CHAPTER 4. WATER RESOURCES

4.1 INTRODUCTION

Water resources as defined in this Environmental Impact Statement (EIS) are sources of water available for use by humans, flora, or fauna, including surface and groundwater, nearshore waters, and wetlands. Surface water resources, including but not limited to lakes, streams, and rivers, are important for economic, ecological, recreational, and human health reasons. Groundwater may be used for potable water, agricultural irrigation, and industrial applications. Groundwater is classified as any source of water beneath the ground surface, and is the primary source of potable water used for human consumption. Consistent with the definition contained in 22 Guam Administrative Rule 5105, nearshore waters are defined as all coastal waters lying within a defined reef area, all coastal waters of a depth of less than ten fathoms (60 feet [ft], 18.3 meters [m]), and all coastal waters greater than 10 fathoms up to 1,000 ft (305 m) offshore where there is no defined reef area. Nearshore waters can be directly affected by human activity, and are important for human recreation and subsistence. Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation, and include marshes, swamps, and similar areas. Areas described and mapped as wetland communities may also contain small streams or shallow ponds, or pond or lake edges.

This chapter contains the discussion of the potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) for water resources. For a description of the affected environment, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

4.2 ENVIRONMENTAL CONSEQUENCES

4.2.1 Approach to Analysis

4.2.1.1 Methodology

This section contains a discussion of potential environmental consequences associated with implementation of the alternatives within the ROI for water resources. The environmental consequences of each action alternative and the no-action alternative are presented in this section. The methodology for identifying, evaluating, and mitigating impacts to water resources has been established based on federal and local laws and regulations as described in Volume 2, Chapter 4, Section 4.1.

The environmental consequences evaluation for water resources includes a qualitative and quantitative analysis of surface water, groundwater, nearshore waters, and wetlands to the extent possible given available project data. Environmental impact assessments were made and compared to baseline conditions, issues of public concern, and significance criteria to determine the magnitude of potential impacts to water resources.

The proposed action analysis is separated into two main activities: construction and operation. Each of these activities has potential effects with associated impacts. The analysis of potential impacts considers both direct and indirect impacts. Direct impacts are those that may occur during the construction phase of the project and cease when the project is complete or those that may occur as a result of project operation following completion of construction. Indirect impacts are those that may occur as a result of the completed project or those that may occur during operation but not as a direct result of the construction or operational action.

Sustainability Requirements and Goals

Implementation of the proposed action would be consistent with Navy policy in compliance with laws and executive orders whereby Department of Defense (DoD) entities are required to reduce demand for indoor water by as much as 20% and outdoor water use by 50% in the coming years. Concurrent with these mandates is the Navy/Marine Corps policy to pursue and facilitate Leadership in Energy and Environmental Design (LEED) Silver certification for their facilities. LEED is a voluntary point system tool that measures the degree of sustainability features incorporated into a development.

Water resource sustainability is addressed in two categories: minimize water demand and maximize the quantity and quality of groundwater recharge. Elements identified to achieve minimum water use are:

- Water Conservation - identify and specify appropriate minimum water demand fixtures and devices
- Irrigation - minimize use of irrigation systems and water
- Grey Water Use - evaluate options for use of grey water for irrigation
- Rainwater Harvesting - investigate harvesting, storage and distribution systems

Provisions of the existing Unified Facility Code (UFC) Low Impact Development (LID) Manual would be followed. This manual includes specific Integrated Management Practices to be considered and included in the drainage design of the proposed action sites. In addition, National Pollutant Discharge Elimination System (NPDES) permitting requirements, LEED goals, and recent laws mandate certain drainage quantity and quality performance standards. Thus, the proposed action includes incorporating post-construction drainage quality, quantity, and velocity dissipation measures to approximate (or improve upon) pre-construction conditions at the property line. Following is a brief discussion of the approach to impact analysis for water resources, including surface water/stormwater, groundwater, nearshore water, and wetlands, for construction and operation. Subsequent sections of the chapter provide a detailed description of the potential impacts to these resources.

Construction

Surface Water/Stormwater

Surface water issues include:

- Water quality
- Flooding
- Flow path alterations

Surface water quality impacts were evaluated by examining the potential increase of contamination including chemicals, heavy metals, nutrients, and/or sediments in the surface water as a result of the proposed action. The analysis was performed by comparing existing water quality data with possible increases in water quality contaminants in the surface water. Potential impacts to surface water quantity and velocity were analyzed by examining changes in drainage volumes and patterns associated with the proposed action.

