/or demonstrated ecosystem recovery), and comprehensive impact avoidance measures (i.e., BMPs) that address all phases of the proposed restoration action.

Navy Response to Conservation Recommendation #5:

The Navy agrees to this recommendation and will provide NMFS time to comment and advise on the final mitigation plans. However, the coral translocation must occur before in-water work is scheduled to begin in November 2025. The Navy will provide NMFS a draft of the coral translocation plan within a reasonable time period for NMFS review prior to that date, but the Navy may need to proceed with translocation in order to ensure corals are not in the footprint before construction begins. The Navy agrees no in-water mitigation work for sea-grass restoration and CCA transplantation will occur until the final mitigation plans are concurred upon.

NMFS Conservation Recommendation #6: Coral translocation, seagrass and algae transplantation, and marine monitoring all require a high level of expertise and should only be performed by experts (i.e., led by a PhD or team lead with similar experience) using well documented and replicable methods (i.e., following guidance from recent literature and focusing on work previously performed within the Pacific region). Any planned deviation from the minimization or offset approach outlined within the EFHA or changes to the future mitigation planning documents should be socialized with NMFS before work begins.

Navy Response to Conservation Recommendation #6:

The Navy agrees with this recommendation that mitigation projects require specific skills and experience and should be performed only by experts. Qualifications for each phase of the mitigation will be outlined in the scope of work to ensure that only skilled and competent teams will be chosen to conduct minimization and offset activities. In addition, the final mitigation plan(s) will be informed by the best available science. The Navy agrees to keep NMFS appraised of any changes to the minimization and/or offset approach.

NMFS Conservation Recommendation #7: The Navy should attempt to translocate and document all corals that meet the translocation criteria defined within the EFHA. That is likely to mean that coral colonies beyond the estimated 902 colonies may be identified.

Navy Response to Conservation Recommendation #7:

The Navy agrees with this recommendation. As performed with other Navy coral translocation projects in Apra Harbor, all coral that meet the translocation criteria will be moved; in addition to other qualifying colonies that may be identified within the project footprint during the translocation process.

NMFS Conservation Recommendation #8: To ensure that the translocation of coral colonies is meeting early survivorship targets, the Navy should work with NMFS to develop appropriate

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

monitoring schedules and protocols and provide a monitoring report to NMFS after each monitoring event. Each report should clearly document the performance between coral morphology types, colony sizes, and translocation location (i.e. if the corals are not all translocated to the same location). If survivorship of translocated corals does not meet the 60% survivorship target (as compared to control sites) at the end of the survey period, the Navy should coordinate with NMFS to discuss the potential need for additional offset.

Navy Response to Conservation Recommendation #8:

The Navy agrees with this recommendation and will ensure that the monitoring schedule will mirror previous Navy coral translocation projects, and that each monitoring event will clearly document the performance of corals with differing morphologies, sizes, and possible locations. The Navy agrees to coordinate with NMFS if the rate of survival does not meet the 60% survivorship target after the final monitoring period.

NMFS Conservation Recommendation #9: The Navy needs to decide whether the development of a coral nursery is going to be part of the mitigation package for this action and if/how the development of a nursery will be factored into reaching the offset requirements. Development of a new coral nursery will also require an additional consultation with NMFS and coordination with the U.S. Army Corps of Engineers as it will require the installation of new structures within the navigable waters of the United States. Methods/procedures for tracking the amount of coral that comes into the nursery and the amount of coral that is outplanted from the nursery to the environment will need to be developed and recorded. The goal will be to track and report when the nursery's output exceeds the input from received corals. Corals that are growing in the nursery are not creditable until they are outplanted and survive for a period of time in the natural environment.

Navy Response to Conservation Recommendation #9:

The Navy agrees with this recommendation and while the Navy is still interested in developing a coral nursery to utilize for mitigation and conservation purposes, unfortunately it will not be feasible at this time. The Navy will continue to consider this option for future projects, as well as the possibility of collaborating with and/or supporting a future coral nursery with INRMP partners/stakeholders.

NMFS Conservation Recommendation #10: To ensure that the proposed offset from the HEA is effective, the Navy should develop a plan for implementation that would quantify seagrass restoration success at Dadi Beach. This data could then be integrated into a follow-up modelling effort to determine if recovery is matching rates and targets used within the original HEA, and that ecosystem function is being effectively offset. To support this effort, the Navy should consider coordinating this monitoring plan with the actions listed within the 2024 JRM INRMP, Marine Habitat Management section. If the 2024 JRM INMRP is not prescriptive enough to meet the needs of this specific consultation, then the Navy should consider including Dadi Beach seagrass surveys within the next update to the JRM INRMP.

Subject: CONSULTATION ON THE EFFECTS TO ESSENTIAL FISH HABITAT FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Navy Response to Conservation Recommendation #10:

The Navy agrees with this recommendation that seagrass restoration success at Dadi Beach will be accurately quantified. This will allow the Navy to measure success and completion, compare to the original HEA values, and better utilize the HEA tool for future mitigation projects.

The Navy agrees to consider adding actions such as: habitat mapping, fish assemblage data collection, mapping and characterization of the benthos, and collecting baseline data around the Dadi Beach seagrass restoration site to the final mitigation plan, and include outcomes in affiliated monitoring reports, as outlined by the 2024 JRM INRMP.

NMFS Conservation Recommendation #11: Should the proposed mitigation strategies fall short of conservation targets at any time (i.e., whether during initial execution, after early monitoring, or following a future HEA analysis), the Navy should coordinate with NMFS and develop a contingency plan/project to ensure all lost ecosystem services and functions are accounted for before mitigation is considered final.

Navy Response to Conservation Recommendation #11:

The Navy agrees to this recommendation and will coordinate with NMFS should the proposed mitigation strategies fall short of Navy estimates and expectations.

The Navy appreciates NMFS's effort and careful deliberation invested in evaluating the proposed actions and providing these EFH conservation recommendations. Should you have any questions or concerns, please contact Kaitlyn Jacobs at NAVFAC Pacific at [redacted] or [redacted]

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By direction of the Commanding Officer

5

** The NMFS acknowledged Navy's responses to the EFH recommended conservation measures in the Biological Opinion (BO; PIRO-2025-00832) was received from NMFS on July 28, 2025.

ESA S7: NBG Consultation Initiation Letter to NMFS

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/ 044
March 26, 2025

Dawn Golden
Assistant Regional Administrator
Protected Resources Division
Pacific Islands Regional Office
National Marine Fisheries Service
1845 Wasp Blvd., Bldg. 176
Honolulu, HI 96818

Subject: REQUEST FOR FORMAL CONSULTATION ON THE EFFECTS FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Dear Ms. Golden,

Pursuant to section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended (16 USC§ 153 et seq.), the U.S. Navy requests formal consultation with the National Marine Fisheries Service regarding the proposed construction of waterfront structures that were severely damaged by Typhoon Mawar at Outer Apra Harbor, Guam. As described in the enclosed consultation document, the Proposed Action may affect but is not likely to adversely affect the following ESA-listed species: the threatened green sea turtle (*Chelonia mydas*), the endangered hawksbill sea turtle (*Eretmochelys imbricata*), and the threatened scalloped hammerhead shark (*Sphyrna lewini*). The Proposed Action may affect and is likely to adversely affect the endangered coral (*Acropora globiceps).* We request your concurrence with our "not likely to adversely affect" determinations (*C. mydas, E. imbricate, S. lewini)* and "likely to adversely affect" determination (*A. globiceps)* and hereby request formal consultation under Section 7 of the ESA.

The Navy proposes to repair Sumay Marina, Sumay Point, and the Admiral Glass Breakwater. The Proposed Action includes the installation and removal of piles at the marina, along with the transport and installation of concrete armor units at the breakwater. The Proposed Action will impact seafloor habitat, benthic organisms colonizing current breakwater boulders and fouling organism colonizing piles at Sumay Marina. The Project is anticipated to begin in September 2025 and the installation will involve some vessel and barge traffic within the harbor. The in-water actions will be undertaken in daylight hours only and will require approximately 5 years to complete.

Potential impacts to ESA-listed species may occur from exposure to the following stressors: disturbance from human activity and physical contact; elevated underwater noise levels; increased suspended sediments; vessel collisions; waste and discharge and entanglement.

Subject: REQUEST FOR FORMAL CONSULTATION ON THE EFFECTS FROM THE SPECIAL PROJECT TYPHOON MAWAR APRA HARBOR WATERFRONT REPAIRS, OUTER APRA HARBOR, U.S. NAVAL BASE GUAM

Based on the best available data, environmental impact analysis and the implementation of Best Management Practices described in the enclosure, the Navy determined that these potential impacts are discountable or insignificant to vertebrate ESA-listed species and likely to adversely affect the *Acropora* coral. The Navy requests your concurrence with our determination that the Proposed Action may affect but is not likely to adversely affect the green sea turtle, hawksbill sea turtle and scalloped hammerhead shark, and likely to adversely affect the endangered *A. globiceps*.

Thank you for consideration of our request and we look forward to your review and concurrence. Should you have any questions or concerns, please contact Kaitlyn Jacobs at NAVFAC Pacific at [redacted]

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By direction of the Commanding Officer

Enclosure: 1. Endangered Species Biological Assessment: Consultation for the Apra Harbor Waterfront Repairs, Apra Harbor, U.S. Naval Base Guam

ESA S7: NMFS Consultation Initiation Response Letter to Navy

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
[redacted]

April 15, 2025

Edward Moon
U.S. Naval Base Guam
PSC 455 Box 152
FPO AP 96540-1000

Re: Initiation of formal consultation under 7(a)(2) of the Endangered Species Act for the Glass Breakwater and Apra Waterfront Repairs Project at Apra Harbor, Guam.

Dear Mr. Moon:

Thank you for your March 26, 2025 letter requesting initiation of formal consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*) for the Navy's Special Project Typhoon Mawar Apra Harbor Waterfront Repairs project. We received an electronic copy of your letter in an email on March 27, 2025. The letter and enclosed biological assessment includes the necessary information to evaluate the proposed action and, per your request, acknowledge the initiation of formal consultation as of March 27, 2025.

Section 7 of the ESA allows the Services up to 90 calendar days to conclude consultation; by regulation, we have an additional 45 calendar days to prepare our Biological Opinion (unless we mutually agree to an extension). Therefore, we expect to provide our biological opinion to you not later than August 10, 2025 (135 days from initiation of consultation).

As a reminder, the ESA requires that after initiation of formal consultation, the Action Agency may not make any irreversible or irretrievable commitment of resources that would preclude the formulation or implementation of any reasonable and prudent alternatives that would avoid violating section 7(a)(2) (50 CFR 402.09). This prohibition is in force during the consultation process and continues until the requirements of section 7(a)(2) are met.

If you have any questions or concerns about this letter, please contact Joel Moribe, at [redacted] or Ron Dean [redacted]

Sincerely,

DEAN.RONNIE.J.1399531868 Digitally signed by DEAN.RONNIE.J.1399531868 Date: 2025.04.15 09:38:22 -10'00'

Ron Dean
Chief, Interagency Cooperation Branch
Protected Resources Division

Cc: [redacted]
NMFS File No.: PIRO-2025-00832
PIRO Reference No.: X-PI-25-2460-DG

ESA S7: NMFS Biological Opinion

NOAA NMFS Biological and Conference Opinion
(PIRO-2025-00832)
July 25, 2025

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

Action Agency:	U.S. Naval Facilities Engineering Command, Pacific. U.S. Naval Base Guam
Federal Action:	Glass Breakwater and Apra Waterfront Repairs Project
Consultation Conducted by:	National Marine Fisheries Service, Pacific Islands Region, Protected Resources Division
NMFS File No. (ECO):	PIRO-2025-00832
PIRO Reference No.:	I-PI-25-2460-DG
Approved By:	MALLOY.SARAH.JOAN.1262526743 Digitally signed by MALLOY.SARAH.JOAN.1262526743 Date: 2025.07.25 13:47:41 -10'00' Sarah Malloy Regional Administrator, Pacific Islands Region
Date Issued:	7/25/25

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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)) states that each federal agency shall insure that any action it authorizes, funds, or carries 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. The ESA requires federal action agencies to consult with National Marine Fisheries Service (NMFS) when the action may affect a listed species or its designated critical habitat under our jurisdiction (50 CFR 402.14(a)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, we provide a biological opinion (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 reasonably certain to occur, 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.

Under section 7(a)(4) of the ESA, each Federal agency shall confer with the Secretary on any agency action that is likely to jeopardize the continued existence of any species proposed to be listed or result in the destruction or adverse modification of critical habitat proposed to be designated for such species. While consultations are required when the proposed action may affect listed species, a conference is required only when the proposed action is likely to jeopardize the continued existence of a proposed species or destroy or adversely modify proposed critical habitat. However, Federal action agencies may request a conference on any proposed action that may affect proposed species or proposed critical habitat (USFWS and NMFS 1998).

We prepared this opinion and ITS in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR part 402. We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). Following signature and finalization, this document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome].

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[1] Under the ESA, the term "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. We further define "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.

For the purpose of this consultation, we considered whether the breakwater repairs, pile replacement, wave attenuator placement, and the direct take and associated mariculture activities would jeopardize the continued existence of *Acropora globiceps*. We also evaluated the action's effects on the nearshore species: Central West Pacific green sea turtles, hawksbill sea turtles, Indo-West Pacific scalloped hammerhead sharks, and Central West Pacific green sea turtle critical habitat. We also considered all pelagic species noted in Table 7 that may be affected by vessel transiting that will occur as part of this proposed action.

1.1 Consultation History

Naval Base Guam is proposing to repair an existing breakwater bordering Apra Harbor and an armored shoreline at Sumay Point in Navy Base Guam (NBG). The purpose of the action is to repair the breakwater and shoreline to support the functioning naval harbor and commercial port within Apra Harbor. We previously consulted on "Phase 1" of the repairs, which patched critical areas within the Admiral Henry Glass Breakwater that needed immediate repair (PIRO-2024-02440; I-PI-25-2383-DG). Copies of this consultation are available at the Pacific Island Regional Office, Honolulu, Hawai'i, and the Environmental Consultation Organizer located here: https://appscloud.fisheries.noaa.gov/suite/sites/eco

On June 12, 2024, NMFS met with Naval Facilities Engineering Command Pacific and Naval Base Guam (collectively the Navy) to discuss their need to immediately repair portions of Glass Breakwater. The Navy informed us that they would not only need portions repaired but also a holistic re-establishment to the entire breakwater. The Navy proposed separate actions to meet the immediate need of the most damaged areas, and the larger repair which would need more information to develop a plan and design to stabilize the entire structure.

On August 21, 2024, the Navy sent a draft ESA/Essential Fish Habitat (EFH) Consultation to NMFS to review. We reviewed the documents and discussed with the Navy to clarify effect calls on species.

On September 19, 2024, NMFS met with the Navy and their contractors on site to observe the condition of the breakwater and the marine environment at the site.

On September 24, 2024, the Navy met with NMFS to discuss their proposed action and on September 27, 2024, NMFS received a written request for emergency informal section 7 consultation for their proposed breakwater repairs at critical sites.

On October 28, 2024, NMFS concurred with the Navy's effect determinations that the action was not likely to adversely affect Central West Pacific green sea turtle, hawksbill sea turtle, Indo-West Pacific scalloped hammerhead shark, and *A. globiceps* (PIRO-2024-02440; I-PI-25-2383-DG).

On February 7, 2025, the Navy shared a draft biological assessment (BA) for the 2nd phase of the project (the subject of this consultation) with us for review and met with us on February 27, 2025 to discuss what details were necessary in the BA to proceed. On March 7, 2025 the Navy requested us to review another draft BA, which we provided comments on March 14, 2025.

On March 27, 2025, the Navy submitted their BA, and a letter requesting formal consultation on this action. We subsequently initiated formal consultation on this date after reviewing the initiation packet for completeness.

On April 30, 2025, the concurrent NMFS EFH consultation was concluded and provided to the Navy. NMFS HCD agreed with the Navy's determination that the proposed action will adversely affect EFH and result in unavoidable loss. Furthermore, NMFS HCD determined that even with the avoidance, minimization, and offset measures proposed by the Navy, the proposed action could still have long-term to permanent adverse effects to EFH associated with the implementation of the proposed mitigation strategies, unexpectedly low survivorship for translocated corals, or resulting from complications that may delay the successful transplantation of crustose coralline algae starters at the breakwater or the success of seagrass restoration at Dadi beach. Eleven conservation recommendations were provided by NMFS HCD (NMFS 2025a) in accordance with the EFH provisions of the Magnuson-Stevens Act (305(b)(4)(A)) to help the Navy ensure that adverse effects to EFH (including corals) are avoided, minimized, offset for, or otherwise mitigated.

On May 28, 2025, the Navy informed NMFS they would accept all of NMFS HCD's conservation recommendations. However, the Navy also noted that "…while the Navy is still interested in developing a coral nursery to utilize for mitigation and conservation purposes, unfortunately it will not be feasible at this time. The Navy will continue to consider this option for future projects, as well as the possibility of collaborating with and/or supporting a future coral nursery with INRMP partners/stakeholders." (DON 2025c). Therefore, we expect corals will be staged in holding areas as identified in the coral translocation plan until such time they can be outplanted. We consider these alterations, modifications, and clarifications in the description of the Navy's proposed action, as appropriate. This consultation was not paused to do so.

1.2 Proposed Federal Action

Under the ESA (50 CFR 402.02), the term "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas (see 50 CFR 402.02).

The consulting agency for this proposal is NMFS' Pacific Islands Regional Office's (PIRO) Protected Resources Division (PRD), Intergovernmental Cooperation Branch (ICB). This document represents NMFS' final biological opinion on the effects of the proposed action on species listed in Table 7. This biological opinion has been prepared in accordance with the requirements of section 7 of the ESA, the implementing regulations (50 CFR 402), agency policy, and guidance. It is based on information contained in the Navy's BA (DON 2025a), NMFS and FWS recovery plans and status reviews for sea turtles (NMFS and FWS 1998a, 1998b, 2007a, 2007b, 2013a, 2013b, 2015; Seminoff et al. 2015), corals (Brainard et al. 2011; NMFS 2021, 2023c), and scalloped hammerhead shark (NMFS 2020a), and other sources of information as cited herein.

The BA, survey reports, and information requests and responses, provide important background information about the action that we considered in this biological opinion as the best available scientific information. It provided the description of the action and most of the information required to initiate section 7 consultation.

Glass Breakwater Activities

The Navy is proposing to repair an existing rock levee on the northwest end of Apra Harbor known as the Glass Breakwater within NBG. The repair of the breakwater will occur by excavating and resetting the existing toe and damaged core sections as depicted in Figure 1.

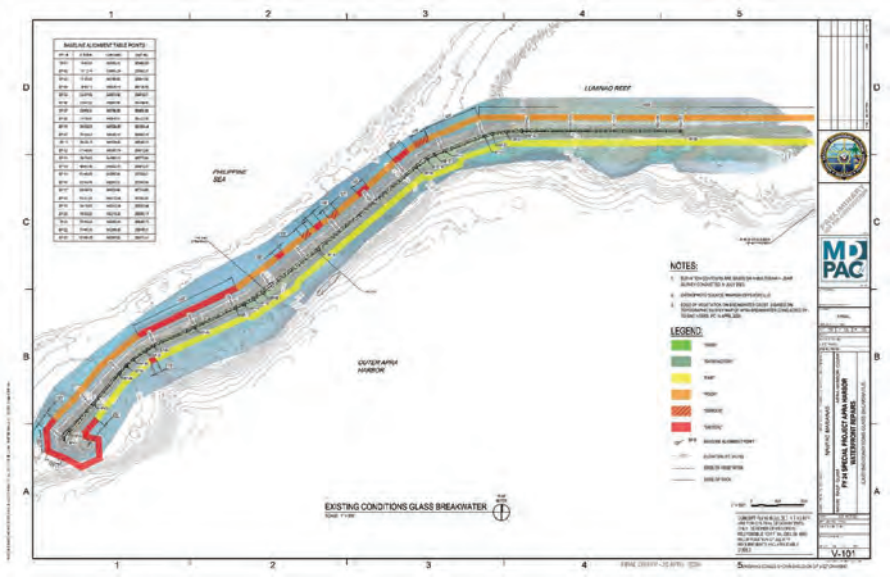

Figure 1. Areas of Glass Breakwater that need repair (red and orange sections; DON 2025a).

The harbor channel provides access for civilian vessels and the Government of Guam's Port Authority, which is in northeastern Outer Apra Harbor. The repairs also include revetment maintenance, replacement of dock piles and installation of a wave attenuator within Sumay Point Marina facing Outer Apra Harbor, to the East of Gab Gab beach within Inner Apra Harbor at NBG. The Navy's authority over Inner Apra Harbor restricts area use to military vessels, including naval and U.S. Coast Guard (USCG) vessels and those from allied nations. No recreational uses are permitted in Inner Apra Harbor. Fourteen wharves are located within Inner Apra Harbor to support the Navy and USCG vessels and operations (DON 2025a). As noted in the BA (DON 2025a), Sumay Cove supports both military and recreational activities by providing moorage for recreational boats, amphibious vessels, and supports other naval training activities. The proposed project is expected to take approximately four years to complete (Table 1).

Table 1. Construction activities with schedule start and duration for each phase as described in DON 2025a.

Project Activity	Anticipated Start	Anticipated Finish
CAU Fabrication	Aug 2025	Oct 2028
Breakwater Core Rebuild/Bedding Stone Placement	Sep 2025	Feb 2029
Aggregate and Stone Transit to Guam	Sep 2025	Dec 2028
CAU Placement	Sep 2025	Feb 2029
Pile Driving (Sumay)	Nov 2027	Mar 2028
Pile Driving (Apra Harbor)	Dec 2025	Jun 2026
Sumay Revetment Demolition	Aug 2027	Mar 2028
Sumay Revetment Bedding Fill	Mar 2028	May 2028

The Navy will place a bedding stone underlayer where necessary, and reshape the slope of the breakwater. Bedding stones will be created primarily by repositioning rocks from the existing breakwater when possible. The Navy will then complete the repairs by installing concrete armor units (CAU; Figure 2) along the toe, slope, and crest of the banked wall. The Navy estimates 20,100 CAU pieces will be placed along the entire length of the breakwater. Coarse aggregate will be shipped in from British Columbia, Canada and stone will be shipped in from South Korea. Both material deliveries will require only one trip each. Contractors will fabricate CAUs on-island using those materials and an admixute[2] to prevent leaching. The CAUs are acropodial-shaped concrete pieces weighing up to 50 tons (100,000 pounds) each. These interlock with each other to increase stability. CAUs will be stored at approved upland areas where they can cure prior to placement. The CAU fabrication may begin by the end of 2025 and will continue throughout the armor placement period as noted above.

Figure 2. Illustration of the acropodial shape of the CAU pieces (DON 2025a).

The Navy will use both land-based and barge-based cranes to conduct the repairs on Glass Breakwater. The Navy anticipates spud barges will be situated at one of four positions on the

[2] MasterPozzolith 200 and MasterGlemium 3030; See Appendix B of DON (2025a) for Material Safety Sheet Data Information.

harbor side of the wall. These barges will remain stationary until those sections of the breakwater are repaired (Figure 3; see also Figures 6 and 8 in DON 2025a). The Navy will install spud barges by pre-drilling holes and impact pile driving four 36-inch steel diameter mooring piles. Four additional 36-inch steel piles will be installed with a deck winch to stand as "legs" to support the platforms. Tug barges will travel up to three times per work day from wharves at NBG delivering CAUs to spud barges to stage them before placement. As sections of the breakwater are repaired, the contractor will deconstruct the spud barge and install them at a new location where it can store CAUs for construction of a particular section. In total, the 36-inch piles will be driven 16 times (four at a time) over the course of the entire project.

Figure 3. Spud barge (crane) locations shown by gray box inside each green area over the course of the project duration (DoN 2025a).

Sumay Cove Marina Activities

The Navy is also proposing to install a wave attenuator, and replace piles within the Sumay Cove Marina which were damaged by Typhoon Mawar in May of 2023 (Figure 4). This activity will require pile driving during all phases, beginning with trestle placement to support the construction.

Figure 4. Example piles (above) at Sumay Marina and the overall layout (below; DON 2025a).

To support construction in the marina, the Navy will install a trestle at the work site. The trestle will be supported by ten steel piles which would be driven with a vibratory hammer, and removed after completion of the action. The Navy proposes to remove the existing wave attenuator which is currently attached to a bulkhead and install a larger free-standing structure near the mouth of Sumay Cove. The structure will attenuate waves from damaging existing docks and structures and provide safe vessel operation and passage in the marina. The face of the attenuator would be constructed of steel or concrete panels that are attached above the water and extend below water with a gap at the bottom to allow for water flow. The panels will be supported by 32 piles.

The Navy will remove 16 deteriorated piles from the marina and replace them with twenty-four 16- to 20-inch concrete or steel piles. The Navy proposes to cut piles at the mudline for removal and install piles by pre-drilling sites with an auger to 20 feet below the mudline and finishing with an impact hammer.

The Navy will also stabilize a deteriorating north-facing shoreline at Sumay Point. The current revetment stabilizing this area has broken apart. Rocks that made up a slope rolled off into the subtidal water and now expose a steel sheetpile wall as shown in Figure 5. The Navy will remove the existing steel sheets and insert fill behind the steel sheets and existing rocks on the slope. The Navy proposes to reshape the slope, using soil and bedding material, then install rocks to shape the slope to stabilize the shoreline. The new revetment will no longer have a steel wall but a sloped profile lined with rocks. The Navy plans on using a combination of reused rocks from the existing site and from the breakwater, or from local sources if possible. The new revetment is designed to extend to the toe of the original wall within the tidal aquatic habitat.

Figure 5. Extent of in-water work at Sumay Point highlighted in red, and the steel structure to be removed circled in yellow.

Best Management Practices and Avoidance and Minimization Measures

The Navy proposes to implement best management practices (BMPs) to avoid or minimize exposure or the severity of effects to species or habitats. The BMPs also feature measures to manage water pollution, sedimentation, vessel transits, CAU placement, pile driving, work in the Inner Breakwater, and work associated with seagrass restoration activities. We incorporate BMPs noted by the Navy on pages 20 through 28 of the BA (DON 2025a) in the description of this proposed action. Additionally, we consider BMPs noted in the EFH Consultation noted on pages 18 through 24 of the EFH Assessment (EFHA; DON 2025b) and Avoidance and Minimization Measures (AMMs) noted on pages 48 through 51 which include actions to avoid,

minimize, and offset the proposed action that were not included, supplement, or reaffirm those noted in the ESA BA's description of the proposed action. These actions would not occur but for the action and are therefore considered herein. We summarize the most relevant BMPs and AMMs to avoid or minimize take below; monitoring for marine animals, and those related to proposed coral translocation activities.

1. The Contractor will comply with the following monitoring requirements:
    a. From the Breakwater, a competent observer will use binoculars to monitor the action area for ESA-listed sea turtles and scalloped hammerhead sharks during all in-water activities. If all work associated with a particular activity takes place above the High Tide Line (HTL), an observer will not be required for that element of the Proposed Action.
    b. Observations will begin each day, 30 minutes prior to the start of in-water activities:
        i. If no ESA-listed sea turtles or sharks are seen during the 30-minute pre-clearance survey period, in-water activities may commence.
        ii. If an ESA-listed sea turtle or shark is seen during the 30-minute pre-clearance survey period, the observer will notify the Project Manager immediately and monitor the animal. If the animal is within 46 m (50 yards [yds.]) of the in-water activity, animal behavior observations shall be recorded. Work will not begin until the animal departs the area voluntarily or after 30 minutes have passed since the last animal sighting.
        iii. During in-water activities, the observer will record environmental and action-related information, including but not limited to date, time, weather, action undertaken, status and effectiveness of BMPs, and ESA-listed marine species observed.
        iv. During in-water activities, all in-water work shall stop when an ESA-listed sea turtle or shark approaches or is sighted within 46 m (50 yds.) of the proposed in-water work. Work shall begin/resume after the animal has departed the area voluntarily or after 30 minutes have passed since the last animal sighting.
        v. If and when impact pile driving occurs with 36" or smaller steel pipes, a shut-down zone of 120 m (131 yds.) will be implemented. All in-water work shall stop when an ESA-listed sea turtle or shark approaches or is sighted within 120 m of the in-water work.
        vii. All sightings of ESA-listed marine species shall be recorded.
2. NBG will document and report monthly to NMFS on all interactions with ESA-listed sea turtles or sharks. NBG will also document any incidents where anchoring, CAU deployment, or other project activities has a direct impact to the benthic community, as reported by the contractors.
3. Vessel operators will reduce vessel speed to 10 knots or less when piloting vessels in the proximity of marine mammals and to 5 knots or less when piloting vessels in areas of known or suspected sea turtle activity. Operators will be particularly vigilant to watch for sea turtles at or near the surface in areas of known or suspected sea turtle activity.

4. Before any equipment or material enters the water, the Contractor will verify that no ESA-listed species are in the area where the equipment (e.g., silt curtain (to be used only where practicable), anchor(s), or materials) are expected to contact the seabed.
5. During in-water pile driving activities, the following measures will be applied to protect ESA-listed species:
    a. A soft start procedure would 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.
    b. If practicable, vibratory hammering and/or the use of a cap shall be used to minimize the impact of noise on marine species. When feasible, measures shall be implemented that attenuate the sound or minimize impacts to aquatic resources during pile installation.
6. All in-water activities, including coral translocation and mitigation work, will cease during the primary Guam coral spawning events each year for hard (order Scleractinia) corals.
7. A Storm Water Pollution Prevention Plan (SWPPP) will be developed by the Construction Contractor to reduce on-site erosion and sedimentation.
8. An oil spill contingency plan to control and clean spilled petroleum products and other toxic materials will be included in the SWPPP and implemented throughout construction of the project.
9. Turbidity and siltation from project-related work shall be minimized and contained through the appropriate use of erosion control practices, effective silt containment devices (to be used only where practicable), and curtailment of work during adverse weather and tidal/flow conditions.

Coral Translocation and Coral Nursery Activities

The Navy will develop a coral translocation plan as part of this proposed action that coordinates compatible coral reef restoration efforts and identifies appropriate and accessible corals that will be selected for translocation. The Navy's intent is to establish a coral translocation plan in cooperation with our office (i.e., NMFS PRD) through this consultation, with NMFS' Habitat Conservation Division (i.e., EFH practitioners), and other INRMP partners to relocate ESA-listed corals that would be unavoidably lost as appropriate. Although the DON (2025c) noted that may need to proceed with translocation in order to ensure corals are not in the foot print before construction begins.