For construction activities, some of the key effects include stormwater discharges that may contain elevated sediment concentrations, spills, and leaks of chemicals such as lubricants, fuels, or other construction materials that may increase pollutant loading in the surface water. In addition, direct construction or alteration of stream channels or reservoirs may cause increased contamination by sedimentation or chemical constituents.

Groundwater

Groundwater impact concerns include water quality and water quantity. Groundwater quality was assessed by examining the potential risk of a hazardous or regulated waste release, as well as approximating the amount of additional stormwater and associated non-point source pollution that enters the groundwater. Water availability is addressed in Volume 6, Chapter 3, Section 3.1, Potable Water.

Potential groundwater impacts associated with construction activities include direct spills and leaks having direct impacts to stormwater runoff that can contribute to groundwater contamination, as well as direct contamination of groundwater resources through percolation.

Nearshore Water

The nearshore water impact analysis focused on water quality. Recreational nearshore issues are addressed in Chapter 9, Recreational Resources. The potential increases of contamination including chemicals, heavy metals, nutrients, and/or sediments in nearshore waters as a result of the proposed action were assessed by comparing existing water quality data with the projected changes in water quality.

Potential impacts associated with construction activities include construction spills and leaks that may discharge to nearshore waters and an increase in stormwater discharge that may increase non-point source pollution.

Wetlands

Impacts to wetlands were evaluated to determine if there would be any impacts from:

Pollutants

Loss of area

Loss of functionality

The potential for pollutants to impact a wetland was evaluated by examining the risk of hazardous materials leaking or spilling and their proximity to the wetlands. The loss of wetland area was assessed by the total amount of delineated wetland area that would be directly removed either in loss of area or function as a result of the proposed action. Wetland functionality refers to the ability of the wetland to trap sediments and nutrients, receive and retain water, maintain wildlife habitat (both flora and fauna), and provide recreational uses. The impacts to wildlife habitat associated with wetlands are addressed in Chapter 10, Terrestrial Biological Resources.

For construction activities, the effects associated with activities in close proximity to any designated wetland or activities in the wetlands themselves are considered. Runoff from nearby construction sites may contain increased chemicals, heavy metals, nutrients, and/or sediment that could adversely affect those wetlands. Wetland impacts could result from changes in land uses and/or spills or leaks from construction operation and equipment. Loss of functionality can also occur if construction operations occur directly within the designated wetlands. Loss of wetland area would occur if the proposed action involves the direct removal of wetlands.

<u>Operation</u>

Surface Water/Stormwater

For non-training operation activities, potential causes of impacts to surface waters include stormwater discharges which may increase the volume of sediment loading to the surface water as well as increased contaminants from sources such as vehicle maintenance, household discharges, privately-owned vehicles, and animal waste. Contamination of surface water from leaks or spills of hazardous, or otherwise regulated materials, is also a potential impact. Increased water usage may reduce the water availability in the reservoirs and/or reduce instream flows. Increased impervious areas may increase the runoff and increase the potential for flooding. Development in the floodplain may result in potential damage from flooding. The storage of hazardous materials and fuels pose a continued risk of contamination of surface water from leaks or spills.

Groundwater

Effects to groundwater from non-training operation activities may result from increases in impervious surfaces, waste generating activities, and storage of potential contaminants. The direct impacts may include an increase in polluted stormwater runoff and contamination from leaks or spills of hazardous or regulated materials. In addition, the increased water usage may increase the depletion of groundwater resources (see Volume 6, Chapter 3). The indirect impacts may include decreases in groundwater recharge from increased impervious areas and saltwater intrusion from increased aquifer pumping.

Effects to groundwater from operational activities may result from increases of impervious areas, waste-generating activities, and storage of potential contaminants. The direct impacts may include an increase in polluted stormwater runoff and contamination from leaks or spills of hazardous or regulated materials. These activities can pose both short-term and long-term effects.

Nearshore Water

Nearshore waters may be impacted by non-point source runoff containing chemical pollutants, nutrients, and/or sediments from upland support sites. In addition, ship operations, most notably docking activity, can stir up sediments, resulting in temporary suspended sediment plumes and associated localized increases in turbidity in nearshore waters.

The CWA prohibits the discharge of oil and hazardous substances in such quantities as may be harmful into or upon the navigable waters of the U.S., including the contiguous zone, exclusive economic zone and adjoining shorelines. Under the CWA, the USEPA published oil pollution prevention regulations in 1973 (amended in 1974, 1976, 2002 and 2004). These regulations include requirements for both oil spill prevention and response. The Navy has developed operations manuals and spill contingency plans, provides personnel training, and conducts testing of transfer equipment to comply with these regulations. OPVAVINST 5090.1C Environmental Readiness Manual Section 22-2.2.7.1 requires all hands to receive environmental training. This training includes oil and hazardous substance management, handling, minimization, and spill response. Chapter 22 also requires ships to strictly comply with fuel transfer and ballasting procedures to ensure ballast water does not become contaminated with oil or any other waste. Ships using self-compensating fuel tanks are required to ensure adequate margin is preserved to prevent inadvertent discharges of oil with the compensating water. OPNAVINST 5090.1C also directs the Navy to prevent the introduction of non-native organisms into natural ecosystems. Section 19-10, Ship Ballast Water and Anchor System Sediment Control provides measures to prevent such aquatic introductions, as mandated by the National Invasive Species Act of 1996 (P.L. 104-332). This law mandates the establishment of an Armed Forces Ballast Water Management Program to prevent such introductions.

As described in the EIS, the proposed action would be implemented in accordance with these aforementioned regulations.

Wetlands

Wetlands were assessed for the potential to be impacted by potential spills and leaks of hazardous materials that may be stored in close proximity. Indirect impacts to existing wetlands could occur by altering (i.e., diverting or restricting) the surface water flowing into the wetlands. Indirect impacts to wetlands could also occur as a result of altered sedimentation of watercourses or drainage conveyances connected to wetland areas.

4.2.1.2 Determination of Significance

The following factors were considered in evaluating potential impacts to groundwater and surface waters:

- Long-term increased inundation, sedimentation, and/or damage to water resources in the ROI caused by project activities, including impervious surfacing that increases and/or diverts rainfall runoff and/or affects its collection and conveyance and implementation of mitigation measures
- Depletion, recharge, or contamination of a usable groundwater aquifer for municipal, private, or agricultural purposes
- Increases in soil settlement or ground swelling that damages structures, utilities, or other facilities caused by inundation and/or changes in groundwater levels
- Creating noncompliance with any applicable law or regulation
- Increasing risk of environmental hazards to human health
- Decreasing existing and/or future beneficial use
- Reducing the amount of water or wetlands available for human use or ecological services
- Reducing availability or accessibility of water resources

If an activity was determined to have a potential impact, the impact was then evaluated to determine its significance. For significant impacts, a determination was made as to whether the impact can be mitigated to less than significance.

4.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on the effects to water resources: surface water, groundwater, nearshore water, and wetlands that could be impacted by the proposed action. As part of the analysis, concerns relating to water resources that were identified by the public, including regulatory stakeholders, during the scoping meetings were addressed. These include:

- Describe water quality with respect to public health requirements, drinking water regulations, and applicable water quality standards
- Estimate quality and quantity of stormwater runoff to be generated by increased impervious surfaces, methods of contaminant removal, methods of runoff redirection to recharge the aquifer, and effects to groundwater under the direct influence of surface water
- Accidental or intentional contamination of groundwater
- Capacity of water resources to meet agricultural needs
- Stormwater management controls to prevent pollution during construction and subsequent operation

- Construction and bulldozing of the jungles that could potentially cause runoff, pollute the beaches, and destroy marine life
- Effects of training and dredging on sedimentation stress for the coral reefs and other marine life
- Identify ways to monitor and mitigate indirect impacts from sediments on coral reefs

4.2.2 Alternative 1 Polaris Point (Preferred Alternative)

4.2.2.1 Onshore

This discussion of potential impacts to onshore water resources focuses on potential impacts to surface water resources, groundwater resources, and wetland areas for Alternative 1, Polaris Point (referred to as Alternative 1). For a discussion of potential impacts to nearshore waters, see the Offshore section below.