This would include colonies of ESA-listed species and other corals expected to provide the greatest ecological benefit due to their larger size (greater than 10 centimeters), branching and mounding morphologies, and corals that have the greatest potential for survival. This would include as many *A. globiceps* that can be relocated. The translocation plan will include appropriate levels of maintenance and monitoring based on other important macroinvertebrates, including *Tridacna* clams will also be considered potential candidates for relocation within the

translocation plan. The Navy will select an appropriate site(s) outside of the current and future construction footprints along the outer and inner Breakwater as a receiving site(s) for selected coral translocation which meet translocation criteria and will be best served by remaining within a similar coastal environment.

The Navy originally presented information that they anticipated to work on the development and/or partnership of an in-water coral nursery to receive and propagate *A. globiceps* fragments with the intent to sustain those colonies for future out planting onto the project or adjacent area footprints post construction. However, as noted by DON (2025c), while the Navy agrees with NMFS conservation recommendation (#9) and is still interested in developing a coral nursery, it likely not feasible at this time. Selection of appropriate coral holding sites(s) will be dependent upon the coral translocation plan that identifies restoration sites that will receive regular maintenance and monitoring to improve the survivability of coral fragments. Once construction is complete, nursery corals will be out-planted in accordance with future construction maintenance of the Breakwater or in designated areas with optimal conditions for this listed species. These associated actions are therefore considered as part of this action. However, we also recognize that additional USACE permitting may be required to deploy nursery materials in the waters of the United States and authorization of those permits is at USACE's discretion, and outside of this action. Additional ESA consultation will be required for activities they authorize at a later time per 50 CFR 402.02 as they are not considered a cooperating agency herein. We do consider the sites used for staging and holding of coral fragments or colonies applicable to the action.

The proposed action will include the removal of approximately 70 *A. globiceps* colonies from the outer Breakwater, 13 from the inner Breakwater, and 0 from Sumay Point. In total, approximately 83 *A. globiceps* colonies will be permanently removed and/or temporarily affected due to placement of the CAU to repair the Breakwater. When the Navy considered how small or hard to find these particular corals can be, the Navy anticipates there to be at least 150 coral colonies in the project area.

If a coral is partially damaged, the colony may continue to survive and reproduce, and it is unlikely that all the *Acropora spp.* colonies in the area would reach complete mortality, thus allowing the species to recolonize post construction activities.

As noted by the Navy, the concurrent EFH consultation for this proposed action (NMFS 2025b) includes avoidance, minimization, and offset measures to mitigate habitat losses, including transplanting additional coral colonies. *A. globiceps*, will be considered a priority for translocation if they fit the translocation criteria.

The Navy defined the following criteria for the appropriate candidates for *A. globiceps* translocation (DON 2025a):

1. "Corals where at least one dimension is greater than 8 cm.
2. Colonies in good health (i.e., no signs of bleaching, wounds, disease or parasites).
3. Morphology that could be removed with minimal damage (i.e., no flat encrusting forms)."

The survey data from 2024 shows that there are 37 *A. globiceps* colonies assumed to be of proper size and morphology to translocate, and the Navy is anticipating up to 47 colonies could be moved.

The Navy safely assumes that 60% of corals survive translocations based on past experiences with coral translocation projects near the action area in Guam. Therefore, the Navy estimates 30 colonies will survive and a conservative total loss of 120 *A. globiceps* colonies from the total 150 estimated effected colonies as noted in Table 11 of DON (2025a) on page 71.

According to the concurrent EFH submission (DON 2025b), the Navy defined the following criteria for the appropriate candidates for additional coral translocations included as part of these proposed actions:

1. "For corals where at least one dimension is greater than 8 cm:
    a. Corals less than 8 cm from 3 coral species (*Leptastrea purpurea, Pavona cactus* and *Pectinia paeonia*); two groups (*Astreopora spp*. and *Porites spp.* massive) and one group complex (*Porites rus*) have been determined to not be fit for translocation.
    b. 3 coral species (*Pachyseris speciosa*, *Porites cylindrica* and *Stylocoeniella armata*); two groups (*Galaxea spp.* and *Lobophyllia spp.*) and one species complex (*Pavona varians sp.)* have been determined to potentially be fit for translocation as corals less than 8 cm.
    c. Several *Pocillopora acuta* colonies, all *Fungia spp*. and *Herpolitha spp.* colonies less than 8 cm are candidates for translocation.
2. Colonies in good health (i.e., no signs of bleaching, wounds, disease or parasites).
    a. Throughout the action area and in all size classes, little to no disease or bleaching was detected.
    b. Corals that are undergoing bleaching, are stressed/diseased, have encrusting or boring sponge cover, or are otherwise unhealthy will not be translocated.
3. Morphology that could be removed with minimal damage, in particular:
    a. No flat-encrusting growth forms, such as *L. purpurea*.
4. Coral species that have been shown to not survive translocation well from other projects (UEMMS and LMN) may not be translocated (i.e., *P. rus*).
    a. These colonies may be moved on the substrate they exist on, where feasible and practical."

The total number of non-ESA-listed corals that are expected to be translocated or lost has not been quantified by the Navy at this time. Given environmental conditions and considerations for diver safety, it is not known how many can be safely moved before construction activities occur. It is expected that approximately 900 colonies will be moved at minimum given information provided in the EFHA (DON 2025b; NMFS 2025a).

Proposed Offsets noted in the concurrent EFHA

The Navy will offset unavoidably lost functions and services provided by coral and other biota through two mitigation actions as part of this proposed action: restoring seagrass habitat and enhancing habitat that promotes coral settlement with crustose coralline algae as described in Table 2.

Table 2. Summary of Mitigation Actions other than BMPs proposed to address the removal of the marine community in the action area (DON 2025b).

Mitigation Action	Type	Quantity
Reducing footprint from new trench to relic toe	Avoidance	Avoided approximately 54,227.7 m^2 of impacts
Using shuttle barge to avoid building a temporary trestle in the inner breakwater	Avoidance	Footprint decreased and eliminated long term building in sensitive habitat
Translocate coral	Minimization	Target moving approximately 844 colonies
Remove algal growth on coral after translocation	Minimization	Primary focus on area where coral is transplanted
Reattaching transplanted coral that becomes dislodged after translocation	Minimization	All broken coral >8cm that has at least 20% living tissue
Seagrass restoration at Dadi Beach	Offset	Up to 9 acres (36,800 m^2) of seagrass meadow restoration
CCA spreading at Glass breakwater	Offset	Approximately 1 m^2 presumed over the course of 30 years

While not provided, or alluded to by the Navy in the ESA BA (DON 2025a), we include the information from the concurrent EFH consultation (NMFS 2025a) as it pertinent for a proper description of the Navy's proposed action and to consider the potential for effects to proposed green sea turtle critical habitat which occurs in the action area. Particularly from the loss of ecological services and functions provided by the corals and any potential effects from subsequent seagrass restoration efforts.

1.3 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 this action, the full extent of direct and indirect effects includes all areas affected by the action physically, chemically, or biologically. Therefore we consider the entire Apra Harbor area (Figure 6 and Figure 7), geographical spaces outside of Apra Harbor on the North side of the breakwater where vessels, personnel, or effects may occur; and projected vessel transiting paths to both South Korea and British Columbia, Canada.

Figure 6. Shoreline of the Glass Breakwater affected by the Proposed Action in Apra Harbor (DON 2025a).

Figure 7. Sumay Point in Outer Apra Harbor, inset to show where part of the action will occur in pink (DON 2025a).

1.4 Analytical Approach

The Navy determined the proposed action is not likely to adversely affect (NLAA) the Central West Pacific green sea turtle, hawksbill sea turtle, Indo-West Pacific scalloped hammerhead shark or critical habitat for the Central West Pacific green sea turtle. Additionally, the Navy documented an additional 29 species they did not consider to occur within the action area. However, NMFS considers these additional species in this action considering the potential for vessel transiting effects. Our concurrence and determinations are documented in the NLAA determination section (see Section 9).

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of jeopardize the continued existence of a listed species, which is "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). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion also relies on the regulatory definition of destruction or adverse modification, which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02). Therefore, the adverse modification analysis considers how federal actions affect the quantity, quality, and availability of the physical or biological features of the designated critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the range-wide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly 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; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2 STATUS OF THE LISTED RESOURCES

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' reproduction, numbers, or distribution for the jeopardy analysis.

2.1 Environmental Considerations

In this assessment, we rely on systematic assessments of available and relevant information to incorporate environmental conditions in several ways. Future climate conditions will depend on warming caused by past anthropogenic emissions, future anthropogenic emissions and natural climate variability. Climate indicator values are projected under the Intergovernmental Panel's (IPCC) Representative Concentration Pathway (RCP) 8.5. RCP 8.5, like the other RCPs, were produced from integrated assessment models and the published literature; RCP 8.5 is a high pathway for which radiative forcing reaches >8.5 W/m^2 by 2100 (relative to pre-industrial values) and continues to rise for some amount of time. A few projected global values under RCP 8.5 are noted in Table 3. Presently, the IPCC predicts that risks for natural and human systems are higher for global warming of 1.5 ºC but lower than the 2 ºC presented in Table 3 (IPCC 2018, 2022). Changes in parameters will not be uniform, and IPCC projects that areas like the equatorial Pacific will likely experience an increase in annual mean precipitation under scenario 8.5, whereas other mid-latitude and subtropical dry regions will likely experience decreases in mean precipitation. Sea level rise is expected to continue to rise well beyond 2100 and while the magnitude and rate depends upon emissions pathways, low-lying coastal areas, deltas, and small islands will be at greater risk (IPCC 2018, 2022).

Table 3. Projections for certain climate parameters under Representative Concentration Pathway 8.5 (values from Table 2.1 IPCC 2014; see Figure 3.4 in IPCC 2022).

Projections	Scenarios (Mean and likely range)	
	Years 2046-2065	Years 2081-2100
Global mean surface temperature change (ºC)	2.0 (1.4-2.6)	3.7 (2.6-4.8)
Global mean sea level increase (m)	0.30 (0.22-0.38)	0.63 (0.45-0.82)

We address the effects of climate, including changes in climate, in multiple sections of this assessment: Status of the Listed Resources (Section 2), Environmental Baseline (Section 3), and Integration and Synthesis (Section 6). In the Status of Listed Resources and the Environmental Baseline we present an extensive 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 habitat variables that are affected by climate change such as sea level rise, temperatures (water and air), and changes in weather patterns (precipitation), and we try 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 adapting environmental variables effect a 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 would likely occur under RCP 8.5, and where available we use 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 would change as they are forced to cope with higher background levels of stress caused by climate-related phenomena.

2.2 Status of the Species

This section consists of narratives for the species occurring in the action area that may be adversely affected by the Navy's action. The status summary provides the point of reference for our analyses of whether or not the action's direct and indirect effects are likely to appreciably reduce a species' probability of surviving and recovering in the wild. The species' narrative presents a summary of:

1. The species' distribution and population structure (which are relevant to the distribution criterion of the jeopardy standard)

2. The status and trend in abundance of the species and affected population(s) (which are relevant to the numbers criterion of the jeopardy standard)
3. Information on the reproduction of the species and affected population(s) (which is a representation of the reproduction criterion of the jeopardy standard)
4. Natural and anthropogenic threats to the species and/or affected population(s) (which helps explain our assessment of a species' likelihood of surviving and recovering in the wild)
5. Recent conservation activities for the species and/or affected population(s) (which also helps explain our assessment of a species' likelihood of surviving and recovering in the wild)

More detailed background information on the general biology and ecology of the species listed in Table 4 can be found in status reviews and recovery plans for the various species as well as the public scientific literature.

Table 4. Listed resources within the action area that are likely to be adversely affected by the proposed action.

Species	Scientific Name	ESA Status	Listing Date	Federal Register Reference
Coral (no common name)	*Acropora globiceps*	Threatened	10/10/2014	79 FR 53852

2.2.1 *Acropora globiceps*

Distribution and Population Structure

A. globiceps was listed as threatened on September 10, 2014 (79 FR 53852). *A. globiceps* is distributed from the oceanic West Pacific to the central Pacific as far East as the Pitcairn Islands. In the U.S., *A. globiceps* occurs in the Northwestern Hawaiian Islands (NWHI), the Pacific Remote Islands Area (PRIA), American Samoa, the Northern Mariana Islands, and the minor outlying islands (Figure 8).

Colonies of *A. globiceps* are typically about a foot in diameter or less, but can reach approximately 1 m in diameter. Colonies are round, with finger-like branches growing upward. Branches are uniform in size and shape, roughly finger length, diameter, and shape, with almost no side branches. Branch tips are rounded. The axial corallite is small and short. Radial corallites (i.e., corallites on the sides of branches) are uniform and fairly small, and often some are in rows. Branches are usually close together and can have a narrow, uniform crack between them, though not always. Length of branches, how close they are together, and the degree of branch tapering varies some between colonies, but usually not within colonies. Colony color is typically cream to brown, and sometimes fluorescent green in some locations. As explained below, this species is similar to some other *Acropora spp*. However, *A. globiceps* has distinctive characteristics and can be reliably identified in the field, as noted below and in more detail in Fenner and Burdick (2016), Fenner (2020b), and NMFS (2024).

Figure 8. Range of *A. globiceps*, modified from the map in Veron et al. (2016), based on sources cited in the text. Dark green indicates ecoregions with confirmed observations of *A. globiceps* by recognized experts, and light green indicates ecoregions where it is strongly predicted to occur by recognized experts.

Status and Trends of Abundance

Detecting changes in abundance over time of Indo-Pacific reef-building coral species such as A. globiceps is complicated by many factors, and time-series abundance data are not available for this species. However, overall mean coral cover (i.e., percentage of live cover of all reef-building coral species combined) has declined across much of the Indo-Pacific since the 1970s, and likely many decades before then in some locations (79 FR 53851-54123; NMFS 2020b). Furthermore, from 2014 to 2017, an unprecedented series of bleaching events impacted most of the Indo-Pacific's coral reefs (Eakin et al. 2019), further reducing overall mean coral cover, especially of relatively sensitive species such as many Acropora spp. including A. globiceps. For example, between 2013 and 2017 on Guam, reduction in mean Acropora cover was much higher than the reduction in overall mean coral cover, and mortality of A. globiceps colonies from bleaching was higher than overall coral mortality from bleaching (Raymundo et al. 2019).

DeVantier and Turak (2017) characterized relative abundances of each reef-building coral species present at a total of 3,075 sites distributed throughout 31 Indo-Pacific ecoregions from the Red Sea to the Great Barrier Reef. The sites were surveyed from 1994 to 2016, and included all main reef types, including fringing, patch, platform and barrier reefs, atolls, and non-reef coral communities. Non-reef areas are those where environmental conditions prevent reef formation by reef-building corals, but some reef-building coral species are present (Perry and Larcombe 2003). Surveys were generally conducted between the surface and approximately 40 m in depth, although some extended to 40-50 m (DeVantier and Turak 2017). The relative abundance of each species in each ecoregion was quantified on a scale of 1 to 5, where 1 = rare, 2 = uncommon, 3 = common, 4 = abundant, and 5 = dominant, then the mean relative abundance of each species was calculated for all of the ecoregions where it was reported. Of the 31 surveyed ecoregions, A. globiceps was reported from 13 ecoregions, and its mean relative abundance was 1.95 (DeVantier and Turak 2017).

In addition to the 13 ecoregions where the relative abundance of *A. globiceps* was estimated by DeVantier and Turak (2017), their rating method has been used to estimate relative abundances of reef-building corals in portions of several other ecoregions in the central Pacific. The relative abundances of *A. globiceps* in these surveys ranged from 1.3 (Saipan) to 2.5 (Wallis), and included scores of 1.8 (American Samoa), 1.5 (Tonga), 1.5 (Fiji), 2.1 (New Caledonia), and 1.7 (Marshall Islands; Fenner 2020b). Based on the results of DeVantier and Turak (2017) and Fenner (2020b), the overall relative abundance of *A. globiceps* is uncommon, but ranges from rare to common, depending on the location. However, based on *A. globiceps*' distribution and relative abundance, Dietzel et al. (2021) estimated an absolute abundance at 654 million colonies (NMFS 2023c).

Within U.S. waters, *A. globiceps* occurs in Guam (a single island), the CNMI (an archipelago of 15 islands), American Samoa (an archipelago of 7 islands), PRIA (an administrative grouping of seven islands, atolls, and reefs widely distributed across the central Pacific), and the NWHI, as described in more detail below.

Guam: *A. globiceps* is widely distributed on the reef slopes around Guam. For example, David Burdick reported *A. globiceps* from 22 sites around Guam (2015 personal communication reported in NMFS 2021), and the U.S. Department of Defense reported the species from 24 sites around Guam (Figure 4-14; Navy 2024).

CNMI: *A. globiceps* has been recorded throughout southern CNMI, including on Saipan, Tinian, Aguijan, and Rota (Maynard et al. 2015; Fenner 2020b). The islands of northern CNMI are uninhabited and rarely surveyed. However, NMFS (2021) reports *A. globiceps* from Anatahan, Pagan, and Maug. In addition, *A. globiceps* has been reported from Farallon de Medinilla (Carilli et al. 2020), an islet between CNMI's southern and northern islands.

American Samoa: *A. globiceps* is widely distributed on the reef slopes around Tutuila and Aunu'u, and has also been recorded on South Bank, a seamount south of Tutuila. The species has also been recorded on four of the other five islands of American Samoa, including Ofu, Olosega, Ta'u, and Rose Atoll. Swains Island is the most isolated island of American Samoa. It has occasionally been surveyed for corals, but *A. globiceps* has not been recorded there (Montgomery et al. 2019; Fenner 2020a; Fenner 2020b).

PRIA: Portions of each of the seven islands, atolls, and reefs of PRIA have been surveyed over the past several years. Williams et al. (2008) and Kenyon et al. (2011) reported *A. globiceps* on Palmyra Atoll, while Kenyon et al. (2011) and Doug Fenner (2017 personal communication reported in NMFS 2021) reported it from Kingman Reef and Wake Atoll, respectively, and Tony Montgomery reported it from Johnston Atoll (2019 personal communication reported in NMFS 2021). The species has not been reported on Baker Island, Howland Island, or Jarvis Island.

NWHI (Papahānaumokuākea Marine National Monument): *A. humilis* has been recorded in the NWHI multiple times over the last several decades, although only at French Frigate Shoals and Muro Reef. Review of photos from French Frigate Shoals taken in 2014 and 2017 indicate that these colonies are *A. globiceps*.

Reproduction

Like other *Acropora* species, *A. globiceps* reproduces by broadcast spawning, whereby colonies release large numbers of eggs and sperm into the water. Colonies are hermaphroditic, in that each colony produces both eggs and sperm. Larvae settle on suitable substrates such as rock or

dead coral and grow into colonies. Skeletal growth of colonies is relatively rapid compared to other reef-building corals. Prolific reproduction, rapid skeletal growth, and branching colony morphology help *A. globiceps* successfully compete for space. However, resilience to disturbance is low, and populations that are frequently disturbed by warming-induced bleaching, storms, and other threats have high levels of mortality, rapid turnover, and high proportions of small colonies (Adjeroud et al. 2015; Kayal et al. 2015; NMFS 2023c).

Many *Acropora* species have branching morphologies, making them potentially susceptible to fragmentation. Fragment survival can increase coral abundance in the short-term but does not contribute new genotypes (or evolutionary opportunities) to the population.

Threats to Species

We incorporate by reference pages 14 through 33, 38 through 41, 63 through 65, 76 through 78, 95 through 98, and 102 through 105 of the Recovery Status Review (NMFS 2023c). Below we list the impacts identified as threats to Indo-Pacific corals and provide specific page numbers in NMFS (2024a) where details, references, and justifications may be found.

- Ocean Warming (NMFS [2023c] concluded that this is the greatest present threat to corals, with a very high threat level).
    - Oceans absorb and store most of the excess heat produced by greenhouse gas (GHG) warming (page 15).
    - Causes increased coral bleaching and mortality (page 16).
    - Expected to worsen substantially for the foreseeable future (page 17).
- Ocean Acidification (NMFS [2023c] concluded a high threat level)
    - Reduces coral calcification and skeletal growth rates, and erodes the physical structure of coral reefs (page 18).
    - Interacts with ocean warming to further increase mortality (page 19).
    - Expected to worsen substantially for the foreseeable future (page 19).
- Disease (NMFS [2023c] concluded a high threat level)
    - Most common diseases are white syndrome, black band disease, brown band disease, skeletal eroding band, and growth anomalies (page 19).
    - Exacerbate effects of other stressors (page 20).
    - Expected to worsen substantially for the foreseeable future (page 20)
- Fishing (NMFS (2023c) concluded a medium threat level)
    - Direct damage to corals from certain types of fishing equipment (page 21).
    - Lost or abandoned gear entangles reefs, damaging corals for months to years (page 21).
    - Destructive methods like blasting or poisoning kills or damages corals (page 21).
    - Reduction of grazers can cause increases in macroalgae that compete with corals (page 21).
    - Reduction of piscivores can lead to increases in corallivores and increased predation of corals (page 21).
    - Expected to worsen with increasing human populations and advances in fishing technology (page 22).
- Land-based Sources of Pollution (LBSP) (NMFS [2023c] concluded a low-medium threat level)
    - Sediment, nutrients, contaminants, salinity, and other types of pollutants originate from human activities in coastal and inland watersheds (page 23).

  - Enter the ocean through river discharge, groundwater seeps, and surface runoff (page 23).
  - Sedimentation and increased turbidity can kill polyps by smothering, lower colony growth and reproductive output, reduce settlement and recruitment, and block light needed for photosynthesis and growth (page 23).
  - Increased nutrients can cause increased macroalgae growth and increased turbidity due to higher plankton growth (page 23).
  - Likely to worsen with increasing human populations, urbanization, and industrialization. However, more extensive coastal protections may mitigate the impacts of development (page 23).
- Predation (NMFS [2023c] concluded a low-medium threat level)
  - Outbreaks of predators like Crown-of-Thorns Sea stars (COTS), *Drupella* spp. snails, fish, and others drain energy in coral reefs, exacerbating effects of other stressors, and can wipe out large areas of coral cover (page 24).
  - COTS outbreaks can likely be caused by phytoplankton blooms due to LBSP, and removal of their predators by fishing (page 24).
  - Predation is expected to worsen as other stressors like LBSP worsen (page 24).
- Collection and Trade (NMFS [2023c] concluded a low-medium threat level)
  - Collection trade has grown substantially over the past decades (page 25).
  - Collection methods damage areas of reef habitat around corals that are collected (page 25).
  - Coral collections are likely underreported despite listing under Appendix II of the CITES (page 26).
  - Collection growth has slowed due to several factors including bans on wild collection in exporting countries and increasing captive culture use (page 26).
  - Expected to worsen as demand increases with growing human populations and economic development (page 26).
- Sea-level Rise (NMFS [2023c] concluded a low threat level)
  - Global sea levels are expected to continue accelerating as the ocean warms (page 27).
  - Increased coastal erosion and water quality degradation (page 27).
  - Potentially beneficial in certain areas as more substrate is available (page 27).
  - Submergence of corals below their depth limits (page 27).

Recent Conservation Activities

The Recovery and Status Review (NMFS 2023c) summarizes current international and local efforts to mitigate present threats to corals. We incorporate by reference that information from pages 13 and 28 through 32 and summarize it below. Coordinated international efforts to limit ocean warming by curbing GHG emissions have been ongoing for decades through a series of treaties and multinational agreements. The most recent is the Paris Agreement in 2015, with 195 signatory countries that have agreed to set and achieve goals for GHG reductions. The aforementioned efforts have led to some reductions in global GHG emissions. However, those reductions are likely insufficient to avoid severe impacts to corals by ocean warming and acidification.

Among the 68 countries where Indo-Pacific corals occur, local laws and regulations have been implemented with the aim of protecting corals from the effects of fishing, LBSP, and collection/trade. These measures have had variable success in reducing anthropogenic harm to corals.

For example, coastal development has been limited in certain areas, reducing LBSP. In some locales destructive fishing practices have also been prohibited. However, these laws are often limited in scope and difficult to enforce. Additionally, international regulatory mechanisms like CITES are designed to control the global collection and trade of endangered species, including corals. Though, the efficacy of these mechanisms is subverted by underreporting.

3 ENVIRONMENTAL BASELINE

The environmental baseline is defined by regulation (50 CFR 402.02). 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 completed formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

We incorporate pages 28 through 38 of the Navy's BA (DON 2025a). We summarize the most relevant notes to conceptualize the current conditions within the environmental baseline and supplement the information as noted herein.

Apra Harbor is a semi-enclosed lagoon with a rich diversity of coral species located on the West coast of Guam and is the largest and busiest U.S. deepwater ports in the western Pacific (DON 2025a). The Glass Breakwater is a manmade structure that separates the Philippine Sea from Apra Harbor on the western shore of Guam. Within Apra Harbor are two geographically separate areas, inner and outer Apra Harbor (Figure 9). Minimal freshwater inputs are from a few small streams that discharge into the harbor. The island's mountains shelter Apra Harbor from the dominant trade winds and periodic typhoon-driven waves may occur within the harbor. In general, the bathymetry is deeper toward the west, but abrupt bathymetry changes are common, particularly as numerous small and large coral reefs characterize the harbor seabed. Tides in the harbor are mixed, with a mean tidal range of 0.49 m (1.6 ft.) and a mean diurnal range of 0.72 m (2.4 ft.; Nelson et al. 2016 as cited in DON 2025a).

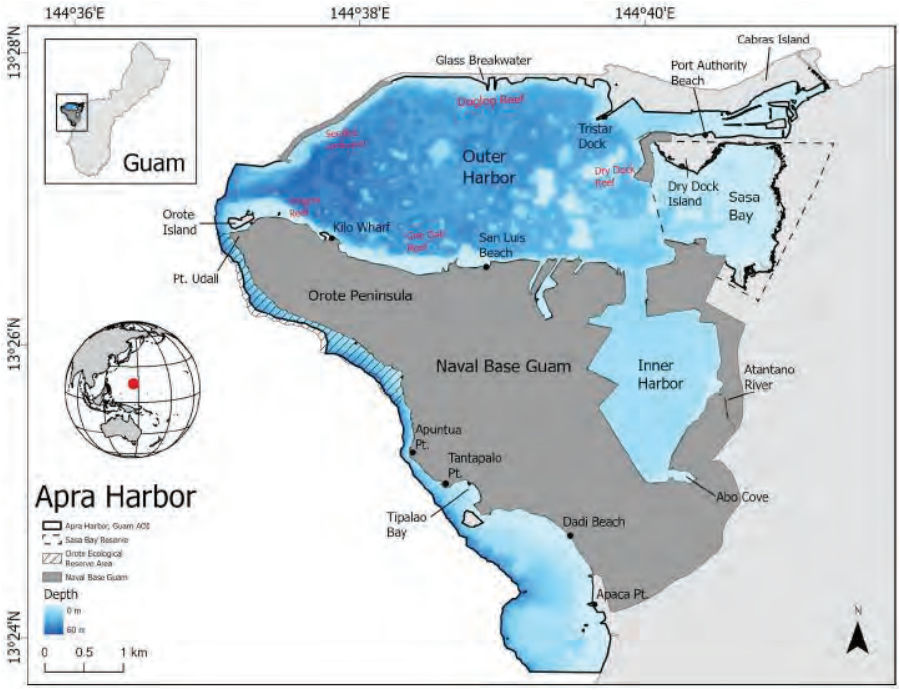

Figure 9. Inner and Outer Apra Harbor, Guam where the action is expected to occur (Costa and Sweeney 2024 as cited in DON 2025a).

As the Navy (DON 2025a) describes using data from NOAA, tides are usually weak to moderate semi-diurnal currents with surface seawater temperatures generally between 26 and 30 degrees Celsius (°C). Turbidity in Apra Harbor is highly variable with clear oceanic type conditions near the harbor mouth; while highly turbid conditions are common in Inner Apra Harbor, to the East in Sasa Bay, and southeast in Inner Apra Harbor. Bottom sediments range from silty clay to complex coral reefs depending on location (Figure 10). The outer Breakwater is a highly dynamic area with considerable wave energy and experiences the brunt of storms generated from the North. Locally-generated waves and refraction also create choppy sea surface conditions at the breakwater.

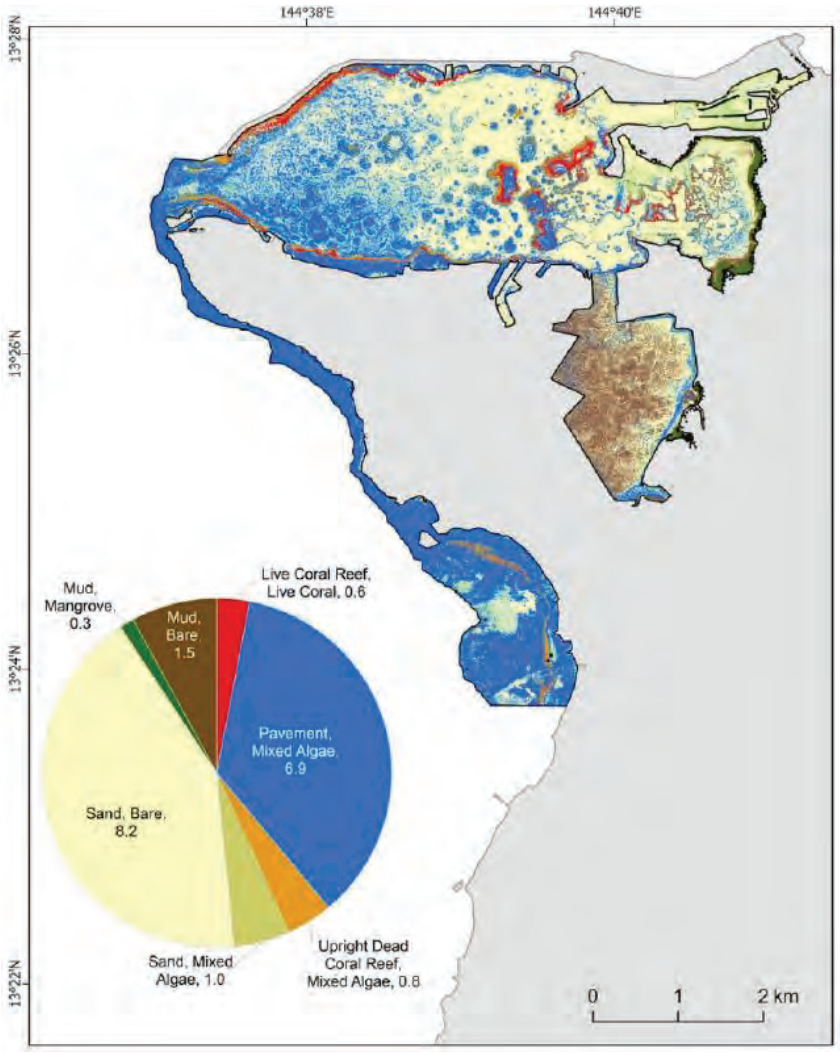

Figure 10. Apra Harbor benthic habitat overview (Costa and Sweeney 2024 as cited by DON 2025a).

Increasing water temperatures, ocean acidification, rising sea levels, changes in intensity and frequency of large storm events, and other changes associated with adapting environmental conditions largely affect corals and coral communities within Apra Harbor.

Following World War II, the Navy made extensive port improvements, including dredging a navigation channel to a depth of approximately 14 m (46 ft.). Submerged lands at NBG's main base were altered significantly during and immediately following World War II (DON 2024, 2025a). During this period, dredging occurred throughout Apra Harbor to support ship movement and berthing. Large amounts of fill were used to construct port infrastructure, which covered reefs in areas of Inner Apra Harbor. Wetlands southeast of Inner Apra Harbor were also converted for agricultural use in the 1930's (DON 2024, 2025a).

Today, maintenance dredging is performed as necessary in Apra Harbor to maintain navigable depths to support vessel activities. Historically, the Navy has performed maintenance dredging actions on an individual project specific basis (Table 5). The Navy's maintenance dredging program includes dredging activities that occur at Delta and Echo Piers in Outer Apra Harbor and areas within Inner Apra Harbor including; the Entrance Channel, Former Ship Repair Facility (SRF; Lima, Mike, November), Bravo Wharf, Sierra Wharf, Tango Wharf, Victor Uniform Wharf, Victor Wharf, X-ray Wharf, the T-AKE Turning Basin, and the Mooring Buoy Areas.

Table 5. Historical dredging in Apra Harbor.

Year	Type	Location	DA Permit	Depth	Volume (cy)	Disposal Area
1946-1950	Construction	Inner Harbor		-32	n/a	Wharves created
1962-1964	Construction	Upper Inner Harbor Entrance		-35	64,600	Upland
1964	Maintenance	Delta		-43	n/a	
1989	Maintenance	Kilo	1636SD	-35	3,500	Orote Airfield
1978	Maintenance	Inner Harbor	1399SD	-32	104,900	S. Polaris Pt.
1993	Maintenance	Delta and Echo		-43	5,000	
1997-1998	Maintenance	Delta and Echo		-43	11,000	
2003	Maintenance	Inner Harbor Phase I		-32	13,105	Ship Repair Facility/ Orote Airfield
2003	Emergency Maintenance	Uniform, Victor and X-Ray	NWP 35 SP20020034	-32	10,000	
2004	Maintenance	Inner Harbor Phase II	NWP 35 SP200400328	-35	101,290	
2004	Maintenance	Romeo, Sierra, and Tango	NWP 35 SP200300447	-35	101,000	Orote Airfield
2005	Maintenance	Delta and Echo	NWP 35 SP200400328	-43	3,839	Echo CDF
2008	Construction	Alpha and Bravo	POH 2005-355	-40	180,000	Field 5

Year	Type	Location	DA Permit	Depth	Volume (cy)	Disposal Area
2008	Construction	Kilo and approach	POH 2008-0038	-45	165,000	Orote Airfield
2012	Maintenance	Victor	POH 2011-206	-32	7,288	Orote Airfield
2012	Maintenance	X-Ray	POH 2011-206	-32	3,318	Orote Airfield
2013	Maintenance	Delta and Echo	POH 2010-255	-45	7,317	Orote Airfield
2014	Maintenance	Uniform	POH 2012 133	-32	16,500	Field 5
2015	Maintenance	Sierra Tango	POH 2012 133	-35	16,600	Orote Airfield
2015	Maintenance	Half of Romeo	POH 2012 133	-35	4,608	Orote Airfield
2017	Construction	T-AKE Turning Basin	POH 2014 209	-35	104,573	Ocean Disposal
2019	Maintenance	SRF and Entrance Channel	POH 2016-73	-40	49,000	Upland

On September 27, 2022, NMFS (2022a) completed a programmatic ESA consultation with the Navy covering maintenance dredging activities and associated vessel support from outside of Guam, and included dive support operations, removal of marine debris, anchors, and mooring systems; potential removal of unexploded ordinance, upland disposal of dredged materials and the disposal of dredged material at the Guam Deepwater Disposal Site (G-DODS; PIRO-2022-01869, I-PI-22-2034-DG). Maintenance dredging activities are an ongoing and routine process. Areas for maintenance dredging in a particular year are selected according to the most recent hydrographic survey results (conducted every 2 to 5 years), operational needs, dredge material storage and disposal requirements, and other factors.

Dredging activities are covered by the programmatic include specific locations within the Harbor:

1. In Outer Apra Harbor at Delta and Echo Wharves on the south side of Cabras Island Channel.
2. In Inner Apra Harbor at the former Ship Repair Facility (SRF; Lima, Mike, November wharves) and the Inner Apra Harbor Entrance Channel.
3. In Inner Apra Harbor at Bravo Wharf, Sierra Wharf, Tango Wharf, Victor Wharf, Victor Uniform Wharf, and X-ray Wharf.
4. In Inner Apra Harbor at the T-AKE Turning Basin.
5. In Inner Apra Harbor at the designated Mooring Buoy Area.

Projects excluded from the programmatic that require individual consultation are projects in or near the marine environment that include any of the following activities:

1. Dredging operations occurring at depths that exceed previously conducted dredging in the area are considered construction dredging, and are excluded from coverage under the programmatic consultation.
2. Dredging at any of the following locations: Oscar, Papa, Quebec, and Romeo Wharves (OPQR), the Undeveloped Bravo Wharf, the Finger Piers, and Alpha Wharf.
3. Any dredging with enhanced natural recovery (ENR).
4. If take of ESA-listed species are expected to occur from the proposed action(s).

The Navy has also engaged NMFS' Pacific Islands Regional Office for technical assistance related to upcoming dredging operations within Apra Harbor as part of future actions that do not fit within the scope of the programmatic consultation (INQ-2024-00244, I-PI-24-2260-DG) and are concurrent to this proposed action. To date, the Navy has not requested consultation. However, we consider it in the baseline as it is reasonably certain to occur.

Additionally, On January 16, 2025 we completed an informal ESA consultation and conference on the effects for the use of the Guam Deep Ocean Disposal Site (NMFS 2025b; I-PI-24-2403-DG, PIRO-2024-02973, INQ-2024-00253) with the EPA which covers Navy maintenance dredging operations within Apra Harbor for the foreseeable future as long as conditions are met for disposals.

The offshore site is used only for the disposal of suitable, non-toxic sediment dredged by USACE from federally authorized navigation channels in Guam's harbors, as well as for disposal of suitable, non-toxic dredged sediment from other permitted navigation dredging projects by the Navy. Additionally, vessel transit paths may overlap as part of this action for materials coming from South Korea.

The suitability of dredged material for ocean disposal is determined based on criteria in the Marine Protection, Research and Sanctuaries Act (MPRSA) and in EPA's Ocean Dumping Regulations (40 CFR Part 227). The EPA and USACE have a joint national sediment testing manual titled Evaluation of Dredged Material Proposed for Ocean Disposal (EPA and USACE 1991), or the Ocean Testing Manual. The manual details the testing and sampling methods needed to comply with the MPRSA and EPA's regulations. The MPRSA and EPA regulations call for careful alternatives analysis and BMPs to reduce or eliminate potential adverse effects on marine resources. Importantly, the regulations only allow for suitable, non-toxic sediments to be discharged at EPA-designated ocean disposal sites; even when sediment is suitable for ocean disposal, it is only approved when there is no practicable alternative.

EPA's regulations also establish strict criteria for evaluating whether dredged material is suitable for ocean disposal (40 CFR Part 227.5-9). The regulations specify that certain prohibited constituents (for example, industrial wastes or high-level radioactive wastes) may not be disposed of in the ocean, while other constituents such as organohalogen compounds or mercury, may only be discharged if they are present in no more than "trace" amounts that will not cause an unacceptable adverse impact after dumping. The "trace" criterion is determined by passing a series of bioassays that address the potential for short- and long-term toxicity and bioaccumulation.

Among sediment testing prior to disposal, careful site selection, and disposal alternative evaluations, the EPA actively takes additional management measures at the sites to further minimize adverse effects to the marine environment once a dredging project has been approved for ocean disposal.

Local point source and non-point source pollution can have significant effects on colonies where stormwater dumps sediments or chemical pollutants to nearshore waters. Storm runoff often includes sewage and animal feces that run off from residential and rural properties. Coastal development can also disrupt freshwater input regimes, and increase water temperatures through impervious surfaces or lack of coastal shading. While unpopulated or lightly-populated places are almost unaffected by man-made development and pollution, some nearshore areas close to urban areas in the Mariana Islands have seen degradation in recent decades (Houk and van Woesik 2008; Houk and Camacho 2010; Kendall et al. 2017). As more development occurs in Guam, we can expect more degradation of coral reefs and their colonies (NMFS 2020b).

We have recently completed several section 7 consultations in Guam including the EPA's authorization of the Apra Harbor Wastewater Treatment Plant (NMFS 2023a; PIRO-2023-02135; I-PI-23-2206-DG) which discharges into the action area, and will continue to do so for the foreseeable future. Corals are not expected to be adversely affected from those releases given the outfall locations, although they contribute to decreased water quality conditions within the action area.

Other actions within Apra Harbor include the EPA's proposal to authorize the renewal of the General NPDES permit for Bulk Fuel Storage Facilities authorizing discharges of treated water associated with tank bottom water draws, treated stormwater which may be discharged concurrently with tank bottom draws, equipment maintenance activities, hydrostatic test water from integrity testing of piping and tankage, service water flows associated with incidental leaks, system tests, facility maintenance activities, and firewater system testing from five bulk fuel storage facilities operating in Apra Harbor, Guam:

1. Mobil Oil Guam Inc. Cabras Terminal,
2. Tristar Guam F-1 Pier Terminal,
3. South Pacific Petroleum Corporation Cabras Island Terminal,
4. Tristar Guam Agat Terminal, and
5. Guam Power Authority Piti Terminal

Discharges from these facilities may come into contact with petroleum products, including gasoline, and oil-water separators are typically the only means of treatment. Facilities are currently covered under the existing permit that became effective April 1, 2019 and expired March 31, 2024. In accordance with 40 CFR 122.6, the requirements of the existing permit are effective until the EPA reissues the permit.

The EPA issues NPDES permits pursuant to Section 402 of the Clean Water Act (CWA) which require point source dischargers to control the level of pollutants discharged to waters of the United States. Effluent limitations in the permit are derived to meet Guam Water Quality Standards (EPA 2018), which are developed by Guam EPA and approved by USEPA. The EPA provided NMFS a draft permit as part of the initiation packet in addition to the biological evaluation (EPA 2024a, 2024b; INQ-2023-00274; NPDES GUG000001). As part of this permit, the EPA is also establishing the first per- and polyfluoroalkyl substances (PFAS) monitoring site within Apra Harbor.

The EPA also permits NPDES general construction permits which cover stormwater discharges from land disturbances from projects outside waters of the U.S. Once submitted, projects have a 14-day review period for the Services review. Our reviews of these submissions are to determine whether effects would be expected to occur to our ESA-listed or EFH trust resources and

whether consultation would be required for the federal action or to determine whether the proposed action falls outside of the scope of previous formal consultation with NMFS Office of Protected Resources (OPR-2021-02825). Between Quarter 4 of 2017 and April 2025, the NMFS Pacific Islands Regional Office (i.e., PRD and HCD) reviewed a total of 278 proposed actions in Guam. Of those, 24 projects discharged into either Apra Harbor or the associated watershed (i.e., Apra drainage) connected to the Harbor.

Considering other federal actions within the action area, the USACE also regularly permits various actions in Apra Harbor through the programmatic informal consultation and conference on the standard local operating procedures in the central and western Pacific Region (PacSLOPES; NMFS 2022b; PIRO-2021-01430, I-PI-21-1928-AG). USACE issues permits pursuant to Section 10 of the Rivers and Harbors Act of 1899 or Section 404 of the Clean Water Act to various applicants conducting 14 categories of common activities occurring throughout the Pacific Islands Region, including Guam. Activities permitted in the Harbor include projects like the replacement of floating docks, harbor repairs, the removal of derelict vessels (e.g., ADV Voyager, MV Sun, etc.), maintenance dredging, etc. USACE permitted activities are expected to continue on a regular basis as projects are proposed.

The USFWS Region 1 has also engaged in technical assistance with NMFS for their funding of Guam Division of Aquatic and Wildlife Resources' (DAWR) proposed project to release aquarium raised bumphead parrotfish (*Bolbometopon muricatum*) throughout Guam (INQ-2024-00201; I-PI-24-2364-DG). DAWR intends to install tracking tags in the fish and deploy acoustic receivers along the contiguous coastline at 5 km intervals including at least 6 stations within Apra Harbor including one north of Sumay Marina, and 3 on the actual breakwater. These will be deployed to determine the species' movement patterns, site fidelity, home ranges, etc. after release.

As the action area contains portions of international waters, military activities may occur in the action area that are unknown to us. However, at this time, we do not have the ability to describe the risk posed to the species under consideration though we attempt to address United States resources in the Region.

The United States Navy (including the United States Marine Corps aboard naval vessels) may conduct training and testing activities, military readiness activities, or could potentially face active combat operations in the action area. The United States Pacific Fleet is the world's largest naval fleet with an estimated Area of Responsibility of 100 million square miles including the entire action area. The command oversees approximately 200 vessels, 1,200 aircraft, and 13,000 personnel (DON 2019). Additionally, the United States Marines Indo-Pacific Command's Area of Responsibility includes the entire action area. Training operations occur regularly within the U.S. Military Mariana Islands Training and Testing (MITT) Activities area (Figure 11).

During training, existing and established weapon systems and tactics may be used in realistic situations to simulate and prepare for combat. Activities include routine gunnery, missile, surface fire support, amphibious assault and landing, bombing, sinking, torpedo, tracking, and mine exercises. Testing activities are conducted for different purposes and include at-sea research, development, evaluation, and experimentation. Any training or readiness operations that may occur in the action area of this proposed action would be expected to complete separate ESA section 7 consultation before operations commence. However, routine operations such as

patrolling, search and rescue, maritime inspections, flight operations, refueling, humanitarian aid, disaster relief, etc. may occur on a regular basis.

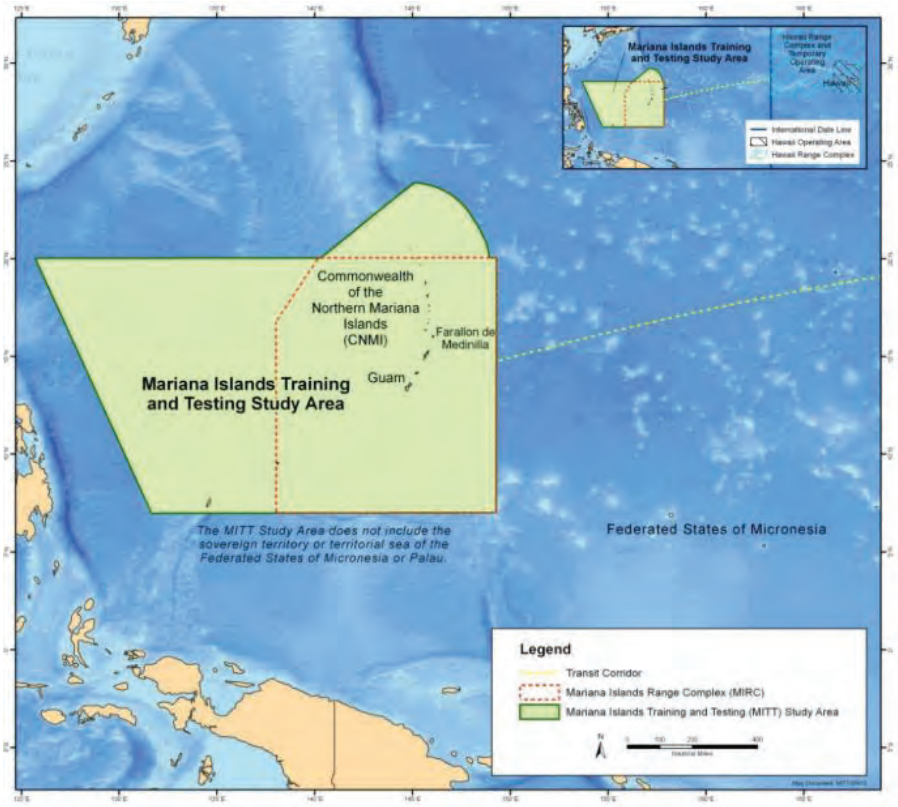

Figure 11. Mariana Islands Action Area with the Mariana Islands Range Complex (NMFS 2017a).

The use of submerged lands within Apra Harbor by the Navy for separate activities may overlap in time or space. Particularly of concern would be sound effects generated from this action (i.e., pile driving) and any of those created from underwater demolition ranges which occur through covered activities in MITT (FRP-2014-9070; NMFS 2017a; Figure 12).

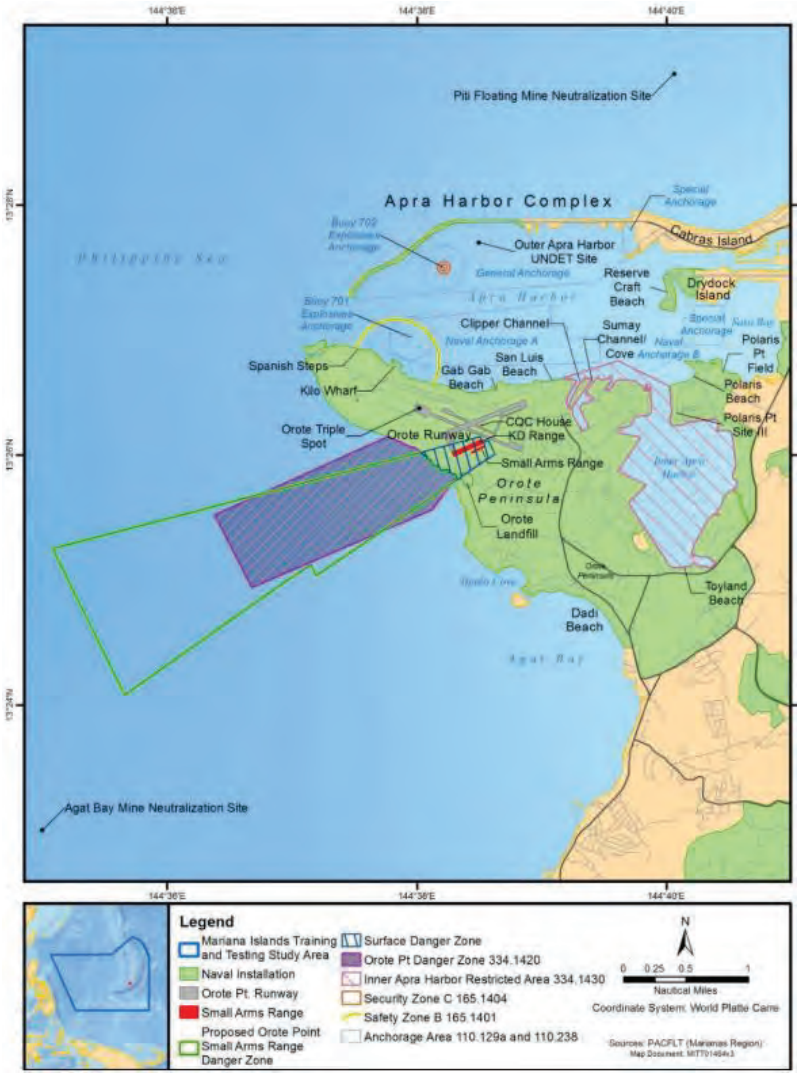

Figure 12. Apra Harbor Naval Complex (Main Base) and Main Base/Polaris Point submerged lands use, identifying Underwater Detonation and Mine Neutralization Sites in and around Apra Harbor, Guam (NMFS 2017a).

Sector Guam of the USCG's District 14 provides services to a broad expanse of the Pacific including the action area. USCG operations are ongoing and are expected to continue into the

future and are similar in nature and scope to those described above for the United States Navy. However, USCG live fire drills, otherwise known as GUNEX operations, are conducted in Hawaiian or Northern Mariana's waters within the Hawaii- Southern California Training and Testing (HSTT) or MITT ranges respectively. Effects to ESA-listed species from USCG munitions would likely only occur during active combat, drug interdictions, or other situations related to national security where ammunition would be fired. The USCG is expected to complete section 7 consultation for any training exercises that would occur in the action area, however they may conduct the same routine operations as the United States Navy and Marine Corps as noted above.

Responses of listed species struck by projectiles or from explosives may range from induced behavioral responses and avoidance measures, to direct impacts from munitions. An animal subjected to a direct hit or very near miss from a fired projectile would result in wounding or possibly death. Responses to an explosion would vary depending on proximity to the blast (Duronslet et al. 1986; Govoni et al. 2008; Viada et al. 2008; DON 2017; Fetherston et al. 2019). Potential injuries from projectiles and explosions may include cuts, gashes, bruises, gunshot wounds, broken bones, hearing loss, rupture or hemorrhage of internal organs, cracked or crushed carapaces, amputations, or other broken body parts; any of which could result in an animal's death. Air-breathing turtles and mammals could be injured in a manner that impairs their ability to reach the surface, and subsequently drown (Duronslet et al. 1986). Wounded animals may be less able to maneuver or travel, thereby increasing the animal's likelihood of being killed by predatory species (e.g., sharks). Impacts from harassment due to these types of activities include changes from foraging, resting, milling, and other behavioral states that require lower energy expenditures to traveling, avoidance, and behavioral states that require higher energy expenditures to flee an area (DON 2017).

The United States Air Force and other military entities may conduct flight operations within the action area, however effects to ESA-listed species are not expected as aircraft would be at altitude where auditory effects to underwater animals would be minimal. Sonic booms would most likely provide the largest auditory stress, but would be highly unlikely to illicit effects from ESA-listed species as determined by prior consultations conducted by NMFS (ex: see NMFS 2019a, 2019b). Nearshore activities could affect corals, Indo-West Pacific scalloped hammerhead, hawksbill sea turtle, the Central West green sea turtle and their proposed critical habitat. We completed consultations with the Navy on MITT Activities (FRP-2014-9070) and in the Hawaiian Archipelago (FPR-2018-9275). We consider these in the environmental baseline given overlap in geographic space will occur; however, no take of *Acropora globiceps* was expected to occur from those other activities in the action area (see NMFS 2017a).

The United States Maritime Administration (MARAD), in coordination with the Port Authority of Guam, also engaged NMFS to conduct ESA technical assistance for proposed construction repairs at Berths F2 through F6 (INQ-2024-00183, I-PI-24-2351-DG) in Outer Apra Harbor. Currently MARAD is drafting NEPA documents and NMFS is unsure exactly what repairs are needed, the proposed alternatives, or a selected action. However, we consider this in the environmental baseline as we expect port repairs are likely imminent.

Lastly, two vessel transits from this action will also overlap U.S. federal fisheries in the Western and Central Pacific Ocean. They include the bottomfish fisheries of American Samoa, Guam, the Northern Mariana Islands, and the Main Hawaiian Islands as managed under the American Sa-

moa, Mariana Archipelago, and Hawai‘i Archipelago Fishery Ecosystem Plans; and the U.S. Hawai‘i Deepset Longline Fishery. We do not report the ITS' for these consultations in the environmental baseline as the species considered LAA between the various consultations and this one are not the same. However, we recognize some species occur within the same geographic space considered in the action area which we consider NLAA in this consultation (see Section 9).

4 EFFECTS OF THE ACTION

Under the ESA regulations (50 CFR 402.02), effects of the action are all consequences to ESA-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 but that are not part of the 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. For this proposed action, we determined it will not cause any other activities.

We use a stepwise approach to analyze effects to species and critical habitats:

1. Identify those physical, chemical, or biotic effects of the proposed action that directly or indirectly affect the action area (hereafter using the term stressors).
2. Identify the species and/or critical habitats likely to co-occur with these stressors in space and time (exposure).
    a. For species, estimate the number, age or life stage, and other pertinent characteristics (e.g. gender) of the individuals and the populations or subpopulations those individuals represent.
        i. If estimating the number is not possible, use a habitat-based analysis.
    b. For critical habitat, if applicable, identify the physical or biological features exposed.
3. Determine if/how exposed species and critical habitats will likely respond to the exposure.
    a. For species, determine the individual's probable response and if it is likely to have consequences on its fitness (growth, survival, annual reproductive success, etc.).
        i. If using a habitat-based analysis, explain the changes in habitat and the consequences to individuals.
        ii. Determine what consequences the effects on individuals have on the populations those individuals represent (changes in the population' abundance, reproduction, spatial structure and connectivity, growth rates, etc.).
    b. For critical habitat, if applicable, examine the relationships between the habitat changes and physical and biological features and overall value of the affected area.

4.1 Stressors

We determined that the following stressors may affect ESA-listed species considered in this proposed action (see Section 9 for more details):

1. Take of ESA-listed corals
2. Elevated Noise Levels

3. Increased Suspended Sediments
4. Disturbance from Human Activity and Equipment Operation Including Direct Physical Contact
5. Vessel Collisions
6. Wastes and Discharges
7. Entanglement
8. Unexploded Ordnance

We determined that stressors 2 through 8 are not likely to adversely affect any ESA-listed species or designated or proposed critical habitats. The rationale for those determinations is documented in Section 9.1. As a result, in this section we focus on the stressors likely to adversely affect listed species and/or designated critical habitats.

4.2 Acropora globiceps

4.2.1 Exposure

The proposed action would include both incidental and direct take of *A. globiceps*. Houk et al. (2024) estimated around 120 *A. globiceps* colonies on the Glass Breakwater. Extrapolating these values from the survey area to the entire project footprint, and considering how small or hard to find corals can be, the Navy anticipates there to be at least 150 colonies in the project area that will be adversely affected by the action. Direct take includes the removal (i.e., collection) of approximately 70 *A. globiceps* colonies from the outer Breakwater, 13 from the inner Breakwater, and 0 from Sumay Point. The purpose is to translocate these coral colonies nearby or to another location in West Guam. In total, approximately 83 *A. globiceps* colonies may be permanently removed and/or temporarily affected due to translocation efforts. Therefore, we would expect approximately 67 of those 150 colonies to be incidentally lost from crushing injuries from placement of the CAU.

NMFS recognizes the exact number of coral colonies may be difficult if not impossible to enumerate given the expected crushing injuries and when considering that personnel safety is paramount. Divers would not be in-water when CAU are being installed. Additionally, identification of coral rubble to species may be impossible without genetic testing. However, we consider the information presented in the Navy's pre-construction surveys and agree that 150 colonies is the best estimate for expected effects to the species from the proposed action given the footprint of the proposed activities and the density of corals which were observed.

4.2.2 Response

Translocated colonies would be attached with epoxy onto hard substrate where they will continue to live and reproduce. Some colonies will fail attachment effects and may not survive. Handling live coral will likely kill polyps, although the number is unknown and difficult to quantify. Even so, coral colonies will continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. Regrowth of tissues and re-establishment has energetic costs that could slow other growth and reproduction. Exposed areas of coral skeleton are prone to bioerosion and overgrowth by algae and certain sponges, and damaged and stressed tissue may be more susceptible to infection by coral diseases that may hinder or prevent healing to the point that the colony dies.

The removal and loss of tissue and subsequent regrowth of tissues has energetic costs that could slow other growth and reproduction, exposed areas of coral skeleton are prone to bioerosion and overgrowth by algae and certain sponges, and damaged and stressed tissue may be more susceptible to infection by coral diseases that may hinder or prevent healing to the point that a colony dies. Even so, coral colonies will continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. Coral transplantation efforts through collection described in this opinion would potentially injure and negatively affect colony polyps, but given the small sample size (and associated sampling protocol), and the colonial nature of corals, we would not expect significant injury would occur to any colony but consider them a loss in the event transplanted corals do not adapt to their new environment at the translocation site(s). Breakage of coral fragments are common naturally as surf breaks on coral colonies move objects that break corals, and fish such as parrotfish graze on coral or in the bumphead parrotfish's case break and ingest pieces of branching corals. Most coral colonies will heal their wounds and live after samples are taken. Moving whole colonies increases the chances that the coral will survive.

Lesions often heal naturally, may do so quickly with little to no effect on the colonies (Jayewardene 2010), but can result in the affected coral colony being subject to reduced fitness in three ways. First, coral tissue regeneration requires energy so that resources may be diverted from growth and reproduction (Meesters et al 1994; Van Veghel and Bak 1994; Lirman 2000). Secondly, colony health and survival may be compromised because open lesions provide sites for the entry of pathogens and bioeroders and space for the settlement of other organisms such as algae, sponges, and other corals (Henry and Hart 2005). Third, injuries reduce the coral's surface area available for feeding, photosynthesis and reproduction (Wahle 1983; Hughes and Jackson 1985), which may alter colony survivorship (Hughes and Jackson 1985; Babcock 1991; Hall and Hughes 1996). Severe injuries to colonies can lead to death, especially if the colony is simultaneously exposed to other stressors such as warm sea temperatures, and bleaching (e.g. Meesters and Bak 1993).

The ability for lesions to heal ultimately depends on the species of coral, colony growth form, the surrounding environment, colony interactions with other organisms on the reef, and the size and shape of the lesion (Meesters et al. 1994). *A. globiceps* colonies are typically small (about 12 cm in diameter) round, with finger-like branches growing upward. Branches are uniform in size and shape, roughly finger length, diameter, and shape, with almost no side branches. The size and appearance of branches depends on degree of exposure to wave action, but are always short, closely compacted, with dome-shaped ends (NMFS 2020b). *A. globiceps* lives on reef flats, but also upper reef slopes often exposed to surf. A coral with these characteristics likely experiences natural breakage. To survive in such conditions, *A. globiceps* like many of the *Acropora spp*. that are digitate, branching, or table- or plate-like, have likely adapted to breakage and are more likely to heal readily.

A study by Hall (1997) on 18 branching *Acropora spp*. colonies noted that all lesions in the study healed within 74 days, while some began vertical branch extension from the lesion. In Saipan, ten out of 11 lesions on *A. globiceps* parent colonies from which fragments were taken in 2019 as part of the Saipan coral nursery pilot project healed successfully within 2-4 months post collection. Regenerated tissue across lesions included symbionts, and formed new apical polyps. The lesion on the one parent colony that did not heal successfully is believed to have been adversely affected by boring sponges that were documented on the colony when the initial fragmentation occurred (Steve McKagan, NMFS HCD, personal communication 2020).

Monitoring of a lesion on *A. globiceps* in the coral nursery in the summer of 2020 indicated that tissue regenerated across the lesion within a single week.