<u>Construction</u>

Surface Water/Stormwater

Proposed construction activities under Alternative 1 would be located more than 1,500 ft (457 m) from any of the streams around Apra Harbor. Due to the distance from these streams, the proposed action is not anticipated to have any direct impacts to these streams. However, there is a potential to increase the amount of sediment in the runoff that could eventually flow into area streams, resulting in an indirect impact. The sediment can transport other constituents such as nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. To minimize these potential temporary increases in stormwater runoff, erosion, and sedimentation, a Construction General Permit (CGP) would be obtained and followed and a SWPPP would be prepared and implemented. The SWPPP would identify construction-specific Best Management Practices (BMPs) (Volume 2, Chapter 4, Table 4.2-1) that would be implemented as part of Alternative 1 to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. Project and site-specific BMPs would retain silt laden stormwater before it reaches a sensitive surface water resource. Further, stormwater runoff would be diverted away from water bodies to protect waters of the U.S. A Spill Prevention Control and Counter-measures (SPCC) Plan would be implemented to reduce the potential for leaks and spills of petroleum, oil, and lubricants (POLs) and other hazardous or other contaminants from equipment. The facilities associated with the Polaris Point wharf would be constructed within the 100-year flood zone. Thus, all structures within this area would be designed and constructed to elevate the structure out of the flood zone and reduce potential impacts from flooding.

Under Alternative 1, dredged material would potentially be placed in an upland placement facility. Five potential upland placement facilities have been identified at Naval Base Guam, none of which would be located on a surface water feature (refer to Figure 4.2-2 in Volume 2, Chapter 4). Only the Polaris Point upland placement facility would be located in the 100-year flood zone. Upland placement facilities would consist of a fully bermed disposal area, thereby isolating the dredged material from the surrounding environment. Following placement of dredged material, the sediments would be allowed to consolidate, settle, and dewater. Water would evaporate or percolate into the ground. The exterior slope of the upland placement facility berms would be seeded with grass to minimize erosion.

Water generated from mechanically dredged material (i.e., effluent) placed in an upland placement facility would not discharge into sensitive surface waters because infiltration rates of the foundation soils at the upland placement sites are greater than any potential effluent discharge (NAVFAC Pacific 2005). In addition, runoff generated from rainfall would not be expected to exit the upland placement site due to high infiltration rates. Because dredged material placed in an upland placement facility would be finer and therefore, have lower infiltration rates than foundation soils, trenches would be constructed to allow water to reach foundation soils and facilitate rapid infiltration of runoff. Based on recent Inner Apra Harbor maintenance dredged material placement experience that used the same dredging and dredged material handling methods, little water would accumulate in the upland placement sites. Therefore, construction activities associated with Alternative 1 would result in less than significant impacts to surface water.

Groundwater

Under Alternative 1, proposed construction and dredged material upland placement activities would be in compliance with the water protection measures identified in the surface water section above, which would therefore also protect local groundwater quality. The dredged material upland placement sites would be located over aquifers. However, those aquifers are not used for supplying drinking water; thus, any effluent that might percolate into the aquifer would not affect regional groundwater drinking quality or quantities. Based upon recent and historical sediment sampling that has been conducted in association with Outer and Inner Apra Harbor Navy dredge projects, it is anticipated that the dredged material would be within effects range-low (ER-L) thresholds for National Oceanic and Atmospheric Administration (NOAA) sediment quality guidelines as the majority of the sediments tested contain no or low concentrations of contaminants of concern. Based on these sampling efforts, a limited area of sediment in the vicinity of Sierra and Romeo wharves in Inner Apra Harbor was identified that may be unsuitable for ocean disposal due to effects range-medium (ER-M) thresholds and amphipod toxicity and would be placed in an upland placement site (NAVFAC Pacific 2007a). The indication for the Sierra Wharf dredge sediments not being likely suitable for ocean disposal was based upon only one amphipod test where the toxicity levels were only slightly elevated. The overall low contaminant concentrations and tissue concentrations below published effects levels may allow for ocean disposal of these materials for Sierra Wharf (NAVFAC Pacific 2007a). Additional analysis of the sediments in the vicinity of Romeo Wharf would be required to determine ocean disposal suitability of those materials. The results of the 2007 dredge sediments study are available in Volume 9, Appendix K. The location of these samples for Area P-436B is presented in Volume 2, Chapter 2.4,Water Resources. Material unsuitable for ocean disposal would be placed upland. No impacts to groundwater from upland placement of these sediments are expected. Leachate analysis to groundwater is discussed below.