NMFS believes that the magnitude and intensity of the impact from the directed take on colonies considered herein will be mitigated by the following factors:

1) maximizing the number of colonies that can be saved from crushing injuries would increase the chances of the species' survival;
2) the creation of a coral nursery with long term monitoring should improve survivorship;
3) eventual outplanting and additional coral propagation efforts create opportunities to replace lost colonies;
4) restoring colonies to the area improves the ability of the species to retain its natal range reducing adverse population level effects from loss of genetic connectivity; and
5) retains pre-action biodiversity and coral composition of the environmental baseline within the action area.

However, it is possible that colonies may become stressed from the damage, in particular if simultaneously exposed to other environmental stressors, which may reduce their fitness and possibly lead to their death. Of those collected, most will survive as lesions heal. Survivorship can also be improved if a portion of live rock under the coral can be collected, thereby reducing the chances of actual physical harm to the colony. However, some colonies will die or be severely hampered while recovering. We cannot predict how many of those would die, but consider all 150 as a best estimate.

A. globiceps are widespread and the total global population is estimated to be 654 million colonies (Dietzel et al. 2021; NMFS 2023c). The loss of up to 150 colonies would have a negligible effect on the species throughout their range. The loss of those colonies represents negligible risk to the overall population (i.e., 2.29×10^{-5} percent). We therefore conclude that the proposed action presents negligible risk to the overall species. NMFS considers the risk negligible that project-related effects from direct take from colony collection and indirect take from crushing injuries from CAU placement would not appreciably reduce reproduction rates, numbers, or distribution of this species in the action area, and across their global range.

5 CUMULATIVE EFFECTS

Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). A conclusion of reasonably certain to occur must be based on clear and substantial information, using the best scientific and commercial data available. 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.

NMFS searched for information on future State, tribal, local, or private actions that were reasonably certain to occur in the action area. Most of the action area is outside of territorial waters of the U.S., which would preclude the possibility of future state, tribal, or local action that would not require some form of federal funding or authorization. NMFS conducted electronic searches of business journals, trade journals, and newspapers using Google scholar, and other electronic search engines. Those searches produced no evidence of future private action and their

effects in the action area that would not require federal authorization or funding and is reasonably certain to occur.

We are aware that the Port Authority of Guam provides full services to vessels in support of cargo operations for Guam and Micronesia. According to the Port Authority's (2025) mission statement, they also provide land and infrastructure to private interests to further develop the maritime industries on Guam and are responsible for 90 percent of the island's total imports. Recent quantification on the vessel trips made through the port are not available as the USCG has removed associated port data from Homeport (i.e., the USCG's publicly available data platform), but current information suggests 100,000 shipping containers pass through the port annually although the number of vessel trips is not quantified (Port Authority of Guam 2024a). Additionally, this past year, the port also saw a record number of cruise ships (e.g., 10) using the port (Port Authority of Guam 2024b). It is expected that port operation activities will continue for the foreseeable future. Some activities may require ESA consultation when federal permits are required (e.g., MARAD port repairs as noted previously in the Environmental Baseline).

While we considered various state managed vessel-based fisheries that exist in Guam's waters, we do not believe they will overlap in geographical space for fishing activities and would only overlap when vessels from this proposed action transit materials to the site. The same could be said for recreational boating around Guam as well. The primary effects we would expect from State fisheries and recreational boating, would include injury and mortality from ship strikes and fishing, as well possibly changes in local prey numbers and distribution. NMFS is not aware of any other actions that are likely to occur in the action area during the foreseeable future.

Population growth in Guam is expected to increase due to military personnel relocations from Japan. Increases in human populations will likely increase stressors associated with population growth from increased impervious surfaces, pollutant loading, and effects of recreational activities in the action area. These effects will likely intensify when population grows and may diminish with population decreases.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the Status of the Listed Resources section (Section 2.2).

6 INTEGRATION AND SYNTHESIS

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the Effects of the Action (Section 4) and the Cumulative Effects (Section 5) to the Environmental Baseline (Section 3), and in light of the Status of the Listed Resources (Section 2), formulate our opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of critical habitat as a whole for the conservation of the species.

Our analyses find that the proposed action, while it results in sublethal injuries or stress and occasional death to *A. globiceps*, has very small effects on the dynamics of the populations those

individuals represent or the species those populations comprise. Despite their ESA-listing, the species has a widespread distribution and relatively large number of individuals. However, the species shows a decreasing trend throughout their range from an identical array of effects.

As described in the Effects of the Action section, we estimate that the Navy anticipates up to 150 ESA-listed *A. globiceps* will be adversely affected by the proposed action.

As discussed in the Status of the Listed Resources section, *A. globiceps* is the most abundant of the ESA-listed species in U.S. waters with up to 654 million colonies worldwide, and is found in 13 ecoregions throughout the Indian and Pacific Oceans (Dietzel et al. 2021; NMFS 2023c). Despite its large numbers and good distribution, their temperature and depth range where they live in the water column is limited and changing rapidly. These conditions make this species vulnerable to rapid declines in population during warming events.

The Navy will collect specimens and attempt to transplant colonies that are most likely to survive. The Navy will also select areas to outplant corals at a later time within the action area to improve coral diversity within the area. This reduces the likelihood of *A. globiceps* from being extirpated from the sampled area due to the Navy's action.

Considering the present abundance and distribution of the species throughout its range, the injuries associated with the loss of up to 150 colonies of *A. globiceps* would represent a miniscule portion of the global population. We estimate that at least 70 to 83 of these colonies would be saved through transplantation efforts in an attempt to increase survivorship of the species. The creation of a coral nursery as part of this proposed action with long term monitoring should improve survivorship and eventual out-planting with additional coral propagation efforts would create opportunities to replace lost colonies. Furthermore, restoring colonies to the area improves the ability of the species to retain its natal range reducing adverse population level effects from loss of genetic connectivity and retains biodiversity and diverse coral composition within the action area.

Even in the unlikely case where all 150 colonies were to die, *A. globiceps* would not be vulnerable to extirpation in the area, which could otherwise affect their regional and global distribution. This action will not measurably reduce the abundance, reproduction, spatial structure and connectivity, growth rates, or variance. Thus, the proposed action will not lead to an appreciable reduction in the likelihood of survival or recovery of *A. globiceps*.

7 CONCLUSION

After reviewing and analyzing the current status of *A. globiceps*, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is our biological opinion that the proposed action will not reduce appreciably the likelihood of both the survival and recovery of *A. globiceps* in the wild, and is therefore not likely to jeopardize the continued existence of *A. globiceps*.

8 INCIDENTAL TAKE STATEMENT

Section 9(a) of the ESA prohibits taking of endangered species. 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 term "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). The proposed action results in the incidental take of *A. globiceps*. 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 this incidental take statement (ITS).

We have not yet promulgated an ESA section 4(d) rule prohibiting take of *A. globiceps*, so an exemption from the take prohibitions of section 9 of the ESA is neither necessary nor appropriate for these species.

Consistent with the decision in *Center for Biological Diversity v. Salazar*, 695 F.3d 893 (9th Cir. 2012), we have included an incidental take statement to serve as a check on the no-jeopardy conclusion by providing a reinitiation trigger if the level of take analyzed in the biological opinion is exceeded. In addition, 50 CFR 402.14(i)(3), without regard to 9(a) prohibitions, provides that in order to monitor the impacts of incidental take, "the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the ITS."

8.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of incidental taking as the amount or extent of such taking (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 the action.

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur is described in Table 5.

Table 6. Estimated Amount of Incidental Take.

Species	Type of Take	Amount
Acropora globiceps	Harm, wound, capture through collection, kill	150 colonies

8.2 Reasonable and Prudent Measures

Reasonable and prudent measures refer to those actions the Director considers necessary or appropriate to minimize the impacts of the incidental take on the species (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 the proposed action on threatened and endangered species and to monitor the level and nature of any incidental takes.

1. The Navy shall ensure the proposed action has a monitoring and reporting program sufficient to confirm the amount and extent of take are not exceeded, and that the terms and conditions in this incidental take statement are effective in minimizing incidental take.

8.3 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action may lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:
    a. The Navy shall establish record keeping and reporting standards for these data collections and provide an annual summary to NMFS PRD to track the take and transplantation and propagation efforts of *A. globiceps*.
    b. The Navy shall work with NMFS to develop appropriate monitoring schedules and protocols for a coral translocation plan prior to implementation of the action. If survivorship of translocated corals from subsequent monitoring reports does not meet the 60% survivorship target (as compared to control sites) at the end of the survey period(s), the Navy shall coordinate with NMFS to determine if additional steps can be taken to improve survivorship.
    c. The Navy shall provide annual reports to NMFS by the end of December of each year that detail the results of the monitoring efforts for the previous calendar year.
    d. The Navy shall also coordinate and report all related metrics to the Joint Region Mariana Integrated Resources Management Plan partners at the annual metrics meetings so long as the project or nursery related activities occur.

8.4 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1. The Navy should remove trees along the Sumay Point wall which may impact the walls' function and longevity; and considerations should be made facility-wide through the INRMP. Native vegetation should be used to stabilize the shoreline instead.
2. The Navy should create a facility-wide INRMP coral transplantation plan or program which considers preemptively removing and mariculturing corals from manmade naval structures throughout Apra Harbor. This could extend the service life of Navy structures within the Harbor.
3. The Navy should develop a plan for implementation that would quantify seagrass restoration success (or failure) at Dadi Beach and coordinate a monitoring plan with INRMP partners to determine the ecological services lost or gained to proposed green sea turtle critical habitat from the proposed offset. The 2024 JRM INRMP should be updated by the Navy to include seagrass restoration efforts which are not currently present.
4. The Navy should implement a safety zone based on the projected acoustic isopleth to determine the geographical area required for observation to better protect Central West

Pacific green sea turtle, hawksbill sea turtle, and Indo-West scalloped hammerhead sharks.

5. The Navy should confirm additive acoustic effects do not occur from pile driving activities with concurrent MITT operations in Apra Harbor (e.g., see munition disposal operations in Table 24 of NMFS 20202c) to protect Central West Pacific green sea turtle, hawksbill sea turtle, and Indo-West scalloped hammerhead sharks which may occur in the area. Additive effects are not considered herein and may require reinitiation of both biological opinions if appropriate.

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.

8.5 Reinitiation of Consultation

This concludes formal consultation for the Department of the Navy. Under 50 CFR 402.16(a), reinitiation of consultation is required and shall be requested by the Federal agency, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

1. If the amount or extent of taking specified in the incidental take statement is exceeded;
2. If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
3. If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or
4. If a new species is listed or critical habitat designated that may be affected by the identified action.

9 NOT LIKELY TO ADVERSELY AFFECT DETERMINATIONS

9.1 Stressors Not Likely to Adversely Affect Listed Resources

The applicable standard for a “not likely to adversely affect” determination is being reasonably certain to be discountable, insignificant, or completely beneficial (USFWS and NMFS 1998). Discountable effects are those extremely unlikely to occur. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Beneficial effects are contemporaneous positive effects without any adverse effects. We determined the following stressors are not likely to adversely affect any listed species or designated critical habitats.

Table 7. ESA-listed and proposed resources within the action area that are not likely to be adversely affected by the proposed action. Common name, scientific name, ESA status, effective listing date, critical habitat designation, and recovery plans, with Federal Register reference for ESA-listed species considered in this consultation.

Species/ common name	ESA Status	Effective Listing Date/ FR Notice	Critical Habitat	Recovery Plan
Chelonia mydas Central West Pacific Green Sea Turtle	Endangered	05/06/2016 81 FR 20057	Proposed 07/19/2023 88 FR 46572	
Chelonia mydas Central North Pacific Green Sea Turtle	Threatened	05/06/2016 81 FR 20057	Proposed 07/19/2023 88 FR 46572	
Chelonia mydas Central South Pacific Green Sea Turtle	Threatened	05/06/2016 81 FR 20057	Proposed 07/19/2023 88 FR 46572	
East Indian-West Pacific Green Sea Turtle	Threatened	05/06/2016 81 FR 20057	Proposed 07/19/2023 88 FR 46572	
Southwest Pacific Green Sea Turtle	Threatened	05/06/2016 81 FR 20057	Proposed 07/19/2023 88 FR 46572	
Eretmochelys imbricata Hawksbill Sea Turtle	Endangered	06/03/1970 35 FR 8491		5/22/98 63 FR 28359
Caretta caretta North Pacific Loggerhead Sea Turtle	Endangered	10/24/2011 76 FR 58868		5/22/98 63 FR 28359
Lepidochelys olivacea Olive Ridley Sea Turtle	Threatened	08/27/1978 43 FR 32800		5/22/98 63 FR 28359
Olive Ridley Sea Turtle; Mexico (Pacific coast) breeding populations	Endangered	08/28/1978		43 FR 32800
Dermochelys coriacea Leatherback Sea Turtle	Endangered	06/03/1970 35 FR 8491		5/22/98 63 FR 28359
Neomonachus schauinslandi Hawaiian Monk Seal	Endangered	11/23/1976 41 FR 51612	9/21/2015 (revised) 80 FR 50925	8/22/07 72 FR 46966
Balaenoptera musculus	Endangered	12/02/1970 35 FR 18319		Proposed 10/12/18 83 FR 51665

Species/ common name	ESA Status	Effective Listing Date/ FR Notice	Critical Habitat	Recovery Plan
Blue Whale				
Balaenoptera physalus Fin Whale	Endangered	12/02/1970 35 FR 18319		8/06/10 75 FR 47538
Balaenoptera borealis Sei Whale	Endangered	12/02/1970 35 FR 18319		7/22/11 76 FR 43985
Eschrichtius robustus Western North Pacific Gray Whale	Endangered	12/2/1970 35 FR 18309		
Physeter macrocephalus Sperm Whale	Endangered	12/02/1970 35 FR 18319		12/28/10 75 FR 81584
Eubalaena japonica North Pacific Right Whale	Endangered	04/07/2008 73 FR 12024		6/07/13 78 FR 34347
Megaptera novaeangliae Western North Pacific Humpback Whale	Endangered	09/08/2016 81 FR 62259	4/21/2021 86 FR 21082	
Pseudorca crassidens False Killer Whale Main Hawaiian Island Insular	Endangered	12/28/2012 77 FR 70915	8/23/2018 83 FR 35062	
Orcinus orca Southern Resident Killer Whale	Endangered	11/18/2005 70 FR 69903		
Sphyrna lewini Scalloped Hammerhead Shark Indo West Pacific	Threatened	09/02/2014 79 FR 38213		
Carcharhinus longimanus Oceanic Whitetip Shark	Threatened	03/01/2018 83 FR 4153		
Manta birostris Giant Manta Ray	Threatened	02/21/2018 83 FR 2916		
Corals *Acropora globiceps*	Threatened	10/10/2014 79 FR 53852	7/15/2025 90 FR 31800	
Hippopus hippopus/ Horse's Hoof Clam	Proposed threatened	7/25/2024 89 FR 60498		
Tridacna derasa/ Smooth Giant Clam	Proposed endangered	7/25/2024 89 FR 60498		

Species/ common name	ESA Status	Effective Listing Date/ FR Notice	Critical Habitat	Recovery Plan
Tridacna gigas/ True Giant Clam	Proposed endangered	7/25/2024 89 FR 60498		

NMFS also considers the East Indian-West Pacific green sea turtle, Southwest Pacific green sea turtle, and endangered populations of Olive Ridley sea turtles. These species are documented to occur within U.S. federal fisheries (from genetic data collected by fishery observers; see NMFS 2023b) which overlap the proposed vessel transit route from Guam to Canada.

Table 8 describes the species and critical habitats no longer considered in our analysis of this proposed action. We provide a brief explanation for each below.

The Navy also considered giant clams *Tridacna maxima* and *Tridacna squamosa.* However, the proposed designation of similarity of appearance under section 4(e) of the Act would not extend any other protections of the Act, such as the requirements to designate critical habitat, the recovery planning provisions under section 4(f), or consultation requirements for Federal agencies under section 7, to these two giant clam species. Therefore, should this proposal become final, Federal agencies will not be required to consult with us on activities they authorize, fund, or carry out that may affect either *Tridacna maxima* and *Tridacna squamosa.* Consequently, we do not consider them further in our analyses of the proposed action.

The Navy considered *Acropora retusa* as potentially occurring in Guam from one proposed documented colony. However, the confidence in correct identification is low and the coral cannot be relocated. NMFS does not recognize this coral's presence in Guam (NMFS 2023c), and therefore is no longer considered in our analysis.

After identifying species which may be present in the action area, the Navy did not consider corals: *Fimbriaphyllia paradivisa, Isopora crateriformis, Acropora speciosa;* chambered nautilus, and designated Hawaiian monk seal or MHI insular false killer whale critical habitats further. NMFS does not comment or concur on no effect determinations; therefore, we do not consider them further in our analysis of the proposed action.

We also note, designated coral critical habitat (90 FR 31800) does not occur within the action area given National Security Exclusions under section 4(b)(2), and is not considered further.

Table 8. Species and critical habitat no longer considered in the analysis of the proposed action

Species/ common name	ESA Status	Effective Listing Date/ FR Notice	Critical Habitat	Recovery Plan
Tridacna maxima/ Small Giant Clam	Proposed Threatened (4e)	7/25/2024 89 FR 60498		
Tridacna squamosa/ Fluted Giant Clam	Proposed Threatened (4e)	7/25/2024 89 FR 60498		
Acropora globiceps critical habitat	Threatened	10/10/2014 79 FR 53852	7/15/25 90 FR 31800	

Species/ common name	ESA Status	Effective Listing Date/ FR Notice	Critical Habitat	Recovery Plan
Corals *Acropora retusa*	Threatened	10/10/2014 79 FR 53852	7/15/25 90 FR 31800	
Corals *Acropora speciosa*	Threatened	10/10/2014 79 FR 53852	7/15/25 90 FR 31800	
Corals *Fimbriaphyllia (prev: Euphyllia) paradivisa*	Threatened	10/10/2014 79 FR 53852	7/15/25 90 FR 31800	
Corals *Isopora crateriformis*	Threatened	10/10/2014 79 FR 53852	7/15/25 90 FR 31800	
Nautilus pompilius Chambered Nautilus	Threatened	10/29/2018 83 FR 48976		
Hawaiian Monk Critical Habitat			9/21/2015 (revised) 80 FR 50925	
False Killer Whale Main Hawaiian Island Insular Critical Habitat			8/23/2018 83 FR 35062	

Proposed Critical Habitat in the Action Area

Central West Pacific Green Sea Turtle. In areas of Guam, proposed critical habitat for green sea turtles includes the marine environment from the mean high-water line to 20 m depth. The specific areas within the proposed designation, with their physical and biological features are:

1. From the mean high-water line to 20 m depth, sufficiently dark and unobstructed nearshore waters adjacent to nesting beaches proposed as critical habitat by USFWS, to allow for the transit, mating, and internesting of reproductive individuals, and the transit of post-hatchlings.
2. From the mean high-water line to 20 m depth, underwater refugia (*e.g.*, caves, reefs, protective outcroppings, submarine cliffs, and "potholes") and food resources (*i.e.*, seagrass, marine algae, and/or marine invertebrates) of sufficient condition, distribution, diversity, abundance, and density necessary to support survival, development, growth, and/or reproduction.

Detailed information on proposed green sea turtle critical habitat is available at:
https://www.fisheries.noaa.gov/action/proposed-rule-designate-critical-habitat-green-sea-turtles

9.1.1 Elevated Noise

The Navy may expose all ESA-listed species considered in Table 7 to vessel related noises. However, only nearshore ESA-listed species (specifically the Central West Pacific green sea

turtle, hawksbill sea turtle, Indo-West Pacific scalloped hammerhead shark, *A. globiceps, A. retusa,* and proposed giant clams) would be expected to be exposed to pile driving activities.

Man-made sounds can affect animals exposed to them in several ways such as: non-auditory damage to gas-filled organs, hearing loss expressed in auditory injury (AUD INJ) or temporary threshold shift (TTS) hearing loss, and behavioral responses. They may also experience reduced hearing by masking (i.e., the presence of one sound affecting the perception of another sound).

Vessel transiting
Given the number of vessels the Navy expects to use, the fact that the sound field produced by the vessels is relatively small and would move with the vessel, the animals would be moving as well, vessel transit vectors would be predictable, and sudden or loud noises would be unlikely or infrequent, we are reasonably certain any exposure to noises generated by these vessels would be short-term and transient. These will generally be ignored by animals that are temporarily exposed to sounds emanating from the vessels as part of this proposed action. Numerous studies demonstrate that marine animals are unlikely to change their behavior when confronted with stimuli with these attributes, and we would also expect masking would be highly unlikely to occur, if not improbable. Although hydraulics may have the potential to create loud noises; due to the expected above water operations, frequency and duration of time these species spend at the surface, dissipation of sound from the source, and the poor transference of airborne generated sounds from the vessel to ocean water through the hull, it is highly unlikely noises generated from vessel operations would elicit behavioral reactions from ESA-listed species noted in Table 7. NMFS is reasonably certain some individuals of ESA-listed resources will hear noise, but the resulting response will not rise to the level of harm or harassment, nor would create a noisy environment that could degrade critical habitat and are therefore insignificant.

Pile driving activities
Up to 56 concrete or steel piles (16- to 20-inch diameter; 12 for the Sumay Marina dock piles, 12 for the Sumay Marina Finger dock piles, and 32 for the wave attenuator) would be driven into pre-drilled sites to a depth of approximately 20 feet below the mud line using an impact hammer. Additionally, 10 steel piles will be used to build a temporary trestle in Sumay Marina off of which the repairs will be completed. These piles will be vibrated into the substrate and removed when construction is completed.

Impact pile driving creates a distinctly different sound than vibratory pile driving, the former of which are described as impulse sounds with high wave forms that spike and fall rapidly. These impulsive sounds from impact pile driving are what is commonly associated with fish kills in pile driving by barotrauma or rupturing of gas-filled organs (Popper et al. 2014; Woodbury and Stadler 2008). This mechanism of injury can occur to any animal with gas filled organs, including the lungs and ear drums of mammals and reptiles (Popper et al. 2014). However, impact pile driving is not likely to create sound intensities great enough to rupture lungs or ear drums in sea turtles, but could cause AUD INJ and TTS, and behavioral responses.

To assess the maximum auditory effects of the construction generated noise, we will analyze the impulsive sounds of the impact hammer used to drive piles as these sounds would be the most intense likely to be produced by the proposed activities. Characteristics that factor into pile driving sound generation include pile material, geometry, equipment, and physical site characteristics. Noise from other proposed activities would be less intense, and thus less likely to adversely affect the Central West Pacific green sea turtle, hawksbill sea turtle, Indo-West Pacific

scalloped hammerhead shark, *A. globiceps*, and proposed giant clams. Shutdown zones were calculated by taking the largest isopleth (from behavioral responses or AUD INJ) that occurred at a given structure and pile type and adding an additional 20 m and rounding up to the nearest 10.

To develop some of the hearing thresholds of received sound sources for sea turtles, expected to produce TTS and AUD INJ, the Navy compiled all sea turtle audiograms available in the literature in an effort to create a composite audiogram for sea turtles as a hearing group. Measured or predicted auditory threshold data, as well as measured equal latency contours, were used to influence the weighting function shape for sea turtles. For sea turtles, the weighting function parameters were adjusted to provide the best fit to the experimental data. The same methods were then applied to other species for which TTS data did not exist.

However, because these data were insufficient to successfully model a composite audiogram via a fitted curve as was done for marine mammals, median audiogram values were used in forming the sea turtle hearing group's composite audiogram. Based on this composite audiogram and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to hearing loss or damage. Sea turtles generally have a limited hearing range that appears to end near 1 kHz. It is described in detail in the technical report Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III) (Navy 2017). The frequencies around the top portion of the function, where the amplitude is closest to zero, are emphasized, while the frequencies below and above this range (where amplitude declines) are de-emphasized, when summing acoustic energy received by a sea turtle (Navy 2017). Furthermore, sea turtle' hearing appears to be affected more by particle velocity rather than sound pressure, which is what we generally use for management of sound effects for all animals.

Sea turtles have different ear structures and have different ranges of frequencies than marine mammals. We used a modified version of the publicly available NMFS marine mammal sound calculator (https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance), to calculate the distances for all sound sources. Thresholds for all sound types, exposure types, and hearing groups are presented in the calculator. The thresholds identified in the calculator is established by NMFS (2018) and NMFS (2024a). We used thresholds established by the Navy (2017) for sea turtles in their projects. We grouped both sea turtle species as one because they are similar in body type, ear structure, and hearing range. Barotrauma is predicted for all animals at 237 dB (re 1 µPa). Sea turtles exposed to peak pressures as loud as 232 dB and 204 dB for SEL could experience auditory injury or hearing loss. We also predict that all animals may experience TTS at levels 15 dB less than the AUD INJ thresholds.

Elasmobranchs, like all fish, have an inner ear capable of detecting sound and a lateral line capable of detecting water motion caused by sound (Hastings and Popper 2005; Popper and Schilt 2009). Data for elasmobranch fishes suggest they are capable of detecting sounds from approximately 20 Hz to 1 kHz with the highest sensitivity to sounds at lower ranges (Casper and Mann 2006; Casper and Mann 2009; Casper et al. 2012; Ladich and Fay 2013; Myrberg 2001). However, unlike most teleost fish, elasmobranchs do not have swim bladders (or any other air-filled cavity), and thus are unable to detect sound pressure (Casper et al. 2012). Particle motion is presumably the only sound stimulus that can be detected by elasmobranchs (Casper et al. 2012). Particle motion dynamics and effects to species are poorly understood and merit further research (Popper and Hawkins 2018). Given their assumed hearing range, elasmobranchs are anticipated

to be able to detect the low frequency sound from the proposed pile driving activities if exposed. Furthermore, although some elasmobranchs have been known to respond to anthropogenic sound, in general, elasmobranchs are not considered particularly sensitive to sound (Casper et al. 2012).

Projected isopleths are described in Table 8 of the Navy's BA (DON 2025a) on page 64. The largest isopleth expected to occur from this proposed action will create an AUD INJ isopleth of 45.1 m for the wave attenuator's 36-inch steel pipes with an associated 100 m behavioral isopleth. NMFS confirmed these calculations which considers a peak of 210 dB for one pile per day with 2,400 strikes per day and a transmission loss constant of 15. As noted in the BMPs, the Navy will implement a 120 m observation and shutdown zone for impact pile driving activities to account for these isopleths. Additionally, due to the action area being semi enclosed by Sumay Cove, we expect sounds to be blocked or absorbed within the marina or ground sediments and we predict the zone of influence to be contained within the marina entrance channel.

Marine turtles and scalloped hammerhead sharks may respond to noises by avoiding, halting their activities, experiencing reduced hearing by masking, or approaching source noises. Although the true causes of those anticipated behavior responses are unclear since animals can use other cues such as vision to trigger behavior response. Avoidance is most likely, a common natural reaction by sea turtles and elasmobranchs and considered low risk. With the BMPs, ESA-listed species will avoid effects associated with attraction because construction will stop when sea turtles are observed within 50 yds for general work and 120 m for pile driving activities, and will not restart until the animal is no longer present. This observation zone also includes the area where significant potential effects could occur and includes work stoppages. Additionally, a turbidity curtain will have already been installed providing a physical barrier. Moreover, it is expected that sufficient numbers of observers will be utilized to adequately observe the area, and soft starts will be implemented where lower hammer energy levels will be used initially and ramp-up to full operational speed and force. This will provide an opportunity for an animal to become aware of the noise disturbance and move away from the source on their own accord before higher operational sound levels are reached.

While corals and giant clams have exoskeletons that could break from intense sounds and shock waves, none of the sounds generated from this action are loud enough to break exoskeletons or hard substrates where corals or giant clams are settled. Corals and giant clams are simple organisms that do not use hearing like reptiles or other marine species. We do not expect sounds to have hearing loss or behavioral effects on corals or giant clams. We are reasonably certain that giant clams will not detect or react to sounds generated from this action. Additionally, the giant clam species considered may already be locally extirpated from the action area.

We do not expect the proposed pile driving activities would overlap in time and space with demolition or military exercises as described in the MITT biological opinion (FRP-2014-9070; NMFS 2017a). Particularly for the annual 20 mine neutralization explosive ordnance disposals, the 40 to 60 limpet mine disposals, 45 underwater demolition qualifications, and any sonar testing as described in Table 24 of NMFS 2017a; are not expected to occur in the Sumay Marina channel. Therefore, potential additive acoustic effects are not expected between the two actions. However, NMFS is unsure whether overlap may occur with pile driving activities at the Inner Breakwater. Additive effects were not presented to NMFS by the Navy.

NMFS considers the effects to the Central West Pacific green sea turtle, hawksbill sea turtle, Indo-West Pacific scalloped hammerhead shark, *A. globiceps*, and proposed giant clams exposed to appreciable sounds generated by pile driving activities from this proposed action to be extremely unlikely and therefore discountable.

9.1.2 Exposure to increased turbidity

The Navy may expose nearshore ESA-listed species (specifically the Central West Pacific green sea turtle, hawksbill sea turtle, Indo-West Pacific scalloped hammerhead shark, *A. globiceps*, and proposed giant clams) to elevated turbidity during construction activities, which could cause disturbances or interrupt their behavior. Pelagic species considered in the analysis would not be expected to be exposed to significant quantities of particulate sediment in suspension and are not considered further.

Turbidity can reduce sea turtles' ability to detect predators (Oliver et al. 2000), and sedimentation on coral reefs and seagrass can negatively influence turtle food sources (USFWS and NMFS 1998a, 1998b). Sea turtles are highly motile, and may temporarily avoid localized turbidity plumes in favor of clear water, reducing their exposure risk. These minor movements will be too small to be meaningfully measured or detected, and we would not expect any elevated turbidity to create long-term effects on these species by altering the trophic structure within the action area (Chivers et al. 2013). The effects of turbidity on sharks are not well documented; however, studies (e.g., Yates et al. 2015) suggest that sharks may favor turbid waters, which could provide cover for foraging. But it's possible that Indo-West Pacific hammerhead sharks will temporarily avoid any localized turbidity plumes in favor of clearer water. Corals are sessile and unable to avoid a sediment plume if one occurs. Effects on nearshore ESA-listed species could be variable depending on the time, length, and/or intensity of exposure, and the concentration of the sediment within the water column—referring to the severity of the exposure, and the frequency of exposure (Browne et al. 2015).

Turbidity may occur when equipment contacts the bottom and sediments are disturbed during the removal/placement of CAU. This activity may cause a temporary increase in suspended sediment in the project area. Equipment contacting the bottom including anchors, spuds, and CAU would cause sedimentation resembling the removal of piles, which is considered as a proxy here. Using available information collected from a project in the Hudson River, pile driving activities are anticipated to produce total suspended sediment concentrations of approximately 5.0 to 10.0 milligrams per liter above background levels within 300 ft. (91 m) of the equipment contacting the bottom (NMFS 2017b). The small resulting sediment plume will settle out within a few hours.