The upland placement sites would be enclosed by earthen berms of 16 to 30 ft (5-9 m) in height. As the dredge dewatering effluent has the potential to impact the quality of the local, non-potable groundwater beneath the upland placement sites, a leachate pathway analysis was conducted for dredged material placement at the Field 5 upland placement site as part of the Environmental Assessment (EA) for Alpha and Bravo Wharves. No contaminants of concern were discovered in the leachate that would exceed the Guam Environmental Protection Agency (GEPA) water quality standards for groundwater, and no engineering controls at the upland placement site were required (NAVFAC Pacific 2005). Because the dredged material to be generated in this action would be similar to that evaluated for the Alpha and Bravo Wharf EA, the impacts to groundwater are expected to be similar. In addition, a dewatering plan would be submitted to the GEPA prior to placing the dredged material in an upland placement site. Therefore, construction activities associated with Alternative 1 would result in less than significant impacts to groundwater.

Wetlands

The dredging activities proposed under Alternative 1 would occur in Outer Apra Harbor, away from the wetlands located in Inner Apra Harbor and Sasa Bay. The nearest wetland to the proposed dredging activity would be Wetland Area T, located approximately 2,500 ft (762 m) east of the nearest extent of proposed dredging (Figure 4.2-1). Other wetland areas (W, V2, U, S, X, and SV-O) would be located even further away from the proposed dredging areas. To the west, Wetland Areas A and B are located over 3,000 ft (914 m) from the nearest extent of proposed dredging (Figure 4.2-1). Due to the distance and implementation of BMPs such as the use of silt curtains in nearshore waters and operational controls, there would be no impacts to wetlands.

Distance to the wetlands, and the prevailing currents (i.e., the prevailing surface water motion in Apra Harbor is generally westward, away from the majority of wetland areas in Apra Harbor and Sasa Bay) would minimize impacts.

<u>Operation</u>

Surface Water/Stormwater

The operational phase of Alternative 1 would increase the area of impervious surface, resulting in an associated relatively minor increase in stormwater discharge intensities and volume. However, existing stormwater infrastructure or new stormwater infrastructure improvements included as part of the proposed action would incorporate LID Integrated Management Practice (IMP) measures and BMPs to ensure stormwater retention would be consistent with local and federal requirements and thus minimize potential impacts to surface water quality. These IMP and BMP measures would provide stormwater pre-treatment to remove contaminants prior to discharge into the harbor, as detailed in a design-phase plan that would cover the entire project area.

Alternative 1 would be conducted in accordance with all applicable federal, Government of Guam (GovGuam), and military orders, laws, and regulations, including the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP), Stormwater Management Plan (SWMP), and SPCC Plan that would control runoff and minimize potential leaks and spills. In addition, Alternative 1 would include the implementation of BMPs and LID measures. All nonpoint and point source discharges would be monitored pursuant to Clean Water Act (CWA) permits. Implementation of these protective measures would minimize potential effects of runoff, spills, and leaks, and would minimize potential effects to surface water resources by retaining and treating stormwater prior to discharge to surface waters and by responding to oil and hazardous waste spills and preventing their discharge to surface waters. Therefore, operations associated with Alternative 1 would result in less than significant impacts to surface water.

Groundwater

The project area is located over 4 miles (mi) (6.4 kilometers [km]) west of the Northern Guam Lens Aquifer (NGLA). The BMPs and follow-on measures and plans identified under the surface water discussion would also serve to protect groundwater quality in the project area by reducing the potential for spills and leaks from POLs or hazardous materials. Therefore, operations associated with Alternative 1 would result in less than significant impacts to groundwater.