Additional BMPs for all activities should minimize the exposure of ESA-listed species to turbidity. All work will be postponed or halted when ESA-listed marine species are within 50 yds. of the activity, and will only begin/resume after the animals have voluntarily departed the area. The Navy will also deploy a silt curtain around work areas to minimize turbidity and sediment movement into surrounding waters prior to armor stone placement and pile driving. Silt curtains will not be used along the outer wall of Glass Breakwater due to rough environmental conditions that do not allow for safe and effective deployment. It is anticipated that a work boat or skiff will be required to deploy and retrieve the silt curtain. If water turbidity levels reach an unacceptable

level a secondary turbidity curtain will be installed. If a visible plume occurs outside of the allowable radius, then operations will cease, and the contractor will evaluate the cause of the problem and take immediate corrective action. Given the temporary nature of turbidity caused by the project activities and the implemented BMPs, we are reasonably certain the effects from exposure to turbidity on ESA-listed individuals will not reach the scale where harm or harassment occur, and are therefore insignificant.

9.1.3 Disturbance from Human Activity and Equipment Operation Including Direct Physical Contact

Disturbance from human activities may affect Central West Pacific green sea turtles, hawksbill sea turtles, Indo-Pacific scalloped hammerhead sharks, *A. globiceps;* giant clams- *T. derasa*, *T. gigas*, and *H. hippopus* in the nearshore. Again, we only consider vessel related effects to the list of pelagic species, and therefore focus on the nearshore species for this stressor discussion.

These disturbances may include visual disturbances from land-based equipment operations (i.e., excavators, bulldozers, cranes, etc.) and the presence of construction workers. Though ESA-listed species are likely habituated to moderate human activity (Martin and Jones 2017), an increase in activity may disturb Central West Pacific green sea turtles, hawksbill sea turtles, and Indo-West Pacific scalloped hammerhead sharks if they move into the action area.

Construction equipment and the presence of construction workers may cause a visual disturbance to ESA-listed species. Land-based equipment operation will occur from shore and produce in-air noise. Elevated in-air noise is unlikely to generate underwater noise above ambient levels because the sound does not efficiently transfer from the air into the water column. Anticipated responses to visual disturbances by ESA-listed species may include a startled reaction resulting in active avoidance or fleeing from the area (Meadows 2004). However, the most frequent response to this type of interaction is a low-energy behavioral avoidance, and ESA-listed species could move away from the activity. This low-energy behavioral avoidance could temporarily displace feeding and resting activities.

The action may also affect these species as displaced stones are removed from the water. It is possible that they will come into contact with these nearshore species. Sea turtles and sharks are highly motile, and will likely avoid work areas due to human presence and noise. However, corals and giant clams are sessile. We already considered the direct take to corals herein. Surveys of the action's footprint did not find proposed ESA-listed clam species which may occur in Guam (*T. derasa*, *T. gigas*, and *H. hippopus*). However, we recognize the Navy confirmed identification on the giant clams that they could, while conversely recognizing not all clams were likely identified given the entire action area was not sampled and take of coral had to be extrapolated. Given the sampled area did not identify these species and the various species' status within Guam, we find it unlikely they may be present within the greater footprint reducing the likelihood of effects from this stressor.

In accordance with the established BMPs, the Navy will designate a competent observer who will search and monitor work sites and adjacent areas at the start of each day, including prior to resumption of work following any break of more than 30 minutes. All in-water work will be postponed or halted when ESA-listed marine species are within 50 m of the proposed work and will only begin/resume after the animals have voluntarily departed the area. Considering the implemented BMPs, including turbidity curtains that will act as a physical barrier between

species and activities, and that ESA-listed designated corals would be translocated, we are reasonably certain that the probability of exposure to direct impacts for Central West Pacific green sea turtles, hawksbill sea turtles, Indo-Pacific scalloped hammerhead sharks, and proposed giant clams- *T. derasa*, *T. gigas*, and *H. hippopus* is extremely unlikely and therefore discountable.

9.1.4 Vessel Collision

The proposed action would expose all ESA-listed marine species under NMFS' jurisdiction found in Table 7 to the risk of collision with vessels. The proposed action requires two vessel trips to deliver aggregate material and stone from quarries abroad. One trip is expected to and from South Korea and one additional trip to British Columbia, Canada. Navy vessels will travel at speeds less than 14 knots (kts.), especially when burdened with construction materials. Vessel speed is an important component of the risk for a collision between a vessel and an individual from a listed species.

The Navy will minimize exposure by operating vessels with professional and certified vessel operators who are trained to operate safely and avoid all visible objects and wildlife at the surface. Observers will alert operators of wildlife at the surface to help avoid collisions.

Nearshore Sea turtles: The action area contains a significant overlap of high-density boating activity and sea turtle habitat. Sea turtles may be in the action area and could be struck by transiting vessels on the high seas, vessels transiting within Apra Harbor, or by small vessels supporting activities during the proposed actions.

Green turtles have been documented occasionally being hit by boats in Guam from stranded animals that have been recovered with propeller wounds (Seminoff et al. 2015). While there are few data on vessel strikes in Guam, we have no indication that the rate of striking is higher than it is in Hawai'i. NMFS (2008) estimated 37.5 vessel strikes of sea turtles per year from an estimated 577,872 trips per year from vessels of all sizes in Hawai'i. More recently, we estimated as many as 200 green sea turtle strikes annually in Hawai'i (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%, calculated by dividing the most recent strike estimate of 200 per year by the best estimate of all vessel transits of 577,872 per year).

Hawksbill sea turtles likely have a much lower rate of strikes when compared to green sea turtles. A lower abundance of hawksbill sea turtles compared to green sea turtles were sighted in surveys around Guam from 2015-2019 (Gaos 2021). The rate is likely lower due to hawksbill sea turtle's preference for deeper offshore waters (Kelly 2020). Vessel strikes to hawksbill sea turtles have not been documented in Guam (Summers et al. 2018), and there were four documented vessel strikes of hawksbill sea turtles between 1984 and 2020 in Hawai'i (Kelly 2020). We have no data to indicate the rate of vessel strike with these species will be higher than the rate in Hawai'i.

Pelagic sea turtles: Leatherback sea turtles, Olive Ridley sea turtles, and Loggerhead sea turtles would likely have a much lower rate of vessel strikes based on the number of transits expected to occur outside Apra Harbor (one transit to and from South Korea and Canada each), and to the number of transits occurring within Apra Harbor.

Turtles cannot consistently notice and avoid vessels traveling greater than two miles per hour (Hazel et al. 2007), thus vessel operators must be responsible for watching out for and avoiding sea turtles. 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. However, the vessels used in the proposed action will operate under a speed restriction of 10 kts. in areas of known turtle activity, and 5 kts. if a turtle is observed. Furthermore, vessels in the proposed action will use other BMPs to reduce ship strike probability of ESA-listed species, including using a dedicated observer, altering course to remain at least 50 yds. from sea turtles, and if an animal comes within those distances, putting the engine in neutral until the animal is at least 50 ft. away. Therefore, the probability of a sea turtle strike is likely less than the overall rate calculated above for nearshore sea turtles. Thus, we are reasonably certain the probability of exposure of any sea turtles to vessel strikes from this action is extremely unlikely, and therefore discountable.

Seals: Hawaiian monk seals are highly agile and vessel strikes with monk seals are infrequent (Carretta et al. 2021, 2024). According to the Pacific Islands Fisheries Science Center's database there have been only four verified vessel strikes of Hawaiian monk seals between 1981 and 2016. Considering the BMPs included with this action (such as a dedicated observer and speed restrictions), the rarity of documented vessel strikes, and monk seals only occurring in the action area from the one vessel transit from Canada to Guam; we are reasonably certain the likelihood of exposure of any monk seal to vessel strikes from this proposed action is extremely unlikely, and therefore discountable.

Whales: Whales surface to breathe, with calves surfacing more regularly than adults. While at the surface, a whale is at risk of being struck by a vessel along transit routes from South Korea or Canada to Guam, or within other ports in Apra Harbor.

In a study by Lammers et al. (2013) documenting trends in collisions between vessels and North Pacific humpback whales, 22 whale/vessel incidents were recorded between 1975 and 2003, with 14 of those occurring during the years from 1994 to 2003. The vast majority (17) of the vessel strikes were from vessels traveling at speeds in excess of 15 kts, and nearly all of them occurred in close proximity to the coastline of the main four Hawaiian Islands. Most ESA-listed baleen whales in the action area will be solitary and the rate of vessel strikes for these species will be likely lower than the rate of strikes documented by Lammers et al. (2013).

Other data suggest that the probability of vessel collisions between whales and vessels associated with this action is low. Over the 2007 to 2016 ten-year period, 11 blue whale ship strikes were observed on the US West Coast, however none were reported for Hawai'i or the Marianas (Carretta et al. 2019). No ship strikes of other threatened or endangered cetaceans were recently reported (Carretta et al. 2019). The severity of vessel strike is directly related to speed, with the probability of lethal injury increasing from 21% at 8.6 kts. to over 79% at 15 kts. or greater (Vanderlaan and Taggart 2007).

Vessels used for the proposed action will be traveling at speeds less than 10 kts. when near marine mammals, and they will use dedicated lookouts, limiting the already extremely low probability of a strike. Based on adherence to BMPs, the collision risks from the references cited above, and the low abundance and widely scattered nature of whales in the action area; the likelihood of an individual from the whale species listed in Table 7 being struck during the proposed action is extremely unlikely, and therefore discountable.

Invertebrates: While it has properly been assumed for ESA-listed coral species that physical contact of equipment or humans with an individual constitutes an adverse effect due to high potential for harm or harassment, the same assumption does not hold for ESA-listed corals due to two key biological characteristics:

1. All corals are simple, sessile invertebrate animals that rely on their stinging nematocysts for defense, rather than predator avoidance via flight response. So, whereas it is logical to assume that physical contact with a vertebrate individual results in stress that constitutes harm and/or harassment, the same does not apply to corals because they have no flight response.
2. Most reef-building corals, including all the listed species, are colonial organisms, such that a single larva settles and develops into the primary polyp, which then multiplies into a colony of hundreds to thousands of genetically-identical polyps that are seamlessly connected through tissue and skeleton. Colony growth is achieved mainly through the addition of more polyps, and colony growth is indeterminate. The colony can continue to exist even if numerous polyps die, or if the colony is broken apart or otherwise damaged. The individual of these listed species is defined as the colony, not the polyp, in the final coral listing rule (79 FR 53852). Thus, affecting some polyps of a colony does not necessarily constitute harm to the individual.

Corals are sessile invertebrates which do not move locations except for extenuating circumstances such as when progeny are broadcasted into ocean currents or breakage and recolonization of substrate from severe weather events. Vessels are expected to use established transportation channels or be deep enough water to avoid contact with corals and would only pertain to transits where *A. globiceps* has been documented (i.e. nearshore).

Similarly, giant clams have exoskeletons and are sessile invertebrate animals like corals. While they do not support a colony of polyps like coral and will not regrow fragments that are broken, they share the same habitat, have many of the same ecological needs, and face the same threats as corals. We do not expect vessel damage from Navy's proposed action because they are expected to use established transportation channels or be deep enough water to avoid contact with reefs and hard substrates where corals and giant clams live.

In conclusion, given the small number of vessels participating and the small number of anticipated vessel trips, the slow vessel speeds during transiting, the expectation that ESA-listed marine species would be widely scattered throughout the proposed action area, the potential for an incidental vessel strike is extremely unlikely to occur. Thus, NMFS is reasonably certain this the probability of vessel collision with all ESA-listed species considered in Table 7 is extremely unlikely, and therefore discountable.

9.1.5 Introduction of Vessel Wastes and Discharges, Gear Loss, and Vessel Emissions

The diffuse stressors associated with the vessel operations: vessel waste discharge, gear loss, and carbon emissions and greenhouse gasses, can affect both pelagic and coastal areas. ESA-listed species could be exposed to discharges, and run-off from vessels that contain chemicals such as fuel oils, gasoline, lubricants, hydraulic fluids and other toxicants. Navy vessels burn fuel and emit carbon into the atmosphere. Parker et al. (2018), estimates that in 2011, the world's fishing fleets burned 40 billion liters of fuel and emitted 179 million tons of carbon dioxide greenhouse

gasses into the atmosphere. Between 1990 and 2011, emissions grew by 28% primarily due to increased harvests of crustaceans, a fuel intensive fishery (Parker et al. 2018). While we don't have an accurate estimate of the carbon footprint of the Navy's activities, we expect the contribution to global greenhouse gases to be relatively inconsequential based on the low number of vessel trips required for this proposed action.

The Navy will implement BMPs to prevent the introduction of plastics and spills. If any accidental spill were to occur, it is anticipated to be small in size, contained, and quickly cleaned up prior to entering the aquatic environment. Although leakage, wastes, gear loss and vessel emissions could occur as a result of Navy's actions, given the small number of vessels, use of BMPs, large action area, low density of ESA-listed species; the probability that ESA-listed resources will be exposed to measurable or detectable amounts of wastes, gear, or emissions from this action is extremely unlikely, and therefore discountable to all ESA-listed resources noted in Table 7.

9.1.6 Entanglement

ESA-listed species could become entangled in lines, turbidity curtains, or through exposure to project related trash and debris. Entanglement can cause ESA-listed individuals to be injured or can even cause death. The project's equipment will be managed closely and materials will be deployed in the water only when necessary. In addition, implemented BMPs will reduce the likelihood of entanglement occurring. BMPs require that in-water tethers and mooring lines for vessels and marker buoys are the minimum lengths necessary, anchor lines from construction vessels must maintain appropriate tension, and the removal of construction related equipment that poses an entanglement hazard when not in use. Based on the lack of documented cases of entangled ESA-listed species and the implemented BMPs, NMFS concludes that the effects of entanglement on ESA-listed species to be extremely unlikely and therefore discountable to all species in Table 7.

9.1.7 Unexploded Ordinance

Munitions and explosives of concern (MEC) material could present an explosive hazard (MPPEH), or unexploded ordnance (UXO) may be present in Apra Harbor as a result of World War II-era activities which may affect the nearshore species (Central West Pacific green sea turtles, hawksbill sea turtles, Indo-Pacific scalloped hammerhead sharks *A. globiceps, T. derasa, T. gigas*, and *H. hippopus)*. Pelagic species under consideration would not be expected to be exposed to this stressor and are not considered further.

However, there is no documented evidence of past MEC use in the action area, and MEC activities are not performed currently in the action area. The extensive dredging required to change the depth profile of Apra Harbor post-WWII should have removed any potential MEC from the sediments within Apra Harbor and historical maintenance dredging noted in Table 5 did not discover any. Therefore, the likelihood of encountering MEC, MPPEH, or UXO in the action area is low and expected effects to the Central West Pacific green sea turtles, hawksbill sea turtle, Indo-Pacific scalloped hammerhead shark, *A. globiceps, T. derasa, T. gigas*, and *Hippopus hippopus* are therefore discountable.

9.2 Critical Habitats Not Likely Adversely Affected

We determined the following critical habitats are not likely adversely affected by the proposed action.

9.2.1 Proposed Critical Habitat for Central West Pacific green sea turtle

In Section 9.1, we described effects of the action that could expose individual marine animals including sea turtles, cetaceans, elasmobranchs, and invertebrates to stressors that could potentially harm and harass them. In this section, we will evaluate the effects of the action to proposed green sea turtle critical habitat (88 FR 46572).

Sound Exposure
Sound effects are described in detail in the section above. All sounds generated from all activities are intermittent and temporary in context of the species life histories and will cease once activities are complete. Green sea turtles could hear sounds from vessel noise, divers, pile driving, and other general activities near them but the sources are temporary in nature and are low in intensity. None of the sound sources generated in this action are intense enough, occur frequently enough, or are at durations that can exclude sea turtles from important habitat that supports forage, resting, or access to reproduction areas considering their life histories. Sound exposure is not reasonably certain to prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat as we would consider this stressor insignificant.

Vessel Groundings
This project will only require relatively small vessels to access the various sites, would be transient, and only a low number of trips are expected to occur for all projects considered. The greatest risk of a grounding will likely be the transportation of CAU within Inner and Outer Apra Harbor as 50-ton CAUs are transported by barges for placement at the breakwater. When transiting, vessels and barges will use established transportation channels or be deep enough water to avoid grounding. Barges will be secured to piles installed at the breakwater to support transportation operations and are designed at a depth to eliminate this risk. As such, any risk of grounding will be extremely unlikely to occur.

A vessel grounding in Guam could have severe consequences to the environment and species that depend on the habitat for survival. This area is used for feeding, resting, or various stages of the Central West Pacific green sea turtle’s life cycle. Therefore, exposure risks to this stressor would be variable depending on the location of a grounding or unintended CAU loss or misplacement. Effects to the overall area would depend on the specific site, condition and situation of the vessel or CAU, environmental conditions, exposure interval, and many other variables. Precht et al. (2001) also highlighted that these events may reduce habitat complexity and open space for colonization of algae.

The Navy will minimize the risk of a vessel and barge grounding by using experienced vessel staff, requires operational and maintenance standards for vessels, implements slow boat operating speeds through established BMPs, uses observers to avoid interactions with listed species, and dictating preferable ocean conditions for such operations to commence with contingency plans to cancel or delay the action for favorable weather conditions, and the low

number of expected trips. Additionally, in case of an emergency or safety situation, the captain and crew will rely on their expertise to anchor the vessel following established BMPs. This decreases the likelihood of vessel collisions in the action areas that concurrently exist with proposed green sea turtle critical habitat. Therefore, we are reasonably certain the Navy's activities will not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat. Thus, the risks to proposed green sea turtle critical habitat from the effects of a vessel grounding are extremely unlikely to occur and are therefore discountable.

Vessel wastes and discharges, gear loss, and vessel emissions
We evaluated the effects of potential accidental spills and discharges, and vessel emissions to individuals in the above section. The pathway of exposure of this stressor is generally through exposure of pollutants in their habitat because direct exposure of pollutants onto individual animals is highly unlikely. Exposures are more likely to occur by pollutants entering the water (habitat) and animals swimming through or ingesting it. We determined that individuals have an extremely low probabilities of being exposed to spills and discharges, and effects of vessel emissions would be undetectable because the Navy is incorporating BMPs which minimizes the potential for pollutants entering the water and isolating and cleaning it if it does. Therefore, the potential effects of vessel wastes and discharges, gear loss, and vessel emissions are reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat as appreciable exposure to the stressor is extremely unlikely and therefore discountable.

Changes in Food Availability:
The Navy may temporarily reduce food sources in the action area through construction activities. However, the construction is temporary and episodic, and the amount is minimal portion of the available forage at each sampling location. The nominal reduction of forage at sample sites will not measurably reduce the amount of forage at those locations and are reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat as the stressor is insignificant.

Anchoring
Anchoring could cause temporary disturbance to benthic habitat. The Navy will avoid hard substrate or damaging coral reefs from anchoring. Coral reefs and hard substrates generally support algae and other forage and often provide cover for refuge and resting for green sea turtles. Avoiding reefs and hard substrates minimizes effects to forage and refuge habitat. As mentioned in the section above, anchoring is not expected to create entanglement hazards that can harm animals in the habitat. Therefore, anchoring is reasonably certain to not prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat as the stressor is highly unlikely to occur and is discountable.

In-water personnel work
Nearshore work by personnel will occur in green sea turtle critical habitat. This can cause temporary disruption or displacement which may disrupt feeding or resting while divers are in the area but will return to ambient conditions once the divers leave the area. None of the effects

from these stressors would prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches. Therefore, in-water work completed by personnel are not reasonably certain to prevent accessibility to, nor measurably reduce the quantity or quality of forage and resting areas, and nearshore areas adjacent to nesting beaches, and is not likely to adversely affect proposed green sea turtle critical habitat as the stressor is highly unlikely to occur and is discountable.

Habitat modifications

The Navy only considered acoustic effects to proposed green sea turtle critical habitat and did not consider the removal or unavoidable loss of all corals and benthic disturbance from the habitat on which the Central West green sea turtles depend on. Therefore, a benthic analysis was not conducted or presented by the Navy to assess potential effects and whether destruction or adverse modification would occur from activities at the breakwater in their BA (see DON 2025a).

However, a Habitat Equivalency Analysis (HEA) was provided in the EFH consultation (NMFS 2025a) which estimated the overall construction footprint. The Navy reduced the overall construction footprint to avoid approximately 584,244 ft^2 of direct impacts along the Outer Breakwater, but the activities associated with this action will still directly impact an estimated 511,878 ft^2 of habitat (11.75 acres). The Navy then built in several conservative assumptions into the HEA parameters to account for ecosystem service levels and discount rates, resulting in an estimated replacement habitat requirement of 321,723 ft^2 from the breakwater construction, 7.5 ft^2 from the Sumay marina replacement, and 191 ft^2 from the Sumay revetment repairs (total 321,921.5 ft^2). This results in the benthic modification of 7.39 acres from the proposed action. As noted in 88 FR 46572, we proposed to designate occupied critical habitat, encompassing 202 km^2 (49,915.3 acres) of nearshore waters in Guam and CNMI (Saipan, Tinian, Rota, Pagan, Aguijan, Alamagan, Sariguan, and off the nesting beaches at Agrihan), from the mean high-water line to 20 m depth.

The amount of benthic habitat which may be affected from the proposed action would therefore equate to 0.01% of essential habitat range-wide (7.39 acres/ 49,915.3 acres*100) for Central West green sea turtles. Additionally, the footprint of the current wall will marginally be expanded from previous design specifications although it is close to the toe of the existing wall. An example is provided in Figure 13.

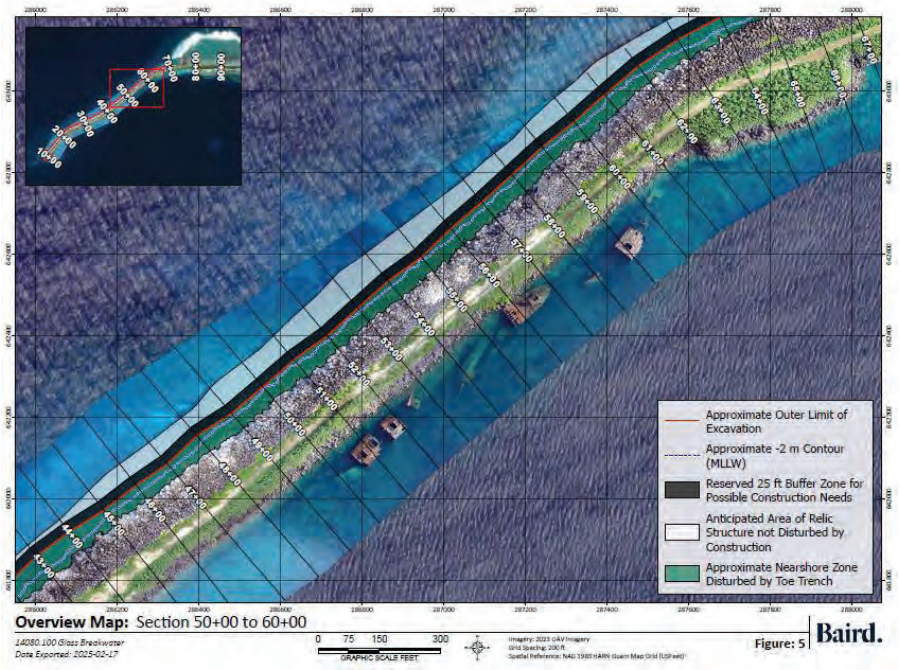

Figure 13. An example section of the breakwater illustrating projected footprint of the action as it relates to the current wall. The light blue area is that from the construction buffer to the relic toe, which will not be impacted.

However, NMFS believes the amount of benthos that might be temporarily adversely affected from the proposed action would not result in a significant amount of habitat loss that would translate to fitness level effects (i.e., growth, development, longevity, and reproduction) in the Central West Pacific green sea turtle. There should be sufficient comparative habitat present locally in Apra Harbor and the greater habitat we would consider essential to these species' survival elsewhere within their respective range. While temporary avoidance of the breakwater may occur, Central West Pacific green sea turtles should be able to find sufficient forage within and around Apra Harbor. We also do not believe the action results in destruction of the proposed critical habitat given the projects footprint compared to the current wall (i.e., the environmental baseline).

Lastly, the Navy is proposing two offsets through their EFH consultation (DON 2025b; NMFS 2025a) including one to restore seagrass habitat at Dadi beach which would improve proposed green sea turtle critical habitat by restoring ecological services and functions. While we applaud these proposed restoration efforts, given that adverse effects will occur to the habitat from the action, we cannot conclude the proposed actions is wholly beneficial. However, it is not expected

to result in any measurable effects to the essential features of the proposed critical habitat and is therefore insignificant.

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Appendix D: NHPA Section 106 Consultation Documentation

NBG NHPA Section 106 Letter to SHPO for Emergency Glass Breakwater Repairs EA (EA-1) with Addendum including Apra Harbor Waterfront Repairs EA (EA-2)

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV /078
March 13, 2025

Patrick Lujan
State Historic Preservation Officer
Department of Parks and Recreation/Guam Historic Resources Division
490 Chalan Palasyo
Agaña Heights, Guam 96910

Dear Mr. Lujan,

Subject: ADDENDUM TO EMERGENCY REPAIRS TO GLASS BREAKWATER, NAVAL BASE GUAM

Naval Base Guam requests your review of our proposed project changes to conducting emergency repairs to the Glass Breakwater, Naval Base Guam, pursuant to Section 106 of the National Historic Preservation Act (NHPA). You have previously reviewed the initial repair portions of this project (RC2024-0091) and, after discussion and additional information was provided, concurred with a determination of No Adverse Effect. This project is similar to repairs undertaken in 2011 with SHPO concurrence (RC 2011-9550) of the Navy's "No Adverse Effect" determination.

We have reviewed the project scope and determined that it is an undertaking as defined in 36 CFR 800.16(y) and the 2008 Programmatic Agreement among the Commander, Navy Region Marianas, the Advisory Council on Historic Preservation, and the Guam Historic Preservation Officer regarding Navy Undertakings on the Island of Guam ("2008 PA"), Section I. This undertaking does not meet the conditions of "Undertakings Requiring No Further Review" (2008 PA Section VII.A), and thus will be reviewed in accordance with the same review process as others under 36 CFR 800.3–800.7, as allowed by Section VII.B.1.

In consideration of the information presented in Enclosure (1) and previous SHPO concurrence for the same type of undertaking in the same area (Enclosure 2), a finding of "No Adverse Effect" is applicable to the proposed project. In accordance with 36 CFR 800.4 (d)(1), if we receive no response from your office within 30 days of receipt of this letter, we will consider our responsibilities under Section 106 fulfilled.

Should you have any questions or require additional information, my point of contact regarding this matter is Mr. Lon Bulgrin at [redacted].

Sincerely,

Ed Moon

E. E. Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam
2. Section 106 Consultation For Emergency Repairs To Glass Breakwater, Naval Base Guam

Email addresses and phone numbers are redacted for security.

National Historic Preservation Act

Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

Purpose:

The project proposes to establish mooring locations, a barge loading area, and construction yards that will be required to support construction activities on the Glass Breakwater, Polaris Point, the Ship Repair Facility and Sumay Point. Also, repair/reconstruct Sumay Point, docks within Sumay Cove, and replace a wave attenuator in Sumay Cove. (Figures 1-3). The laydown areas, concrete casting yards, and staging areas are numbered 1, 2, 2a, 3, 5, 6, 7, and 10 (Figure 3). Please note that additional laydown areas 4, 8, and 9 were initially considered for use but were rejected because of vegetation and other factors and are not considered within this current consultation.

Statement of Work: Project works include the following:

- Define 5 mooring locations for the project in Apra Harbor (each approximately 2,428 sq. M/.6 Acres, Figure 2)
- Establish a barge loading area in Apra Harbor (Site 3 Hotel Wharf, Figures 2 and 3)
- Establish a Primary Concrete Casting Yard (Site 6, Figures 2 and 3) on Polaris Point, a Contingent Storage Yard and Secondary and Potential Secondary Concrete casting Yard on Cabras Island (Site 5, Figures 2 and 3), a Contingent Loading Area in the Ship Repair Facility at NBG Oscar/Papa/Quebec Wharves area Apra Harbor (Site 10, Figures 2 and 3) , a proposed Construction Staging Area on Sumay Point, the peninsula between Sumay Cove and Clipper Cove (Site 7, Figures 2 and 3), and 3 laydown areas on the Glass Breakwater itself (Sites 1, 2, and 2a, Figures 2-5).

Site #	*Total Site Area*
1	1,093.0 Sq. M/0.27 Acres
2	323.8 Sq. M./0.08 Acres
2a	242.8 Sq. M/0.06 Acres
3	13,354.6 Sq. M/3.3 Acres
5	32,172.5 Sq. M/7.95 Acres
6	82,151.2 Sq. M/20.3 Acres
7	18,615.5 Sq. M/4.6 Acres
10	26,709.2 Sq. M/6.6 Acres
5 Mooring Locations	Approximately 12,140.5 Sq. M/3.0 Acres
Total Site Area	186,803.1 Sq. M / 46.16 Acres

- Clearing and grading will occur at only two of the sites, Site 5 and Site 6. Site 5 will have 7.95 acres cleared and graded and run off drains installed. Site 6 will have 20.3 acres cleared and graded, and run off drains installed.
- Chain link fencing will be installed at 5 sites, Sites 3, 5, 6, 9, and10. All fencing will be installed within the acreage for the sites already displayed in Table 1.
- There will be no specialized erosion control employed, except for silt fencing. Silt fencing will be installed at the same locations where the chain link fence is installed.

Page 2 of 11

National Historic Preservation Act
Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

- Reconstruct/stabilize/repair the tip of Sumay Point. The existing engineered revetment along Sumay Point would be repaired by removing a deteriorated steel subsurface structure (approximate dimensions 30 in. X 10 in. X 100 in.) and restoring the rock revetment protection. Excavation will extend to 3 ft./1 M below ground surface. The surface and slope of the current rock revetment will be strengthened and increased. The new rock would be placed such that it ties into the existing rock in the water and at both ends. All materials used in the repairs will be similar to the original materials used. The area of improvements at Sumay Point will be approximately 27,200 sq. ft./2,527 sq. M.
- Conduct dock piling repairs in Sumay Cove. The project proposes to drive up to 12 (16- to 20-inch diameter) concrete piles to provide lateral support and replacement of existing deteriorated piles for the floating docks supporting the U.S. Coast Guard, Port Operations and Navy Security Forces vessels. Each pile would be hammered to a depth of approximately 20 feet below the mud line. The area of the proposed Sumay Cove dock improvements is approximately 142 sq. M./1,529 sq. ft.
- Construct a Fixed Wave Attenuator in Sumay Cove. The wave attenuator is intended to block wave energy that would adversely affect the Sumay Marina docks. Up to 32 steel concrete piles (16- to 20-inch diameter) would be driven into pre-drilled sites to a depth of approximately 20 feet below the mud line to support the fixed wave attenuator. The face of the attenuator would be constructed of steel or concrete panels that are attached above the water and extend below the waterline with a gap at the bottom to allow for water flow. A concrete cap would be constructed on the piles and navigation lights installed on the cap. The area of the proposed Fixed Wave Attenuator is approximately 565.5 sq. M./608 sq. ft.