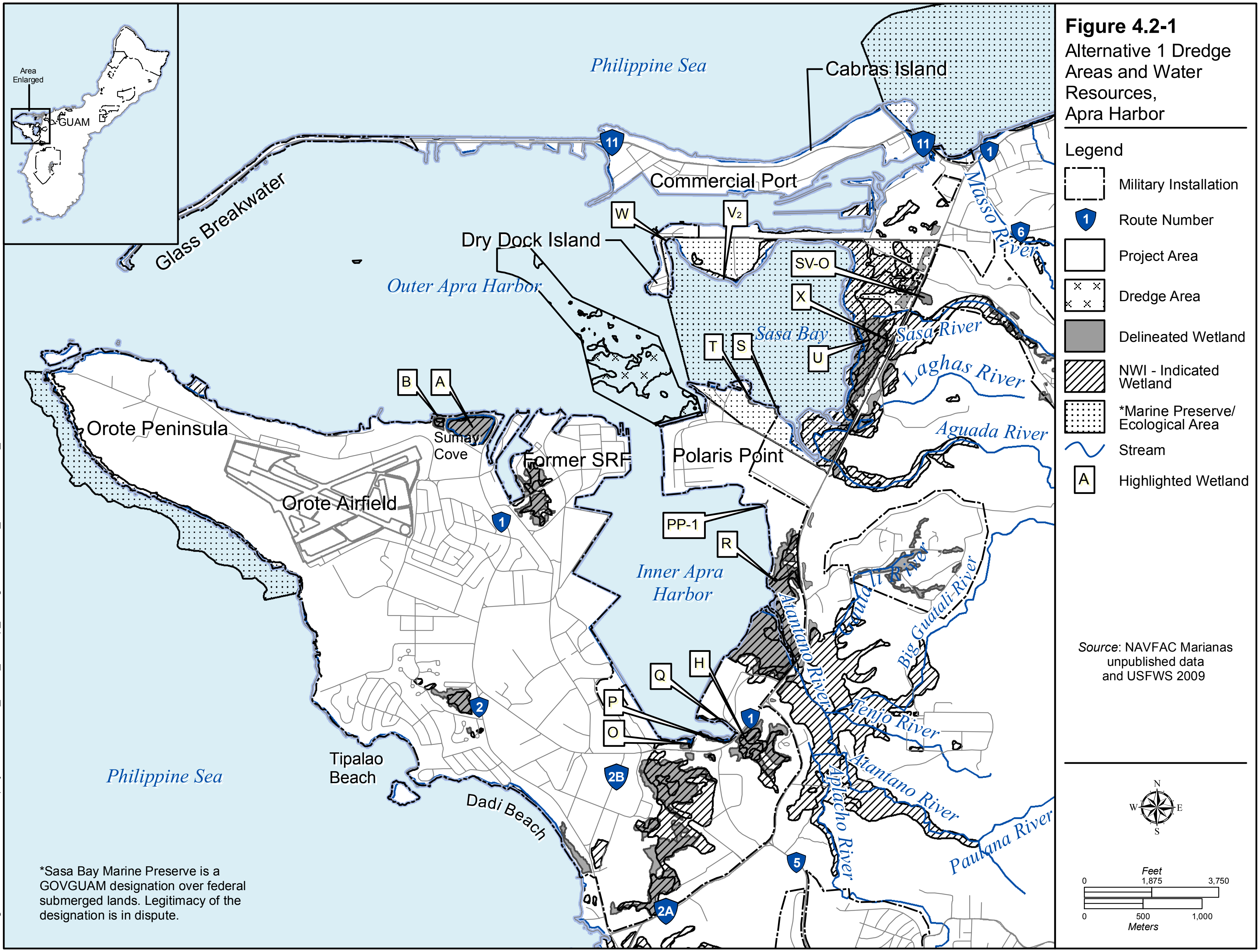

Figure 4.2-1
Alternative 1 Dredge Areas and Water Resources, Apra Harbor

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Wetlands

No wetland areas would be directly or indirectly affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Proposed BMPs, LID measures, and wastewater treatment plant (WWTP) improvements would collectively reduce the potential for pollutants to impact wetland areas. Therefore, operations associated with Alternative 1 would not impact wetlands.

4.2.2.2 Offshore

Construction

Nearshore Waters

As a consequence of construction, approximately 3.6 acres (ac) (1.5 hectares [ha]) of intertidal area and open water would be filled. The 3.6 ac of fill corresponds to the wharf area as depicted on Figures 2.5-2 and 2.5-5. As shown on Figure 2.5-6, this fill area is within the dredging footprint and it would backfill the riprap that would be placed on the dredged area beneath the wharf. The area of fill would consist of a riprapped slope from the Mean High Water line at the shoreline to the outer edge of the wharf. Wharf pilings would be installed first and then the riprap protection slope under the full width and length of the wharf deck would be added. The aggregate impacts to water resources under the preferred alternative are summarized in Table 4.2-1.