Area(s) of Potential Effect (APE):

The APE is determined to be the area encompassed by the proposed project, as depicted in Figures 1 - 5. The total area of the APE is approximately 186,803.1 sq. M./46.16 acres.

Identification of Historic Properties:
In order to meet identification responsibilities contained in 36 CFR 800.4(a) and (b), the Navy conducted nine archaeological, architectural and cultural resources surveys within the APE; Carrel 1991, Lauter-Reinman 1997, Yoklavich and Reinman 1997, Hunter-Anderson et.al. 2001, Mason and Weize 2009, Aaron 2011, Dixon et.al. 2011, Carrell et.al. 2020 and Meehl 2025 (Table 1). Only one of the surveys included subsurface testing. None of these surveys discovered any historic properties in the APE.

Author	*Date of Publication*	*Type of Investigation*	*Location*
Carrell	1991	Underwater Survey	Apra Harbor
Lauter-Reinman	1997	Management Survey of WWII resources	NBG
Yoklavich and Reinman	1997	Surface Survey and Architectural Survey	Naval Hospital and Ship Repair Facility
Hunter-Anderson, Dixon, and Mangieri	2001	Surface and Subsurface Survey	Polaris Point

Page 3 of 11

National Historic Preservation Act

Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

Mason and Weitze	2009	Architectural Inventory Survey	NBG
Aaron	2011	Cold War Context and Historic Properties Overview	NBG
Dixon, Walker, and Carson	2011	Surface Survey	Cabras Island
Carrell, Krivor, Burns Pruitt, and Wright.	2020	Underwater Survey	Apra Harbor
Meehl	2025	Cultural Resources Surface Survey	Clipper Cove

- As identified in Aaron (2011); Lauter-Reinman (1997); Mason (2009), the portions of the APE (Laydown Sites 1, 2, 2a, and 3) on the Glass Breakwater are located in fill lands.
- The Glass Breakwater that was constructed between 1941 and 1946 is eligible for inclusion in the National Register of Historic Places (Aaron 2011; Lauter-Reinman 1997; Mason 2009).
- Site 5 is located in the Cabras Quarry on Cabras Island. This area was surveyed by Dixon et.al. 2011. No historic properties were discovered.
- Hunter-Anderson et.al. (2001) surveyed the Site 6 construction yard location and identified Site 66-3-1723, a post-WWII fuel storage facility. Site 66-3-1723 was determined not eligible for inclusion on the National Register of Historic Places.
- Meehl has detailed that the laydown area (Site 7) at Sumay Cove is located within fill lands created during WWII. No historic properties were identified in this portion of the APE.
- Laydown area Site 10 is located in Post WWII fill lands. Yoklavich and Reinman surveyed this portion of the APE and did not identify any historic properties.
- The five proposed mooring locations have no historic properties within the APE based upon Carrell (1991) and Carrell et.al. (2020).
- The Sumay Point restabilization area was surveyed by Meehl (2025) and the Pontoon Pier K Site was located within the APE. Meehl determined that the pier was significantly deteriorated, had been altered by later seawall repair projects, and was not eligible for the National Register of Historic Places.
- Both the dock piling construction area and the proposed Fixed Wave Attenuator in Sumay Cove are in areas that were extensively dredged during WWII and have had maintenance dredging in the interim. No historic properties have been identified within this portion of the APE.

Determination of Effect:

- Project areas have been previously disturbed (e.g., original construction and grading).
- Ground disturbance (gate/haul road) will be limited to areas where there are existing structures.
- The breakwater is structurally damaged from previous typhoons, namely Typhoon Mawar. Extensive natural wave battering and erosion has damaged the structure.
- The damaged revetment on the Glass Breakwater poses a public health and safety issue.

Page 4 of 11

National Historic Preservation Act
Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

- Repairs of the Glass Breakwater are essential to maintain and ensure the structural stability of the structure. Failure to provide these repairs will lead to further damage to the historic property.
- All materials used in the repairs will be similar to the original materials used for the construction of the breakwater.
- The boulders/rip rap will match existing erosion control measures in the area and shall have minimal impact to the visual landscape.
- The Glass Breakwater is the only historic property identified in the APE. No historic properties were identified in any lay down area, stabilization location, or site improvement located outside of the Glass Breakwater.

Section 106 Evaluation:

In consideration of the evaluated project information, the Naval Base Guam has determined a finding of **"No Adverse Effect"** for the proposed repair to damages on Glass Breakwater.

Certification
The undersigned certifies that, to the best of my knowledge, information, and belief, formed after reasonable inquiry, the information in this report is true, accurate, complete and is provided as a part of our agency's responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended.

Lon Bulgrin, M.A.
Cultural Resources Manager/Archeologist
Naval Base Guam

3/13/2025
Date

Page 5 of 11

Reference(s):

Carrell TL.
1991. *Submerged Cultural Resources Assessment of Micronesia.* Southwest Cultural Resources Center Professional Papers, Number 36. Santa Fe, New Mexico.

Carrell TL, Krivor MC, Burns JM, Pruitt JR, Wright AE.
2020. *Co- Knowledge Production of Historic Property and Habitat Assessments on Navy Coastal Submerged Lands for the Island of Guam.* Volume 1. Cooperative Agreement Number N40192-2-8008. Santa Fe: Ships of Discovery.

Dixon, B., S. Walker, and M. Carson
2011 *Final Report, Cultural Resources Investigations Conducted In The Territory Of Guam Supporting The Joint Guam Build-Up Environmental Impact Statement: Final Archaeological Surveys On Guam 2008-2009 At Air Force Barrigada, Proposed Live Fire Training Range, Andersen South, And Naval Base Guam.* Prepared for NAVFAC Pacific, Pearl Harbor. TEC Inc. and Richard Flores Taitano Micronesian Area Research Center, University of Guam.

Hunter-Anderson, R.L., B. Dixon, and T. Mangieri
2001 *Cultural Resources Survey Of Five Navy Surplus Guam Land Use Plan Parcels, Territory Of Guam.* Prepared for NAVFAC Pacific, Pearl Harbor. Micronesian Archaeological Research Services, Inc.

Lauter-Reinman, Gloria A.
1997 *Final Report. Management Plan for World War II Resources at Navy Installations in Guam. Prepared in Conjunction with Department of Defense Legacy Resource Management Program: #349.* Prepared for Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, HI. Ogden Environmental and Energy Services Co, Inc., Honolulu, HI.

Mason Architects Inc. and Weitze Research (Mason and Weitze)
2009 *Cold War Historic Context and Architectural Inventory for Naval Base Guam.* Prepared for NAVFAC Pacific, Pearl Harbor. Mason Architects Inc. and Weitze Research.

2011 *Regional Cold War History for Department of Defense Installations in Guam and the Northern Mariana Islands.* Department of Defense Legacy Resource Management Program. (Legacy 09-454). Archer, Inc., Annapolis, Maryland. https://www.denix.osd.mil/cr/historic/cold-war/index.html.

Meehl, Nichole
2025 *Final Report - Architectural Survey Clipper Cove and Standard Oil Causeway, Naval Base Guam. MASON Architects, Honolulu, Hawai'i.* Under Contract to International Archaeology, Prepared for Naval Facilities Engineering Systems Command Marianas, Contract N62742-21-D-1801; Delivery Order N4019223F4224. Prepared by Mason Architects, Honolulu, Hawai'i.

National Historic Preservation Act
Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

Yoklavich, A. and F. Reinman
1997 *Cultural Resources Overview Survey at Naval Hospital and Ship Repair Facility, Guam In Conjunction with Department of Defense Legacy Resource Management Program: Project No. 70.* Prepared for Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, HI. Ogden Environmental and Energy Services Co, Inc., Honolulu, HI.

Figure 1. Location of the APE.

National Historic Preservation Act

Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

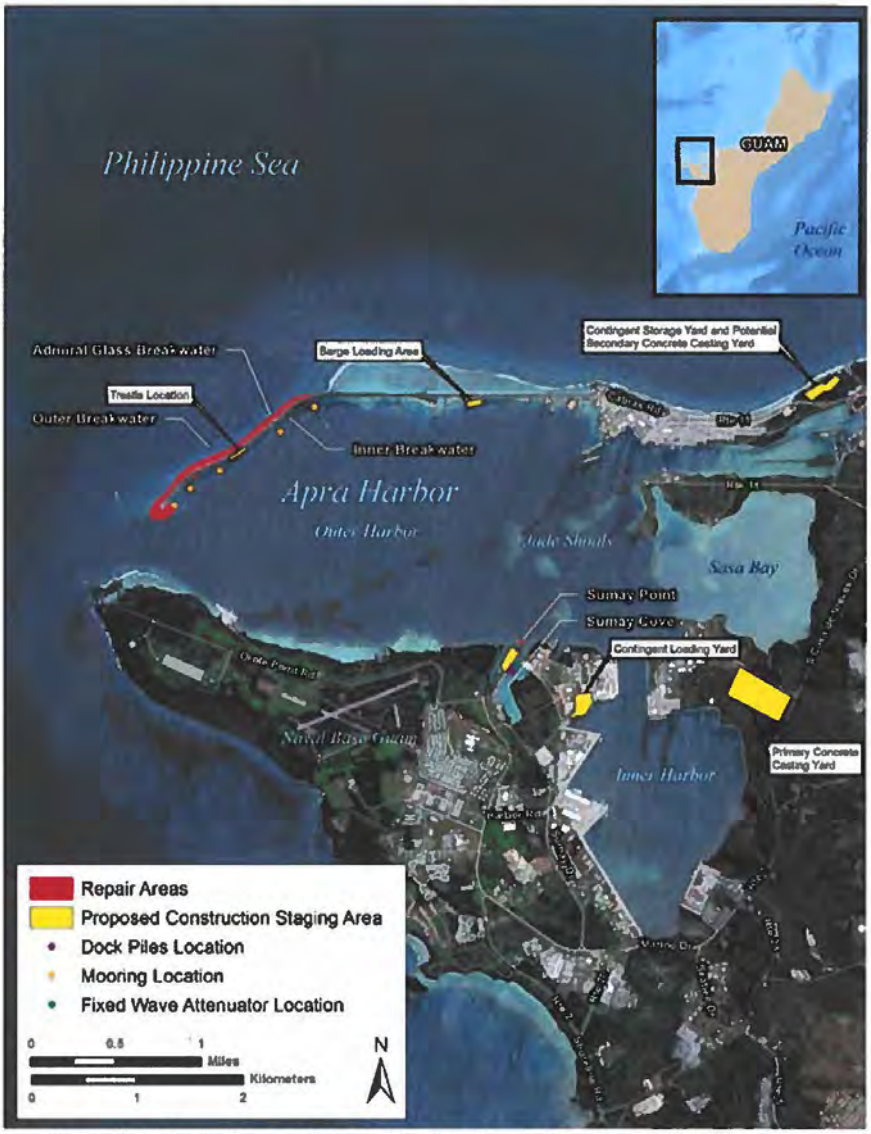

Figure 2. Enlarged view of Apra Harbor showing locations of APE.

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National Historic Preservation Act

Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

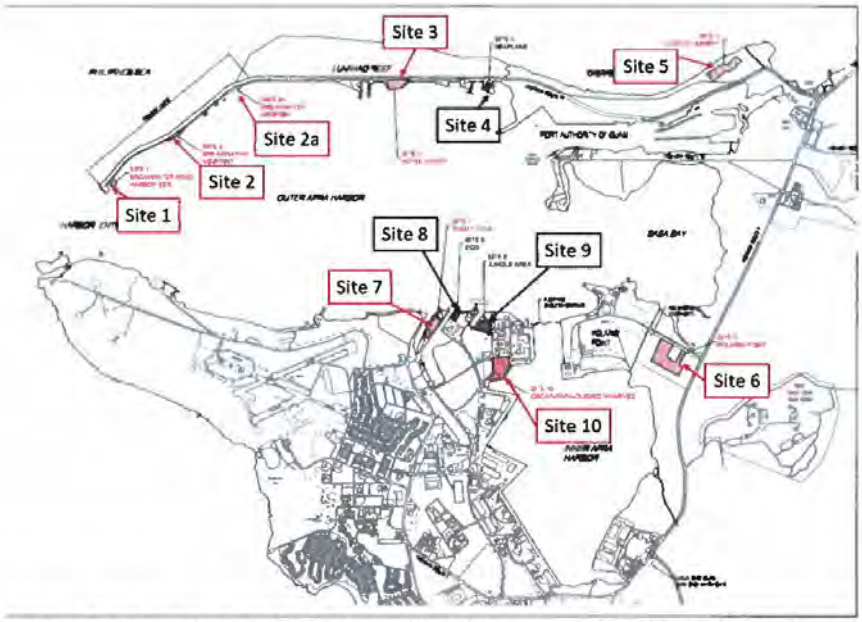

Figure 3. Locations and numbering of all proposed lay down areas. Note that only laydown areas depicted in red are being consulted on. The laydown areas depicted in black are only shown so that gaps in numbering can be understood.

National Historic Preservation Act
Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

Figure 4. Sumay Point restabilization area APE.

National Historic Preservation Act

Enclosure 1. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

Figure 5. The location of the dock piling construction area and the proposed fixed wave attenuator in Sumay Cove

Enclosure 2. Addendum to Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

RECEIVED
La 931
DEC 28 2023
GUAM HISTORIC RESOURCES DIVISION

5090
Ser EV/133
27 December, 2023

Patrick Lujan
State Historic Preservation Officer
Department of Parks and Recreation/Guam Historic Resources Division
490 Chalan Palasyo
Agaña Heights, Guam 96910

Dear Mr. Lujan,

Subject: EMERGENCY REPAIRS TO GLASS BREAKWATER, NAVAL BASE GUAM

Naval Base Guam requests your review of our proposed project to conduct emergency repairs to the Glass Breakwater, Naval Base Guam, pursuant to Section 106 of the National Historic Preservation Act (NHPA). This project is similar to repairs undertaken in 2011 with SHPO concurrence (RC 2011-9550) of the Navy's "No Adverse Effect" determination.

We have reviewed the project scope and determined that it is an undertaking as defined in 36 CFR 800.16(y) and the 2008 Programmatic Agreement among the Commander, Navy Region Marianas, the Advisory Council on Historic Preservation, and the Guam Historic Preservation Officer regarding Navy Undertakings on the Island of Guam ("2008 PA"), Section I. This undertaking does not meet the conditions of "Undertakings Requiring No Further Review" (2008 PA Section VII.A), and thus will be reviewed in accordance with the same review process as others under 36 CFR 800.3–800.7, as allowed by Section VII.B.1.

In consideration of the information presented in Enclosure (1) and previous SHPO concurrence for the same type of undertaking in the same area (Enclosure 2), a finding of "No Adverse Effect" is applicable to the proposed project. In accordance with 36 CFR 800.4 (d)(1), if we receive no response from your office within 30 days of receipt of this letter, we will consider our responsibilities under Section 106 fulfilled.

Should you have any questions or require additional information, my point of contact regarding this matter is Mr. Lon Bulgrin at [redacted]

Sincerely,

Ed Moon

E. E. Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosure 1. Section 106 Evaluation: Emergency Repairs to Glass Breakwater, Naval Base Guam
Enclosure 2. SHPO Concurrence for Glass Breakwater Repairs, dated 17 October 2011

National Historic Preservation Act
Section 106 Evaluation
Enclosure 1: Emergency Repairs to Glass Breakwater, Naval Base Guam

Purpose:

Conduct emergency repairs to the breakwater at sections with serious and critical damage. Reinforce the breakwater at sections with poor conditions along Philippine Sea side from the breakwater head to western edge of Luminao Reef (Sta 0+00 to Sta 65+00) (Figure 4).

Statement of Work: Project works include the following:

- Stabilize the breakwater to protect the seaport and northern part of Apra Harbor from damaging waves during calm and severe weather conditions;
- Temporary removal of slope protection;
- Restore approximately 2,988 meters of the armor slope protection with suitable material;
- Strengthen toe foundation;
- Add heavy concrete armor units for wave dissipation and rebuild damaged core;
- Provide geofabric filter material on the repaired slope with riprap bedding overlay;
- Replace armor rock on repaired slope.

Area(s) of Potential Effect (APE):

The APE is determined to be the area encompassed by the proposed project, as depicted in Figures 1 - 4.

Identification of Historic Properties:

- As identified in Aaron (2011); Lauter-Reinman (1997); Mason (2009), the boundary of the project site is in fill lands.
- The project APE is located within the Glass Breakwater that is eligible for inclusion in the National Register of Historic Places, Aaron 2011; Lauter-Reinman 1997; Mason 2009.
- The structure dates between 1941 and 1946, which is greater than 50 years old.

Determination of Effect:

- Project area has been previously disturbed (e.g., original construction and grading).
- Ground disturbance (gate/haul road) will be limited to areas where there are existing structures.
- The breakwater is structurally damaged from previous typhoons, namely Typhoon Mawar. Extensive natural wave battering and erosion has damaged the structure.
- The damaged revetment on the Glass Breakwater poses a public health and safety issue.
- Repairs of the Glass Breakwater are essential to maintain and ensure the structural stability of the structure. Failure to provide these repairs will lead to further damage to the historic property.
- All materials used in the repairs will be similar to the original materials used for the construction of the breakwater.
- The boulders/rip rap will match existing erosion control measures in the area and shall have minimal impact to the visual landscape.

National Historic Preservation Act
Section 106 Evaluation
Enclosure 1: Emergency Repairs to Glass Breakwater, Naval Base Guam

Section 106 Evaluation:

In consideration of the evaluated project information, the Naval Base Guam has determined a finding of **"No Adverse Effect"** for the proposed repair to damages on Glass Breakwater.

Certification
The undersigned certifies that, to the best of my knowledge, information, and belief, formed after reasonable inquiry, the information in this report is true, accurate, complete and is provided as a part of our agency's responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended.

12/27/2023
Date

Lon Bulgrin, M.A.
Cultural Resources Manager/Archeologist
Naval Base Guam

Reference(s):

Aaron, Jayne
2011 *Regional Cold War History for Department of Defense Installations in Guam and the Northern Mariana Islands*. Department of Defense Legacy Resource Management Program. (Legacy 09-454). Archer, Inc., Annapolis, Maryland. https://www.denix.osd.mil/cr/historic/cold-war/index.html.

Lauter-Reinman, Gloria A.
1997 Final Report. Management Plan for World War II Resources at Navy Installations in Guam. Prepared in Conjunction with Department of Defense Legacy Resource Management Program: #349. Prepared for Department of the Navy, Pacific Division, Naval Facilities Engineering Command, Pearl Harbor, HI. Ogden Environmental and Energy Services Co, Inc., Honolulu, HI

Mason Architects Inc. and Weitze Research (Mason and Weitze)
2009 *Evaluation of Historic Resources at Naval Hospital Guam*. Prepared for NAVFAC Pacific, Pearl Harbor. Mason Architects Inc. and Weitze Research.

Programmatic Agreement among the Commander, Navy Region Marianas, the Advisory Council on Historic Preservation, and the Guam Historic Preservation Officer regarding Navy Undertakings on the Island of Guam, November 2008.

National Historic Preservation Act
Section 106 Evaluation
Enclosure 1: Emergency Repairs to Glass Breakwater, Naval Base Guam

Figure 1. Location of the APE.

Figure 2. Enlarged view of Apra Harbor showing location of Glass Breakwater.

National Historic Preservation Act
Section 106 Evaluation
Enclosure 1: Emergency Repairs to Glass Breakwater, Naval Base Guam

Figure 3. Close-up schematic of project area.

National Historic Preservation Act
Section 106 Evaluation
Enclosure 1: Emergency Repairs to Glass Breakwater, Naval Base Guam

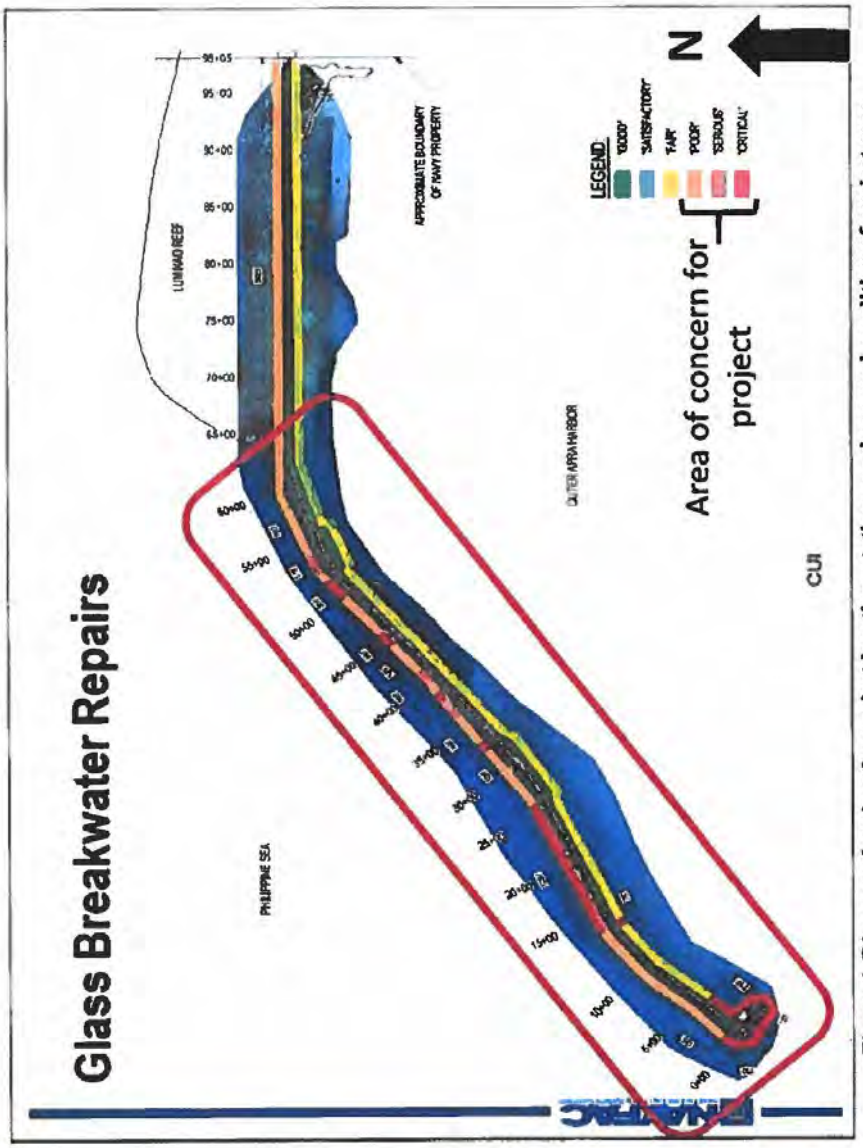

Figure 4. Diagram showing the project location, station numbers, and condition of project area.

Page 6 of 6

Lourdes A. Leon Guerrero
Governor
Joshua F. Tenorio
Lt Governor

Department of Parks and Recreation
Dipattamenton Plaset yan Dibuetsion
Government of Guam
Director's Office, Parks and Recreation Divisions
#1 Paseo de Susana, Hagåtña, Guam 96910
P.O. Box 2950, Hagåtña, Guam 96932
(671) 475-6288, Facsimile (671) 477-0997
Guam Historic Resources Division
490 Chalan Palasyo, Agana Heights, Guam 96910
(671) 475-6294/6355, Facsimile (671) 477-2822

Angel R. Sablan
Acting Director
Warren Pelletier
Deputy Director

February 20, 2024

In reply refer to:
RC 2024-0091

E. E. Moon
Installation Environmental Program Director
Naval Base Guam
PSC 455, Box 152
FPO AP 96540-1000

Subject: Review of: Emergency Repairs to Glass Breakwater, Naval Base Guam

Hafa Adai Mr. Moon,

Thank you for submitting the Emergency Repairs to Glass Breakwater, Naval Base Guam. Per §36 CFR 800 (as amended 5 August 2004) regulations implementing Section 106 of the National Historic Preservation Act (NHPA), Naval Base Guam is seeking the State Historic Preservation Office's (SHPO) comments on the effects the proposed undertaking will have on historic properties.

An email occurred between Logan Myers and Lon E. Bulgrin on 2/15/2023 where Mr. Bulgrin confirmed the APE size to be 354,838 Sqm (87.7 acres). Our office will not accept the "No Adverse Effect" determination without additional information. Our records show four sites within the red breakwater APE box on Page 6 of the submitted document. These sites are *Yosemite 2* GHPI Site No. 66-03-2206 at the southwest, American Tanker GHPI Site No. 66-03-1078 to the southwest, Unnamed Wreck GHPI Site No. 66-03-2191, and Val Bomber GHPI Site No. 66-03-1087 at the northeast. For our office to accept these repairs we need confirmation that these sites will not be impacted by this project. Navy Base Guam needs to submit a map showing these sites and describe how these sites will not be impacted by the repairs. Once we receive this document our office will expedite the review process.

Should you have any questions, please contact Mr. Logan Myers, Archaeologist at [redacted]

Sincerely,

Patrick Q. Lujan
State Historic Preservation Officer

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

5090
Ser EV/[redacted] N-32
February 26, 2024

Patrick Lujan
State Historic Preservation Officer
Department of Parks and Recreation/Guam Historic Resources Division
490 Chalan Palasyo
Agaña Heights, Guam 96910

Dear Mr. Lujan,

Subject: EMERGENCY REPAIRS TO GLASS BREAKWATER, NAVAL BASE GUAM

This letter is in response to your letter of February 20, 2024 (RC 2024-0091). You expressed concerns over four sites; Yosemite 2 GHPI Site No. 66-03-2206, American Tanker GHPI Site No. 66-03- 1078, Unnamed Wreck GHPI Site No. 66-03-2191, and Val Bomber GHPI Site No. 66-03-1087 that could be potentially impacted by the undertaking based upon the APE.

Lon Bulgrin, the Naval Base Guam Cultural Resources Manager/Archaeologist, met with Logan Myers and John Peterson of your staff this morning to present more detailed design plans for the project and to discuss the project plans in regard to the locations of the sites of concern. There was an agreement that the sites were located outside of the proposed project footprint and that of haul roads and laydown areas. The project design plans are included in Enclosure (1).

In consideration of the information presented in Enclosure (1) and our previous letter of December 27, 2023, a finding of "No Adverse Effect" is applicable to the proposed project. In accordance with 36 CFR 800.4 (d)(1), if we receive no response from your office within 30 days of receipt of this letter, we will consider our responsibilities under Section 106 fulfilled.

Should you have any questions or require additional information, my point of contact regarding this matter is Mr. Lon Bulgrin at [redacted]

Sincerely,

E. E. Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosure 1. FY24 SPECIAL PROJECT Glass Breakwater Emergency Repairs Design Plans.

Lourdes A. Leon Guerrero
Governor
Joshua F. Tenorio
Lt. Governor

Department of Parks and Recreation
Dipattamenton Plaset yan Dibuetsion
Government of Guam
Director's Office, Parks and Recreation Divisions
#1 Paseo de Susana, Hagåtña, Guam 96910
P.O. Box 2950, Hagåtña, Guam 96932
(671) 475-6288, Facsimile (671) 477-0997
Guam Historic Resources Division
490 Chalan Palasyo, Agana Heights, Guam 96910
(671) 475-6294/6355, Facsimile (671) 477-2822

Angel R. Sablan
Acting Director
Warren Pelletier
Deputy Director

February 28, 2024

In reply refer to:
RC 2024-0091

E. E. Moon
Installation Environmental Program Director
Naval Base Guam
PSC 455, Box 152
FPO AP 96540-1000

Subject: Review of: Emergency Repairs to Glass Breakwater, Naval Base Guam

Hafa Adai Mr. Moon,

Thank you for submitting the Emergency Repairs to Glass Breakwater, Naval Base Guam. Per §36 CFR 800 (as amended August 5. 2004) regulations implementing Section 106 of the National Historic Preservation Act (NHPA), Naval Base Guam is seeking the State Historic Preservation Office's (SHPO) comments on the effects the proposed undertaking will have on historic properties.

As stated in the submitted document, a meeting occurred on the 26th of February 2024 between Lon Bulgrin of Naval Base Guam, John Peterson, and Logan Myers. In this meeting, it was agreed that the undertaking was not overlapping the sites of *Yosemite 2* GHPI Site No. 66-03-2206, American Tanker GHPI Site No. 66-03-1078, Unnamed Wreck GHPI Site No. 66-03-2191, and Val Bomber GHPI Site No. 66-03-108. Based on this meeting and the enclosed information, our office agrees with the "No Adverse Effect" determination.

Should you have any questions, please contact Mr. Logan Myers, Archaeologist at [redacted]

Sincerely,

Patrick O. Lujan
State Historic Preservation Officer

National Historic Preservation Act
Enclosure 2. SHPO Concurrence for Glass Breakwater Repairs, dated 17 October 2011

Department of Parks and Recreation
Government of Guam
490 Chalan Palasyo
Agana Heights, Guam 96910
Director's Office: (671) 475-6296/7
Facsimile: (671) 477-0997
Parks Division: (671) 475-6288/9
Guam Historic Resources Division: (671) 475-6294/8
Facsimile: (671) 477-2822

Eddie Baza Calvo
Governor

Ray Tenorio
Lt. Governor

Peter S. Calvo
Acting Director

In reply refer to:
RC2011-9550

October 17, 2011

R.M. Rossetti
Department of the Navy
U.S. Naval Base Guam
PSC 455 Box 195
FPO AF 96540-2937

Subject: Section 106 Review
Project: Repair Glass Breakwater, North Shore and Western Point, NBGAH, Piti, Guam

Dear Mr. Rossetti,

We reviewed your request to review subject project and concur with your determination of "No Adverse Effect." However, if inadvertent discovery of historic properties are encountered during the course of the project, please cease all activities, immediately inform our office, and refer to 36 CFR 800.13 Post Review Discoveries.

On a separate note, please properly address Ms. Aguon in future correspondence as State Historic Preservation Officer.

If you have any questions, please contact our office at [redacted]

Sincerely,

Peter S. Calvo
Acting Director

Lydia Bordallo Aguon
State Historic Preservation Officer

Guam SHPO Concurrence for Apra Harbor Breakwater Repairs (21 March 2025)

Lourdes A. Leon Guerrero
Governor
Joshua F. Tenorio
Lt. Governor

Department of Parks and Recreation
Dipattamenton Plaset yan Dibuetsion
Government of Guam
Director's Office, Parks and Recreation Divisions:
#1 Paseo de Susana, Hagåtña, Guam 96910
P.O. Box 2950, Hagåtña, Guam 96932
(671) 475-6288; Facsimile (671) 477-0997
Guam Historic Resources Division:
490 Chalan Palasyo, Agana Heights, Guam 96910
(671) 475-6294/6355; Facsimile (671) 477-2822

Angel R. Sablan
Director
Warren Pelletier
Deputy Director

March 21, 2025

In reply refer to:
RC 2024-0091

E.E. Moon
Installation Environmental Program Director
U.S. Naval Base Guam
PSC 455, Box 152
FPO AP 96540-1000

Subject: Addendum to Emergency Repairs to Glass Breakwater, U.S. Naval Base Guam

Hafa Adai Mr. Moon,

Thank you for submitting the addendum to the emergency repairs to the Glass Breakwater. This undertaking will still follow the avoidance of sites discussed in our February 24, 2024 letter. Due to this and the previous surveys in impact areas, our office will accept the "No Adverse Effect" determination. Please report any inadvertent discoveries to our office.

Should you have any questions, please contact Mr. Logan Myers, Archaeologist at [redacted]

Sincerely,

Patrick Q. Lujan
State Historic Preservation Officer

Appendix E: CZMA CCD

Navy CCD and Letter to Guam BSP

DEPARTMENT OF THE NAVY
U.S. NAVAL BASE GUAM
PSC 455 BOX 152
FPO AP 96540-1000

RECEIVED
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BUREAU OF STATISTICS AND PLANS

5090
Ser EV/042
March 27, 2025

Ms. Lola Leon Guerrero
Director
Bureau of Statistics and Plans
P.O. Box 2950
Hagatna, Guam 96932

ATTN: Edwin Reyes, Administrator, Guam Coastal Zone Management Program

SUBJECT: NOTIFICATION OF A CONSISTENCY DETERMINATION FOR PROJECT: APRA HARBOR WATERFRONT REPAIRS, APRA HARBOR, NAVAL BASE GUAM

Dear Ms. Leon Guerrero,

Naval Base Guam proposes to conduct long-term repairs on the Admiral Glass Breakwater (GBW) and at Sumay Cove in Apra Harbor, Guam. This letter is to provide Guam Bureau of Statistics and Plans with a Consistency Determination finding for this proposed activity in accordance with 15 Code of Federal Regulations (CFR) 930.35. The U.S. Navy has completed an "effects" test and has determined the project will be consistent, to the maximum extent practicable, with mitigating any unintended effects on the Guam Coastal Zone, per 15 CFR 930.36(a).

The long-term breakwater repairs, repairs to the Sumay Marina docks and wave attenuator, and repairs to the Sumay Point revetment are needed due to extensive damage that occurred during Typhoon Mawar in May 2023. The project work on the breakwater will include excavation and replacement of the existing toe, slope, and crest rock protection; rebuild of the damaged core and toe sections; placement of a bedding stone underlayer; and installation of concrete armor units along the toe, slope, and crest. The long-term repairs of GBW would restore the breakwater to Army Corps of Engineer breakwater standards, increase the effectiveness, and ensure long-term reliability and resiliency of the breakwater in order to continue protecting Apra Harbor and its shorelines. Thus, allowing for continued safe use of the area by the public, civil, and federal individuals and organizations.

Project work at Sumay Cove would include driving piles to provide additional anchoring and/or support for the floating docks and to replace deteriorated piles. A pile-supported fixed wave attenuator would also be constructed within Sumay Marina to replace the failed floating wave attenuator. The existing engineered revetment along Sumay Point would be repaired by removing a deteriorated steel structure and restoring the rock revetment protection. A detailed project description is provided in Enclosure 1.

Email addresses and phone numbers are redacted for security.

The proposed federal activity is located entirely within federal property and submerged lands, and therefore not subject to Guam's jurisdiction per 15 CFR 923.33(a). However, the Navy conducted and completed an effects test according to 15 CFR Part 930.33(a)(1), and determined that there is a potential for reasonably foreseeable direct and indirect effects on Guam's coastal zone to mobile and sessile in-water resources (e.g., fisheries, marine mammals, sea turtles, corals, etc.) that can spillover and extend into Guam's coastal zone per 15 CFR 923.33(b). Therefore, the Navy concluded that the project has reasonably foreseeable direct and indirect coastal effects to Guam's defined coastal zone. The Navy reviewed and assessed relevant enforceable policies of the Guam Coastal Management Program (GCMP) and has determined that the proposed activity would be consistent, to the maximum extent practicable, with the enforceable policies of the GCMP.

The coastal zone consistency assessment package (Enclosure 2) is pursuant to the Coastal Zone Management Act and 15 CFR 930. The proposed activity will comply with the enforceable policies of the Government of Guam's approved coastal zone management program and will be conducted in a manner consistent with the program.

The Navy is preparing a Draft Environmental Assessment (EA), which will include all required regulatory consultations (i.e., Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Coastal Zone Management Act and the National Historic Preservation Act). The notice of availability of the EA for public review will be published in both print and online media. Advertisements will be posted in the Pacific Daily News March 25 - 27, 2025 detailing the Draft EA availability.

Best Management Practices will be implemented to ensure that debris and surface runoff do not enter Guam's coastal waters. The construction project has a tentative start date of September 2025 with an estimated projected duration of up to sixty (60) months.

Should you have any questions, or require additional information, please contact Mr. Jesse Cruz at [redacted]

Sincerely,

Ed Moon

Edward Moon
Installation Environmental Program Director
By Direction of the Commanding Officer

Enclosure: 1. Apra Harbor Waterfront Repairs Project Description
2. GCMP Assessment Package

ENCLOSURE 1

FEDERAL CONSISTENCY DETERMINATION
Project Description: Apra Harbor Waterfront Repairs

The United States (U.S.) Navy Naval Facilities Engineering Command Marianas (NAVFAC Marianas) (hereafter, jointly referred to as the Navy) commissioned the Special Project Typhoon Mawar Apra Harbor Waterfront Repairs. The Navy proposes to conduct repairs of waterfront infrastructure along the Admiral Glass Breakwater (Glass Breakwater) and Sumay Cove in Apra Harbor, Guam. Breakwater repairs are needed due to extensive damage that occurred during Super Typhoon Mawar in May 2023. During subsequent engineering analysis, the Navy has determined failure of sections of the breakwater is accelerating, and multiple sections are at risk of catastrophic failure (i.e., a full breach of the breakwater). In 2024, the Navy prepared an Environmental Assessment (EA) to address emergency repairs that would temporarily secure the breakwater until long-term repairs could be made. This EA addresses the Navy's plan for the subsequent completion of long-term repairs of the breakwater and other vital infrastructure in the harbor.

The Proposed Action would repair and rebuild the failing areas of the Glass Breakwater, Sumay Marina docks and wave attenuator, and Sumay Point shoreline protection to provide long-term stability and protection for vessel traffic and Naval Base Guam infrastructure in Apra Harbor.

Construction is anticipated to begin in September 2025 with mobilization of equipment, labor, and some above-water site preparation. Concrete Armor Units (CAU) fabrication may begin by the end of 2025 and will continue throughout the armor placement period. Initial armor placement is anticipated to begin in early 2026 and to continue through the middle of 2029. In-water work is anticipated to continue intermittently for the duration of the Project. Nighttime in-water work is not anticipated; however, above-water nighttime work to prepare the site for placement and delivery of armor units may occur. The timing of in-water work will avoid coral spawning periods; spawning typically occurs between May and August. Coral spawning periods will be verified with the UOG Marine Lab annually. During the spawning periods, construction may continue above the water line.

GLASS BREAKWATER REPAIRS

This approach involves phased placement of CAUs on the western 1.9 kilometers (1.2 miles) of deteriorated and/or failing areas of the breakwater (Figure 1 and Figure 2). CAUs will be placed on the breakwater head section, along approximately 30 meters (100 linear feet) on the leeward (harbor) side, and along the entire ocean (Philippine Sea) side (1.9 kilometers), except for along the Luminao reef. The repair areas would extend from the breakwater crest up to approximately 49 meters [160 feet] seaward from the center of the crest road for the Outer Breakwater and up to 46 meters [150 feet] for the Inner Breakwater. Repair activities would potentially affect a maximum of up to 21.5 acres of underwater area (below the MLLW line) on the outer (Philippine Sea) side of the breakwater and head section. This includes the entire area from the waterline to the outer limit of the breakwater toe. Planned repairs would only likely disturb up to

11.4 acres on the outer breakwater, and up to 0.2 acres of underwater area below the MLLW line on the leeward (harbor) side of the breakwater.

Additionally, this work would require temporary relocation of the existing federal Aid to Navigation (ATON) situated at the breakwater head section. The temporary site for relocation would be within 200 feet of ATON's charted location. Relocation would be coordinated and approved through the U.S. Coast Guard (USCG), and a notice to mariners would be issued through the USCG, the National Geospatial-Intelligence Agency (NGA), and/or the National Ocean Service (NOS), about the temporary change. The ATON would be placed back on the head section when construction is complete.

Repair activities would include the following work elements:

1. Site preparation:

Vegetation clearing and earthwork to create work and access areas on the breakwater crest to accommodate crane pads, construction equipment, and heavy truck traffic would be required prior to repair activities. Several construction laydown areas (including material loading and offloading, concrete casting, and material storage areas) have been identified, as shown in Figure 1. The primary concrete casting yard would encompass the pre-cast yard, materials stockpile, and CAU storage. Contingent CAU and aggregate storage and an alternative concrete casting yard would be located at the old Cabras Quarry site or the paved lot located across the street and approximately 700 feet southwest from the quarry entry along Highway 11.

The Hotel Wharf site along the inner side of the breakwater in the Outer Harbor would be the primary location for loading and unloading barges, personnel transports, supply boats, and push boats to shuttle workers, materials, equipment, and supplies to and from the breakwater work areas. Other wharves located in the Inner Harbor (e.g., Oscar-Papa-Quebec) may also be used on a contingent basis for these purposes and to avoid forecasted typhoon conditions or tropical storms. On the leeward side of the breakwater, a spud/jack-up barge and temporary moorings (piles or anchors) would be used to position vessel for unloading CAUs and for other repair/construction support (Figure 2). The moorings would be supported by piles (up to 16 steel pipe piles). Any spuds or mooring piles installed would be placed only into soft sediment and would be removed following completion. Figure 3 provides a schematic of the process for stone and CAU transport via barge, lifted by crane, and placement along the breakwater.

2. Temporary Removal of Existing Armor Layer and Toe Foundation:

To provide a stable foundation for placement of the CAUs, existing rock and CAUs along the slope, crest, and toe would be removed within the repair areas of the breakwater to be rebuilt. Removal would be down to the breakwater core for the slope and crest and approximately 6 meters (20 feet) deep along the toe section. Figure 4 provides a notional cross schematic of the existing breakwater design and shows the limits of work to the toe of the existing breakwater. The removed rock and CAUs would be used to rebuild the breakwater core, and some (up to 7,800 cubic yards [CY]) would be hauled off-site to be used for shoreline protection repairs within Apra Harbor, including at Sumay Point. Predominantly, existing armor stone that has

settled or fallen from the slope into the water, leaving voids along the breakwater, would be excavated and used to build a reinforcing base approximately halfway between the base of the slope and the outer limit of the existing toe. The reinforcing base would be excavated to an elevation no deeper than 20 feet below the Mean Lower Low Water (MLLW) height to support the buildup of CAUs and/or CAUs and would serve to prevent settling or seaward movement of the CAUs, which would be placed from the reinforcing base up the slope to the crest. Using this approach, repair and buildout of the breakwater could disturb a maximum area of up to approximately 21.5 acres (which conservatively includes the entire the entire area from the breakwater crest to the outer limit of breakwater toe). However, it is likely that the required work would only disturb approximately 11.4 acres of submerged area (below the MLLW line) inside the footprint of the existing toe on the outer (Philippine Sea) side and 0.2 acres of submerged area (below the MLLW line) within the footprint of the existing toe on the leeward (Apra Harbor) side of the breakwater.

3. Rebuilding the Core Foundation:

As necessary in each repair area, the breakwater's core would be graded and rebuilt to provide a stable foundation for placement of the CAUs. Imported, quarried aggregate material and stone that would be used for this work would be transported to Guam via barges.

4. Placement of Bedding Rock:

Up to 54,000 CY of bedding rock would be placed to create a stable underlayer for placement of the CAU. The bedding rock would be imported to the island via ship/barge and transported to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge.

5. Placement of Concrete Armor Units:

Approximately 20,100 large CAUs (25 to 50 tons each) would be placed along the toe, slope, and crest of the breakwater. The CAUs would be transported from the casting yard to the breakwater repair areas either via truck along the breakwater crest road or from a waterside barge. It is anticipated that 75 percent of the CAUs would be hauled to the breakwater repair site from the concrete casting yard via truck, and the remaining 25 percent would be hauled by barge to the Hotel Wharf site for transloading onto barge via crane. When fully laden, the barge would then transit to and moor against the pre-positioned spud barge leeward of the breakwater near the CAU-placing crane. CAUs would then be offloaded from the barge onto the breakwater by the CAU-placing crane.

6. Construction of Concrete Casting Yard.

It is anticipated that CAUs would be fabricated on the island at a concrete casting yard co-located with a construction laydown area (Figure 1). Concrete would be purchased from a local supplier's batching plant to the casting yard via mixer trucks and placed into armor unit molds.

Enclosure 1: AHWR Project Description

Figure 1. Location Map for Glass Breakwater and Sumay Cove Repairs, Apra Harbor.

Figure 2. Overview of the Glass Breakwater Repair Effort

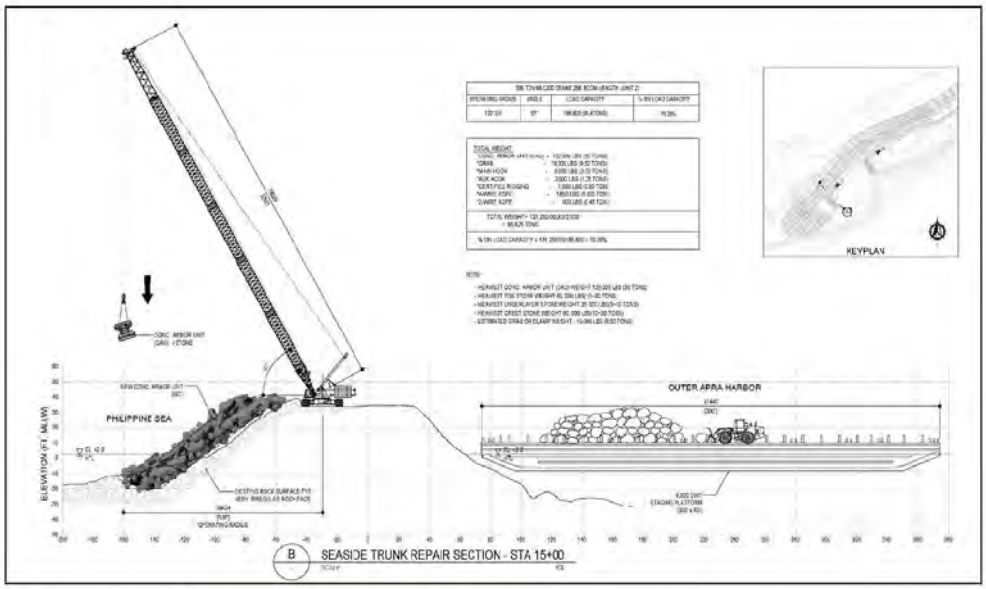

Figure 3. Proposed construction methodology for GBW repairs.

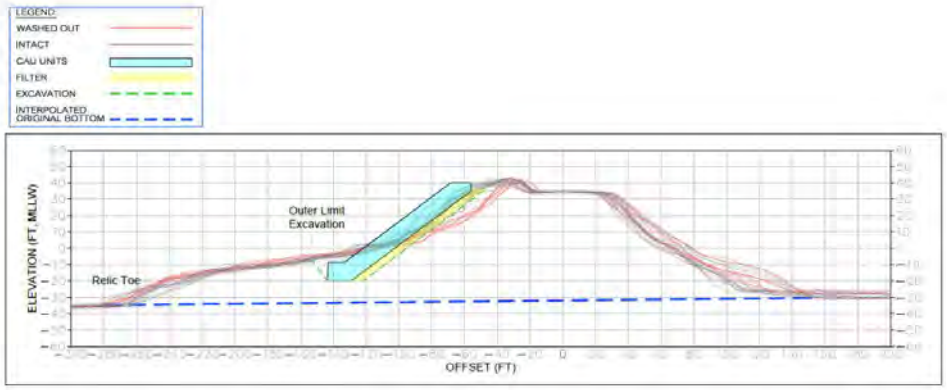

Figure 4. Notional Cross Section – Limit of Work (Blue Shaded Area) to Existing Toe of Breakwater.

SUMAY COVE REPAIRS

Proposed Action activities in Sumay Cove (Figure 5) would include the following component actions:

1. Sumay Marina Floating Dock Repairs. Repairs would drive up to 12 (20-inch diameter) octagonal concrete piles to provide lateral support and replacement of existing deteriorated piles for the floating docks supporting the USCG, Port Operations, and Navy Security Forces vessels and up to 12 (16-inch diameter) octagonal piles to replace damaged/deteriorating main dock guide piles (Figure 6). In the marina area, the ocean bottom is at a depth of approximately 5.5 meters (18 feet) and is comprised of silt. Sites where piles would be driven would be pre-drilled, and then each pile would be hammered to a depth of approximately 20 feet below the mud line. Finger and main dock pile installation for the proposed Sumay Dock repairs and wave attenuator would be conducted in a similar manner as described in the 2011 BiOp for Sumay Cove Marina Repairs and the 2020 LMN Wharf Repair EA and with the same pile driving requirements as assessed in the NMFS 2022 consultation response on similar Navy project work elsewhere in the Pacific Island Region (i.e., PIRO-2020-03728). It is anticipated that on average, one pile would be driven per day over a two-month period for all proposed projects in Sumay Cove.

Following pre-drilling if necessary, the process for impact driving the concrete piles begins by placing a choker cable around a pile and lifting the pile into a vertical position with a crane. The in-water pile is then lowered into position inside the template and set in place at the mudline, vibrated into place, and driven to design elevation using impact hammers. As needed, jetting would be used to assist in pile installation. Impact hammers have guides that hold the hammer in alignment with the pile while a heavy piston moves up and down, striking the top of the pile, driving the pile into the substrate from the downward force of the hammer. Assuming a similar number of strikes as described in the NMFS (2020b and 2022) consultation responses for similar pile driving activities, it is anticipated that driving a concrete pile would require an average of 200 hammer strikes per pile to reach the 20-foot depth below the mudline. This number will vary depending on factors such as soil condition, tip elevation, size of hammer, and final dimensions of the piles.

To support construction of the marina docks and wave attenuator, a temporary trestle may be constructed within Sumay Cove. The trestle would require installation of up to 10 (36-inch) steel pipe piles, which would be set in place via vibratory pile driving. Upon completion of construction, the trestle structure would be removed and the trestle piles would be pulled or cut off at the mudline.

2. Sumay Marina Wave Attenuator. Up to 32 octagonal concrete piles (20-inch diameter) or tubular steel piles (36-inch diameter) would be driven into pre-drilled sites to a depth of approximately 20 feet below the mud line to support the fixed wave attenuator. The pile installation method would be similar as described above for the Sumay Marina dock piles. Storm waves from the harbor can propagate along the Sumay Channel and impact the outer marina docks. A fixed (pile-supported) wave attenuator is proposed to reduce these waves to increase the survivability of the floating docks and to maintain safe vessel operation within the basin

(Figure 7). The face of the attenuator would be constructed of steel or concrete panels that are attached above the water and extend below the water with a gap at the bottom to allow for water flow. The wave attenuator is intended to block wave energy that would adversely affect the Sumay Marina docks while allowing for water flow around and under it to maintain circulation within Sumay Cove. A concrete cap would be constructed on the piles and navigation lights installed on the cap. The adjacent bulkhead contains corals; however, the wave attenuator would not be attached to the bulkhead; it would be its own free-standing structure in the approximate location of the previous attenuator. Figure 8 provides a diagram of the proposed wave attenuator.

Figure 5. Sumay Point Action Areas in outer Apra Harbor, inset to show project areas (pink lines).

Figure 6. Sumay Marina and the overall project layout.

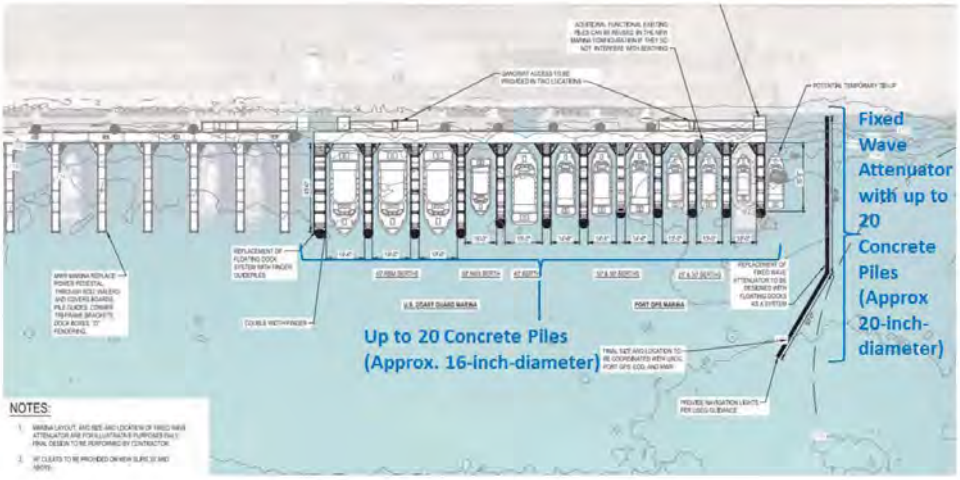

Figure 7. Schematic of Proposed Repair Activities at Sumay Marina.

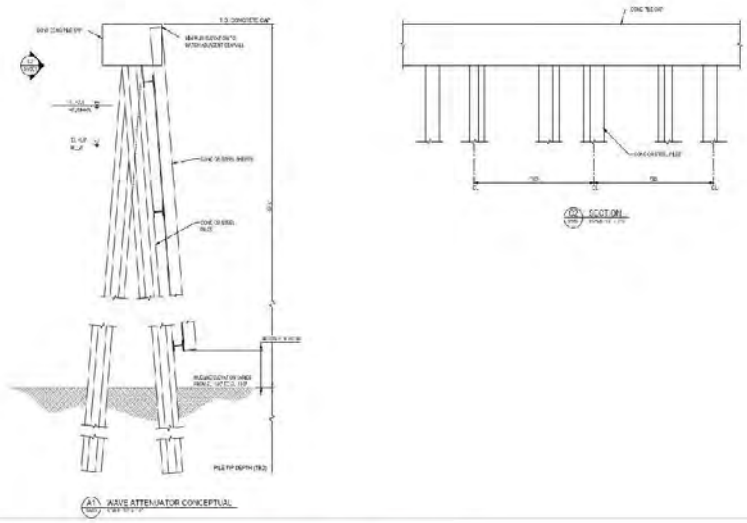

Figure 8. Conceptual Diagram of Wave Attenuator

Sumay Point Revetment Restoration. At Sumay Point (shown in Figure 9), an existing deteriorated steel structure would be demolished and removed (demonstrated in Figure 10). The underlying slope would be backfilled and compacted, likely requiring the import of soil/bedding material, and then imported rock or rock salvaged from the breakwater (approximately 900 CY) would be placed above and in water to restore the previously constructed rock revetment. The new rock would be placed within the existing revetment footprint and such that it ties into the existing rock in the water and at both ends. The rock would be brought to the Sumay Point site via truck from the breakwater (salvaged existing armor and core layer rock from breakwater repair) or from the Port of Guam (imported from off-island via ship/barge). At a haul capacity of approximately 10 CY per truckload, this work would require 90 truck trips. All construction work would likely occur from the landside.

Figure 9. Location for the actions at Sumay Point for the revetment

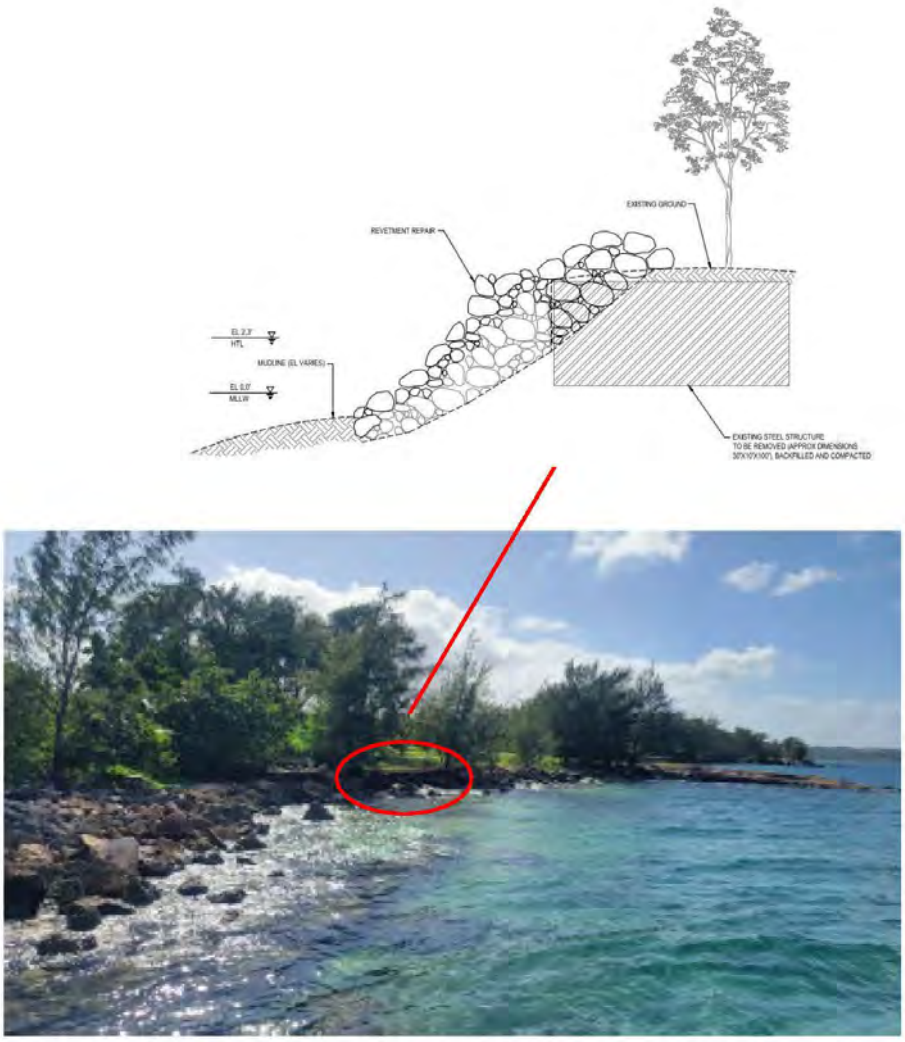

Figure 10. Sumay Point revetment plan (above) and the location of the sheet wall to be removed

References

Department of the Navy (DoN). (2020). Environmental Assessment for the Lima, Mike, Navy Wharf Repair and Modernization at Naval Base Guam, Apra Harbor, Guam. July 2020. Available online: <https://pacific.navfac.navy.mil/About-Us/National-Environmental-Policy-Act-NEPA-Information/>. Accessed 27 September 2024.

National Marine Fisheries Service (NMFS). (2011). Endangered Species Action- Section 7 Consultation Biological Opinion for Sumay Cove Repair and Modernization Naval Base Guam. Consultation number: I-PI-10-856-LVA. Pacific Islands Regional Office, NOAA National Marine Fisheries Service, Honolulu, Hawaii.

NMFS. (2020). Endangered Species Act, Section 7 - Informal Consultation Response Letter to Naval Base Guam [I-PI-20-1815-1G, PIR-2020-00424]. April 8, 2020.

NMFS. (2022). Endangered Species Act Section 7(a)(2) Biological Opinion 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 number: PIRO-2020-03728. Pacific Islands Regional Office, NOAA National Marine Fisheries Service, Honolulu, Hawaii.

GCMP ASSESSMENT FORMAT

GUAM COASTAL MANAGEMENT PROGRAM
ASSESSMENT FORMAT

DATE OF APPLICATION: **March 27, 2025**
NAME OF APPLICANT: **U.S. Naval Base Guam**
APPLICANT: **Mr. Edward E. Moon**
Installation Environmental Program Director
Public Works Department
U.S. Naval Base Guam
PSC 455, BOX 152
FPO AP 96540-1000
[redacted]

TITLE OF PROPOSED PROJECT: **Apra Harbor Waterfront Repairs**

COMPLETE FOLLOWING PAGES FOR BUREAU OF STATISTICS AND PLANS ONLY

DATE APPLICATION RECEIVED: _____

OCRM NOTIFIED: _____ LIC. AGENCY NOTIFIED: _____

APPLICANT NOTIFIED: _____ PUBLIC NOTICE GIVEN: _____

OTHER AGENCY REVIEW REQUESTED:

_____

_____

DETERMINATION:

( ) CONSISTENT ( ) NON-CONSISTENT ( ) FURTHER INFORMATION REQUESTED

OCRM NOTIFIED: _____ LIC. AGENCY NOTIFIED: _____

APPLICANT NOTIFIED: _____

ACTION LOG:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

DATE REVIEW COMPLETED: _____

DEVELOPMENT POLICIES (DP):

DP 1. Shore Area Development

Intent: To ensure environmental and aesthetic compatibility of shore area land uses.

Policy: Only those uses shall be located within the Seashore Reserve which:
- enhance, are compatible with or do not generally detract from the surrounding coastal area's aesthetic and environmental quality and beach accessibility; or
- can demonstrate dependence on such a location and the lack of feasible alternative sites.

Discussion: **DP 1 is not applicable. The Proposed Action is not located within any of Guam's Seashore Reserves. The project areas are completely within federal property and submerged lands. The repairs to the Admiral Glass Breakwater (GBW) and Sumay Cove Marina and shoreline would primarily use the same or similar materials to the existing structure and would not appreciably alter the structure visually. Therefore, the projects would be compatible and would not detract from the aesthetic or environmental quality. The structures are necessary to provide safe passage into and out of Apra Harbor for military, civil, commercial, and recreational users.**

DP 2. Urban Development

Intent: To cluster high impact uses such that coherent community design, function, infrastructure support and environmental compatibility are assured.

Policy: Commercial, multi-family, industrial and resort-hotel zone uses and uses requiring high levels of support facilities shall be concentrated within appropriate zone as outlined on the Guam Zoning Code.

Discussion: **DP 2 is not applicable. The project does not involve introduction of high impact uses such as commercial, multi-family residential, or resort-hotel uses. The project is the repair of the existing GBW and Sumay Cove marina structures.**

DP 3. Rural Development

Intent: To provide a development pattern compatible with environmental and infrastructure support suitability and which can permit traditional lifestyle patterns to continue to the extent practicable.

Policy: Rural districts shall be designated in which only low density residential and agricultural uses will be acceptable. Minimum lot size for these uses should be one-half acre until adequate infrastructure including functional sewering is provided.

Discussion: **DP 3 is not applicable. The project does not involve new development in a rural district and does not involve residential or other new urban development. The project is the repair of the existing GBW and Sumay Cove marina structures.**

DP 4. Major Facility Siting

Intent: To include the national interest in analyzing the siting proposals for major utilities, fuel and transport facilities.

Policy: In evaluating the consistency of proposed major facilities with the goals, policies, and standards of the Comprehensive Development and Coastal Management Plans, Guam shall recognize the national interest in the siting of such facilities, including those associated with electric power production and transmission, petroleum refining and transmission, port and air installations, solid waste disposal, sewage treatment, and major reservoir sites.

Discussion: **The Proposed Action is consistent with DP 4. The project does not involve major new utility, fuel, or transportation facilities, but it supports the national interest by repairing structures that provide safe passage into and out of Apra Harbor for military, civil, commercial, and recreational users.**

DP 5. Hazardous Areas

Intent: Development in hazardous areas will be governed by the degree of hazard and the land use regulations.

Policy: Identified hazardous lands, including flood plains, erosion-prone areas, air installations' crash and sound zones and major fault lines shall be developed only to the extent that such development does not pose unreasonable risks to the health, safety or welfare of the people of Guam, and complies with the land use regulations.

Discussion: **The Proposed Action is consistent with DP 5. GBW repairs and Sumay Cove Marina and shoreline repairs would enhance the safety of Apra Harbor and comply with land use regulations. The Navy would ensure that the facilities to be constructed would be designed for resiliency with regards to erosion. GBW repairs would not change the local hydrology, soils, or vegetation, or affect shoreline ecological functions.**

DP 6. Housing

Intent: To promote efficient community design placed where the resources can support it.

Policy: The government shall encourage efficient design of residential areas, restrict such development in areas highly susceptible to natural and manmade hazards, and recognize the limitations of the island's resources to support historical patterns of residential development.

Discussion: **DP 6 is not applicable. The project does not involve residential development. The project is the repair of the existing GBW and Sumay Cove marina structures.**

DP 7. Transportation

Intent: To provide transportation systems while protecting potentially impacted resources.

Policy: Guam shall develop an efficient and safe transportation system, while limiting adverse environmental impacts on primary aquifers, beaches, estuaries, coral reefs and other coastal resources.

Discussion: **The Proposed Action would be consistent with DP 7. The project does not involve the construction of new public roadways or other transportation systems. Best Management Practices (BMP) would avoid or minimize potential construction period contaminants from being transported from the terrestrial project area to receiving waters and coastal resources. GBW and Sumay Cove are key to the continued function and safety of transportation in and out of, and within, Apra Harbor, respectively. The proposed repairs would restore critical function and enhance safety for federal, civil, commercial, and recreational users.**

DP 8. Erosion and Siltation

Intent: To control development where erosion and siltation damage is likely to occur.

Policy: Development shall be limited in areas of 15% or greater slope by requiring strict compliance with erosion, sedimentation, and land use regulations, as well as other related land use guidelines for such areas.

Discussion: **The Proposed Action is consistent with DP 8. GBW protects the shoreline and harbor entrance from erosion and protects anchorages, helping isolate vessels from marine hazards such as wind-driven waves. The project would employ BMPs and a Storm Water Pollution Prevention Plan (SWPPP) would be developed by the construction contractor to reduce on-site erosion and off-site sedimentation. The project would comply with permit conditions of its required NPDES permit and Clean Water Act (CWA) Section 401 Water Quality Certification permit to avoid or minimize erosion and sedimentation resulting from construction activities. The contractor would prepare and adhere to an erosion control plan and install temporary erosion control features such as silt barriers around landside contractor work zones involving ground disturbance to prevent construction-related sediments and debris from entering marine waters and storm drains.**

The proposed repairs would ensure the continued protection of the shoreline from erosion associated with weather and vessel-generated wave action. The existing facilities and structures would be reused to the extent practicable, and all erosion and sedimentation regulations would be followed during repairs.

The proposed Sumay Cove shoreline repairs would ensure the continued protection of the shoreline from erosion associated with weather and vessel-generated wave action. The existing facilities and structures would be reused to

the extent practicable, and all erosion and sedimentation regulations would be followed during repairs.

RESOURCES POLICIES (RP):

RP 1. Air Quality

Intent: To control activities to ensure good air quality.

Policy: All activities and uses shall comply with all local air pollution regulations and all appropriate Federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality.

Discussion: **The Proposed Action would be consistent with RP 1. Implementation of the Proposed Action would result in temporary air quality impacts from the generation of air pollutants during construction activities. Heavy equipment operation, construction related vehicle traffic (e.g., worker commute trips), and transportation of construction debris would be the primary emission sources. These sources and emissions would be temporary and intermittent. The Navy would ensure that construction contractors would implement best management practices (BMPs) to minimize impacts to air quality. These may include, but are not limited to:**

- **Using standard dust control measures at the project site (such as watering);**
- **Covering trucks conveying demolition debris;**
- **Removing soil or other debris from streets and roadways;**
- **Minimizing idle time for vehicle and equipment; and**
- **Use of alternate fuels and/or low-sulfur diesel.**

The proposed project is located within a nonattainment area for sulfur dioxide. Total construction sulfur dioxide emissions are expected to be below de minimis thresholds for Clean Air Act general conformity, and the project would not trigger a general conformity determination under Section 176(c) of the Clean Air Act. The Navy prepared a Record of Non-Applicability for Clean Air Act Conformity.

RP 2. Water Quality

Intent: To control activities that may degrade Guam's drinking, recreational, and ecologically sensitive waters.

Policy: Safe drinking water shall be assured, and aquatic recreation sites shall be protected through the regulation of uses and discharges that pose a pollution threat to Guam's waters, particularly in estuaries, reef and aquifer areas.

Discussion: **The Proposed Action would be consistent with RP 2. The project would not involve any in-water work that would permanently degrade Guam's waters. The project area is not located over a drinking water source and would have no**

impact on Guam's drinking water. In-water construction activities would require a Clean Water Act Section 404/Rivers and Harbors Act Section 10 permit from the U.S. Army Corps of Engineers and a Clean Water Act (CWA) Section 401 Water Quality Certification permit. The project would comply with the conditions of these permits. Restoration of the GBW and Sumay Cove would facilitate the continued safe passage at and within Apra Harbor, and enhance use by federal, civil, commercial, and recreational users. The construction activities would be short-term in nature and would not have lasting impacts to the water quality in the area. BMPs would be employed and a SWPPP will be developed by the construction contractor during construction to minimize pollution and siltation to the extent possible and ensure that there is no runoff into surrounding waters.

RP 3. Fragile Area

Intent: To protect significant cultural areas, and natural marine and terrestrial wildlife and plant habitats.

Policy: Development in the following types of fragile areas including Guam's Marine Protected Areas (MPA) shall be regulated to protect their unique character.
- historic and archeological sites
- wildlife habitats
- pristine marine and terrestrial communities
- limestone forests
- mangrove stands and other wetlands
- coral reefs

Discussion: **The Proposed Action would be consistent with RP 3. The Navy is currently conducting all required regulatory consultations (i.e. Endangered Species Act, Magnuson-Stevens Fishery Conservation and Management Act, Coastal Zone Management Act and the National Historic Preservation Act) for this project.**

A Section 106 consultation with Guam State Historic Preservation Office (SHPO) has been completed. If any objects of cultural/archeological significance are identified during restoration activities, work would be ceased immediately and the Naval Base Guam Cultural Resources Manager and Guam SHPO would be notified as soon as possible.

The Endangered Species Act (ESA) listed coral species *Acropora globiceps* are located within the project area on the outside of the breakwater. ESA Section 7 consultations are currently on-going with NOAA to determine the project effects level. The Navy has determined the Apra Harbor waterfront repairs may affect and is likely to adversely affect the endangered coral *A. globiceps*. Currently, there is no critical habitat designated or proposed for *A. globiceps* in the vicinity of the project area.

The Navy has determined that the project may affect, but not likely to adversely affect green turtles, hawksbill turtles, and scalloped hammerhead sharks. Currently, there is no critical habitat designated or proposed for sea turtles or scalloped hammerhead sharks in the vicinity of the project area.

The Proposed Action is not expected to appreciably diminish Essential Fish Habitat (EFH) over the long term. However, temporary adverse effects on EFH may occur. The Proposed Action may temporarily contribute to the degradation of aquatic habitat resulting from the loss of sessile organisms, including corals and benthic invertebrates as armor stones are placed along the water's edge. Adverse effects will be minimized through minimizing and avoiding in-water work as much as possible. Due to the implementation of appropriate BMPs, the relative quantity and quality of existing EFH within the action area, and the size and scale of anticipated effects, the Proposed Action is not expected to appreciably diminish habitat value over the long term.

RP 4. Living Marine Resources

Intent: To protect marine resources in Guam's waters.

Policy: All living resources within the waters of Guam, particularly fish, shall be protected from over harvesting and, in the case of corals, sea turtles and marine mammals, from any taking whatsoever.

Discussion: **The Proposed Action would be consistent with RP 4 except for anticipated impacts to the endangered coral *A. globiceps*. The repairs to the outer breakwater may affect and is likely to adversely affect the endangered coral *A. globiceps*, but not likely to jeopardize the existence of the species. Relocation of these impacted coral will be performed to the maximum extent as possible. However, due to safety concerns on the outside of the breakwater (e.g., strong rip currents and wave energy) relocation efforts may be impeded by these natural ocean forces. Consultations with the National Marine Fisheries Service are currently be conducted. The Proposed Action may affect, but not likely to adversely affect ESA-listed green turtles, hawksbill turtles, and scalloped hammerhead sharks BMPs, such as monitoring the area for the presence of protected species, avoidance, and cessation of construction when species are present, will help minimize adverse effects.**

RP 5. Visual Quality

Intent: To protect the quality of Guam's natural scenic beauty.

Policy: Preservation and enhancement of, and respect for the island's scenic resource shall be encouraged through increased enforcement of and compliance with sign, litter, zoning, subdivision, building and related land-use laws. Visually objectionable uses shall be located to the maximum extent practicable so as not to degrade significant views from scenic overlooks, highways and trails.

Discussion: **The Proposed Action would be consistent with RP 5. Repairs to GBW and Sumay Cove marina and shoreline would use the same or similar materials to the existing structures, and would not appreciably alter the structures visually. Therefore, the project would be compatible and would not detract from the**

aesthetic or environmental quality and would not affect existing scenic resources.

RP6. Recreation Areas

Intent: To encourage environmentally compatible recreational development.

Policy: The Government of Guam shall encourage development of varied types of recreational facilities located and maintained so as to be compatible with the surrounding environment and land uses, adequately serve community centers and urban areas and protect beaches and such passive recreational areas as wildlife, marine conservation and marine protected areas, scenic overlooks, parks, and historical sites.

Developments, activities and uses shall comply with the Guam Recreational Water Use Management Plan (RWUMP).

Discussion: **The Proposed Action would be consistent with RP 6. The project does not involve development of recreational facilities. It would not impede or otherwise affect Guam's existing recreational areas or facilities. The proposed project would restore existing structures and ensure continued recreational use consistent with the Guam RWUMP.**

RP 7. Public Access

Intent: To ensure the right of public access.

Policy: The public's right of unrestricted access shall be ensured to all non-federally owned beach areas and all Guam recreation areas, parks, scenic overlooks, designated conservation areas and their public lands. Agreements shall be encouraged with the owners of private and federal property for the provision of releasable access to and use of resources of public nature located on such land.

Discussion: **The Proposed Action would be consistent with RP 7. Public access may be impacted temporarily during the repair activities. The terrestrial project area is located within existing Navy-controlled land, which does not provide access to Guam's public recreation areas. While recreational vessels may traverse the waters near the construction areas, construction activities would not restrict public access to public beaches or other recreation areas. However, restoration of GBW and Sumay Cove Marina and shoreline will enhance and ensure the long-term safe usage of Apra Harbor for military, civil, commercial, and recreational users.**

RP 8. Agricultural Lands

Intent: To stop urban types of development on agricultural land

Policy: Critical agricultural land shall be preserved and maintained for agricultural use.

Discussion: **RP 8 is not applicable. The project is not located on agricultural lands. The project is the repair of the existing GBW and Sumay Cove marina structures.**

GCMP ASSESSMENT FORMAT

FEDERAL CONSISTENCY SUPPLEMENTAL INFORMATION FORM

Date: **March 27, 2025**

Project/Activity Title or Description: **Apra Harbor Waterfront Repairs**

Location: **Cabras Island, Piti Guam and Orote Peninsula, Santa Rita, Guam**

Other applicable area(s) affected, if appropriate:

Est. Start Date: **September 2025** Est. Duration: **60 months**

APPLICANT

Name & Title: **Mr. Edward E. Moon, Installation Environmental Program Director**
Agency/Organization: **Public Works Department U.S. Naval Base Guam**
Address: **U.S. Naval Base Guam, PSC 455, BOX 152, FPO AP 96540-1000**
Telephone No. during business hours:
A/C [redacted]
A/C N/A
Fax N/A

E-mail Address: [redacted]

AGENT

Name & Title: **Mr. Jesse T. Cruz, Environmental Compliance Supervisor**
Agency/Organization: **Public Works Department U.S. Naval Base Guam**
Address: **U.S. Naval Base Guam, PSC 455, BOX 152, FPO AP 96540-1000**
Telephone No. during business hours:
A/C [redacted]
A/C N/A
Fax N/A

E-mail Address: [redacted]

CATEGORY OF APPLICATION (check one only)
(XX) I - Federal Agency Activity
( ) II - Federal Permit or License
( ) III - Federal Grants & Assistance

TYPE OF STATEMENT (check one only)
( ) Consistency
(XX) General Consistency (Category I only)
( ) Negative Determination (Category I only)
( ) Non-Consistency (Category I only)

APPROVING FEDERAL AGENCY (Categories II & III only)

Agency:
Contact Person:
Telephone No. during business hours:
Area Code - Local
Area Code _____ - Govt. Cell

FEDERAL AUTHORITY FOR ACTIVITY

Title of Law:
Section:

OTHER GUAM APPROVALS REQUIRED:

Agency	Type of Approval	Date of Application	Status

Guam BSP CMP Concurrence Response Letter to Navy

LOLA E. LEON GUERRERO
Director
MATTHEW C. SANTOS
Deputy Director

BUREAU OF STATISTICS AND PLANS

Sagan Planu Siha Yan Emfotmasion

LOURDES A. LEON GUERRERO
Governor of Guam
JOSHUA F. TENORIO
Lieutenant Governor

May 23, 2025

Edward E. Moon
Installation Environmental Program Director
Public Works Department
U.S. Naval Base Guam
PSC 455, Box 152
FPO AP 96540-1000
Via Email: [redacted]

RE: Coastal Zone Management Act (CZMA) Federal Consistency Review for Department of the Navy's Consistency Determination for its Proposed Apra Harbor Waterfront Repairs (GCMP FC No. 2025-0010); Reference 5090 Ser EV/042

Håfa Adai! The Guam Coastal Management Program, under the Bureau of Statistics and Plans, has completed its review of the Department of the Navy's (Navy) Consistency Determination for its proposed Apra Harbor Waterfront Repairs received on March 27, 2025. The Navy ("the federal agency") has submitted this determination relative to the proposed Apra Harbor Waterfront Repairs located at Cabras Island, Piti Guam and Orote Peninsula, Santa Rita, Guam.

The Bureau coordinated this review with partnering agencies, provided public notice and received comments from the Department of Agriculture (DOAG) and the Guam Environmental Protection Agency (EPA). Furthermore, the Bureau hereby concurs with the federal agency's determination that the proposal is consistent with the enforceable policies of the Bureau's Guam Coastal Management Program (GCMP) based upon the following comments and conditions:

The Navy acknowledges potential direct and indirect impacts on mobile and sessile in-water resources (such as fisheries, marine mammals, sea turtles, and corals) that could extend into Guam's coastal zone (15 CFR 923.33(b)). Subsequently, the Navy concluded that the project has reasonably foreseeable direct and indirect coastal effects on Guam's defined coastal zone. The Navy further determined that the proposed activity would be consistent to

BUREAU OF STATISTICS & PLANS – GOVERNMENT OF GUAM
Mail: P.O. Box 2950 Hagåtña, Guam 96932 Tel: (671) 472-4201/3 Fax: (671) 477-1812 Web: www.BSP.Guam.Gov

the maximum extent practicable with the enforceable policies of the Guam Coastal Management Program as applicable.

Development Policy 8. Erosion and Siltation. Development shall be limited in areas of 15% or greater slope by requiring strict compliance with erosion, sedimentation, and land-use district guidelines, as well as other related land-use standards for such areas.

The assessment conducted under this policy determines that the proposed action for Sumay Cove involves repairing the shoreline to prevent erosion caused by weather and vessel-generated waves. Measures include the use of a Glass Breakwater (GBW) for protection, adherence to environmental regulations, and implementation of a Storm Water Pollution Prevention Plan (SWPPP) to control erosion and sedimentation during construction. Temporary erosion control features will be installed, and existing facilities will be reused as much as possible. The repairs aim to maintain shoreline stability while minimizing environmental impact.

DOAG comments:

1. Erosion control measures such as silt curtains, sediment barriers, and temporary berms should be implemented during construction to prevent sediment from entering the water. The project should also avoid working during stormy weather or high-tide events to reduce the risk of sediment displacement.

Guam EPA presents the following comments:

1. Comply with the Guam Soil Erosion and Sediment Control Regulations (22 GCA Chapter 10); and apply, to the maximum extent practicable, the erosion and sediment control standards to prevent adverse impacts from construction site runoff. (2006 CNMI/Guam Stormwater Management Manual, Volume I.)
2. Secure permits and install best management practices prior to the start of the project.
3. Ensure that each laydown area is permitted and that appropriate erosion and sediment control measures and BMPs are in place prior to use. Stormwater runoff must also be managed and pretreated prior to discharge. The *concrete casting yard* is classified as an industrial activity; therefore, the contractor must provide a stormwater pre-treatment system using the hotspot design criteria and standards. (Chapter 2 Volume I, 2006 CNMI/Guam Storm water Management Manual.)
4. Stabilize sloped areas to reduce soil erosion.
5. Submit required plans for approval by Guam EPA including Erosion Control Plan, Stormwater Runoff Drainage System Plan, and an Environmental Protection Plan.
6. If the project is covered under the Federal Storm Water Regulations (40 CFR Parts 122 & 123), a notice of intent to discharge storm water to surface and marine waters of Guam must be submitted to USEPA and a copy furnished to Guam EPA. An NPDES permit which authorizes the discharge must also be secured.

Pursuant to Development Policy 8, Erosion and Siltation, the federal agency shall:

(1) Comply with the Guam Soil Erosion and Sediment Control Regulations, 22 GAR Chapter 10.
(2) Comply with the Stormwater Management Criteria for Guam (2006 CNMI Guam Stormwater Management Manual).
(3) Consult with Guam EPA to secure required permits prior to the commencement of the project.
(4) Implement best management practices (BMPs) to stabilize disturbed slopes, preventing sediment from entering the water and reducing soil erosion and runoff from the construction site.
(5) Manage and pretreat stormwater runoff prior to discharge.
(6) Be advised to consult with the Guam EPA for the following:
   a. Erosion Control Plan, Stormwater Runoff Drainage System Plan, and Environmental Protection Plan; and
   b. If the project falls under the Federal Storm Water Regulations (40 CFR Parts 122 & 123), a notice of intent to discharge storm water to surface and marine waters of Guam must be submitted to the USEPA, with a copy provided to Guam EPA. Additionally, an NPDES permit authorizing the discharge is required and must be obtained before any discharge occurs; and
   c. Provide a stormwater pre-treatment system using the hotspot design criteria and standards (Chapter 2, Volume I, 2006 CNMI Guam Stormwater Management Manual).

Resource Policy 1. Conservation of Natural Resources. The value of Guam's natural resources as recreational areas, critical marine and wildlife habitats, the major source of drinking water, and the foundation of the island's economy, shall be protected through policies and programs affecting such resources.

The disturbance of up to 21.5 acres of underwater area in Apra Harbor as part of the proposed Glass Breakwater repairs has the potential to cause significant and lasting environmental harm. This disruption can affect both the recreational value of Guam's waters and the delicate marine ecosystems that rely on a stable seabed for survival.

The long-term consequences of this underwater disturbance could include a reduction in biodiversity and a decline in the overall health and resilience of the Apra Harbor ecosystem. Recovery from such extensive damage can be a slow process, potentially taking years or even decades, depending on the severity and the ability of the affected habitats to regenerate. Therefore, a thorough environmental impact assessment is crucial to fully understand the potential consequences of the proposed Glass Breakwater repairs and to identify mitigation measures that can minimize the lasting harm to Guam's valuable marine environment.

DOAG presents these comments:

1. The repair activities might result in temporary or permanent loss of habitats used by marine species and coastal vegetation. Therefore, an environmental impact assessment should be completed to determine the extent of potential habitat loss or fragmentation, with mitigation measures, such as habitat restoration plans or replanting efforts.
2. A plan to avoid working during sensitive periods for marine life (e.g. spawning or breeding seasons) should also be considered.
3. A hazardous materials management plan should be in place to ensure proper handling, storage, and disposal of materials. Additionally, spill response protocols must be established to quickly address any accidental releases into the environment.

Pursuant to Resource Policy 1, Conservation of Natural Resources, the Federal Agency shall:

(1) Be advised to develop an environmental impact assessment to address marine species, coastal vegetation, habitat loss, and spawning or breeding seasons.
(2) Be advised to implement protocols to prevent spills and manage hazardous materials.

Resource Policy 2. Air Quality. All activities and uses shall comply with all local air pollution regulations and all appropriate federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality.

The assessment conducted under this policy determined that the Proposed Action would result in temporary air quality impacts from construction activities, including heavy equipment operation, vehicle traffic, and debris transport. To mitigate these effects, the Navy would implement best management practices such as dust control, covering trucks, minimizing equipment idle time, and using alternative fuels. Though located in a sulfur dioxide nonattainment area, emissions are expected to remain below Clean Air Act thresholds, avoiding the need for a conformity determination.

The Guam EPA presents the following comments:

1. Criteria pollutant emissions associated with the proposed action must comply with Guam Air Pollution Control Act, 10 GCA Chapter 49.
2. Dust control and maintenance measures must be implemented for the entirety of the project.

Pursuant to Resource Policy 2. Air Quality, the federal agency shall:

(1) Comply with the Air Pollution Control Act, 10 GCA Chapter 49.
(2) Comply with the Guam Hazardous Waste Management Regulations.
(3) Implement dust control and maintenance measures for the duration of the project.

Resource Policy 3. Water Quality. Safe drinking water shall be assured and aquatic recreation sites shall be protected through the regulation of uses and discharges that pose a pollution threat to Guam's waters, particularly in estuarine, reef and aquifer areas.

The assessment conducted under this policy states that the proposed construction requires compliance with Clean Water Act permits and certifications to prevent water pollution. Short-term impacts on water quality are expected, but best management practices and a Storm Water Pollution Prevention Plan will be implemented to minimize siltation and runoff, ensuring safe use of Apra Harbor for various users.

Guam EPA presents the following comments:

1. The installation of respective stormwater systems must comply with design criteria in the 2006 CNMI/Guam Stormwater Management Manual.
2. To avoid construction activity water quality impacts, all project equipment must be managed such that pollution control measures and BMPs are carefully applied to control hydraulic fluid spills and/or oil leaks from cranes and all other equipment. Spill prevention kit(s) must be readily available on site. Proper housekeeping must also be strictly implemented to prevent the transport of contaminants by stormwater runoff onto the ground.
3. No construction equipment is allowed to be located directly in surface or marine waters.
4. Any debris and waste generated during construction must be disposed of at a Guam EPA permitted site and must adhere to the requirements of the Guam Solid Waste Disposal and Collection Regulations. (22 GAR Chapter 20 and 21)
5. Guam EPA is concerned about the exposure of emerging contaminants during earth moving activities. Thorough soil testing, proper handling and disposal of any contaminated soils must be strictly implemented to avoid contamination of surface and/or marine waters.
6. Discharges that would cause or contribute to violations of any applicable G WQ S. or cause or contribute to significant degradation of the waters of Guam is prohibited. (22 GAR 5). Additionally. water quality criteria stated in Section 51 03(a) shall be strictly complied with.

Pursuant to Resource Policy 3, Water Quality, the federal agency shall:

(1) Comply with the Water Pollution Control Act, 10 Guam Code Annotated (GCA) Chapter 47.
(2) Comply with the Guam Stormwater Management Manual Criteria for stormwater systems.
(3) Be advised to consult with the Guam Seashore Protection Commission on matters that may be applicable to the Guam Seashore Protection Act to ensure compliance.
(4) Comply with the Guam Hazardous Waste Management Regulations.
(5) Comply with the Soil Erosion and Sediment Control Regulations by:
    a. Implementing BMPs for erosion and sediment control and stormwater

management.

(6) Implement spill prevention measures during site preparation and throughout the construction period to prevent oil and chemical leaks.

(7) Maintain spill kits on-site; and enforce strict housekeeping to prevent contaminants from spreading.

(8) Dispose of all construction debris and waste at a Guam EPA-permitted site in full compliance with 22 GAR Chapters 20 and 21.

(9) Be advised to consult with Guam EPA on:
   a. Complying with the Guam Water Quality Standards to prevent water degradation from discharges.
   b. Soil testing, proper handling, and disposal of contaminated soils.

(10) Construction equipment is strictly prohibited from being placed in surface or marine waters.

Resource Policy 4. Fragile Areas. Development in the following types of fragile areas shall be regulated to protect their unique character: historic and archaeologic sites, wildlife habitats, pristine marine and terrestrial communities, limestone forests, and mangrove stands and other wetlands.

The proposed Glass Breakwater repairs in Apra Harbor, which involve disturbing up to 21.5 acres of underwater terrain, carry a substantial risk of causing significant and enduring damage to the marine environment. This extensive disruption has far-reaching implications, negatively impacting not only the recreational enjoyment of Guam's coastal waters but also the intricate and fragile marine ecosystems that are intrinsically linked to the stability and health of the seabed. The consequences of such a large-scale disturbance warrant careful consideration due to their potential to undermine the ecological balance of the harbor.

Pursuant to Resource Policy 4, Fragile Areas, the federal agency shall:

(1) Comply with the Endangered Species Act of Guam, 5 GCA Chapter 63 Article 2.

(2) Comply with the Historical Objects and Sites, 21 GCA Chapter 76.

(3) Employ best management practices for the conservation of marine and terrestrial ecosystems.

(4) Be advised to implement habitat and conservation efforts that may include but not limited to endangered species safeguards, monitoring and compliance.

Resource Policy 7. Recreational Areas. The Government of Guam shall encourage development of varied types of recreation facilities located and maintained so as to be compatible with the surrounding environment and land uses; adequately serve community centers and urban areas, and protect beaches and such passive recreational areas as wildlife and marine conservation areas, scenic overlooks, parks, and historic sites.

The recreational value of Apra Harbor, a vital asset for Guam's tourism and local communities, could be significantly diminished. Activities such as swimming, snorkeling,

diving, and boating rely on clear waters and healthy marine life. Sediment plumes generated by the underwater disturbance can reduce water clarity, impacting the aesthetic appeal and the visibility crucial for these activities.

DOAG comments:

1. During the construction period, notice for alternative sites must be provided to the community

Pursuant to Resource Policy 7, Recreational Areas, the federal agency shall:

(1) Comply with Guam Beach Areas, 21 GCA Chapter 64
(2) Provide notice to the community about the duration and locations of closed-off areas.

Resource Policy 8. Public Access. The public's right of unrestricted access shall be ensured to all non-federally owned beach areas and all Territorial recreation areas, parks, scenic overlooks, designated conservation areas and other public lands; and agreements shall be encouraged with the owners of private and federal property for the provision of reasonable access to, and use of, resources of public nature located on such land.

The assessment for this policy states that public access may be temporarily affected during repairs, but the project is on Navy-controlled land with no public access to recreation areas. Recreational vessels can still navigate nearby. Public beaches and other recreation areas will not be restricted. The repairs will ultimately enhance the long-term safe use of Apra Harbor for military, civil, commercial, and recreational users.

DOAG comments:

1. Safe access must be granted to fishers during the seasonal fish runs. Signage must be posted around the construction site to deter any unauthorized entry.

Pursuant to Resource Policy 8, Public Access, the federal agency shall:

(1) Comply with Public Access to the Ocean Shore, 21 GCA Ch. 65.

Although regulatory permits are being sought to ensure protection, the Department of the Navy, and associated agencies, and contractors, must commit to stringent oversight, enforce accountability, and guarantee that conservation measures are in place.

Per 15 CFR §930.4(b), if the requirements for conditional concurrences specified in 15 CFR §930.4(a), (1) through (3), are not met, then all parties shall treat this conditional concurrence letter as an objection pursuant to 15 CFR Part 930 subpart C. Furthermore, if an objection is determined, you are hereby notified that, pursuant to 15 CFR §930.63(e) and 15 CFR Part 930, subpart H, you have the opportunity to appeal an objection resulting from not meeting the requirements of 15 CFR §930.4(a), (1) through (3), to the Secretary of Commerce within 30 days after receiving this conditional concurrence letter.

GCMP FC No. 2025-0010
RE: Coastal Zone Management Act (CZMA) Federal Consistency Review for Department of the Navy's Consistency Determination for its Proposed Apra Harbor Waterfront Repairs

The proposed action shall be operated and completed as represented in the Coastal Zone Management (CZM) federal consistency certification. Significant changes to the subject proposal shall be submitted to the Bureau for review and approval and may require a full CZM federal consistency review, including publication of a public notice and provision for public review and comment. This condition is necessary to ensure that the proposed actions are implemented as reviewed for consistency with the enforceable policies of GCMP. Guam Land Use policies (E.O. 78-37), are the federally approved enforceable policies of GCMP that apply to this condition.

Please do not hesitate to contact Ms. Esther Taitague, Federal Activities Planner at [redacted] or Mr. Edwin Reyes, Coastal Program Administrator at [redacted]. Si Yu'os Ma'âse'.

Sincerely,

LOLA E. LEON GUERRERO
Director

cc: NOAA-OCM
DOAG DAWR
DLM
DPR SHPO
DPW
GEPA
GWA

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