Table 4.2-1. Summary of Aggregate Effects to Jurisdictional Waters of the U.S. and Wetlands

Component Action	*Jurisdictional*		*Type and Area (ac/ha) of Impact*				*Impacted Feature*
	Waters[1]	*Wetlands*	*Direct*	*Indirect*	*Temp.*	*Perm.*	
Dredging	●			ND	●		Outer Apra Harbor
Pilings and riprap	●		3.6ac/ 1.5 ha			●	Outer Apra Harbor

[1] "Waters" refers to jurisdictional waters of the U. S. as defined by the Clean Water Act

During construction operations under Alternative 1, contaminated runoff or spills and leaks could potentially be transported to, or directly released to nearshore waters. However, implementation of the Naval Base Guam SPCC Plan would reduce the potential for spills and leaks of POLs and hazardous materials. Additionally, in-water BMPs such as silt curtains in the nearshore areas and water quality monitoring would be implemented in accordance with USACE Section 404/10 and GEPA WQC which would also serve to reduce potential impacts to nearshore waters from construction activities.

Under Alternative 1, wharf construction activities would result in localized temporary impacts to nearshore water quality from resuspended sediment; however, these localized temporary impacts would be minimized by implementing in-water BMPs such as silt curtains in nearshore areas, water quality monitoring, and other construction BMP measures. In-water BMPs and water quality monitoring would contain turbidity within the immediate area. All applicable local, state and federal certifications and permits would be obtained prior to construction, including: Department of Army permit under Section 10 of the Rivers and Harbors Act, Section 404 of the CWA and GEPA, and Section 401 Water Quality Certification (WQC). Conditions and measures imposed by those certifications and permits would be followed to ensure protection of nearshore waters. Upon completion of construction, water quality would be expected to return to pre-construction conditions.

Under Alternative 1, the total dredged material volume anticipated for Polaris Point would be approximately 608,000 cubic yards (cy) (464,850 cubic meters [m^3]), including the overdredge.

Approximately 30% of the dredged material would be generated at the shoreline area of Polaris Point to provide an appropriate slope for the wharf structure. As discussed previously in Chapter 2 of this Volume, there are five possible disposal scenarios for dredged material: 100% disposal in the ODMDS, 100% disposal upland, 100% beneficial reuse, 50% beneficial reuse/50% ocean disposal and 20-25% beneficial reuse/75-80% ocean disposal. Several beneficial use projects have been identified as described in Chapter 2. However, for the purposes of impact analysis, the EIS conservatively assumes that all dredged sediments would be placed at one or more of five potential upland sites at Naval Base Guam (refer to Figure 4.2-2 in Volume 2, Chapter 4) for dewatering and reuse, or placed in a U.S. Environmental Protection Agency (USEPA) approved Ocean Dredged Material Disposal Site (ODMDS) for Guam. The more likely outcome would be a combination of the three approaches (i.e., ocean disposal, upland placement, and beneficial reuse). The Navy is in the process of developing a detailed dredged material management plan that will incorporate the disposal options, specific plans for beneficial reuse to the extent possible, and include specific monitoring efforts required for each disposal option.

The following sections present an analysis of the potential impacts to nearshore waters from the proposed dredging activity.

Physical Impacts to Nearshore Waters from Dredging

During dredging activities, nearshore water quality would be temporarily impacted by turbidity and sediment generated during the dredging process. Dredging is scheduled to last between 8 and 18 months, depending upon the dredging schedule chosen. Although the project would occur over a period of 8-18 months, dredging activity would be transient in nature and would not occur at any one location for the entire duration of the project. Therefore, impacts to any specific area would be temporary and limited to that specific location. Dredged materials would be transported to existing upland disposal sites for upland placement or disposed of at an offshore site, if available. Prior to disposal of dredge materials, a sampling and analysis plan would be submitted to the GEPA.

Mechanical dredging was used for analysis because it represents the maximum potential adverse environmental effect to water quality. The primary physical impact from mechanical dredging involves a disturbance to the marine environment that generally leads to re-suspension of sediments and increased turbidity that could adversely affect marine corals and filter-feeding invertebrates. Selection and operation of the type of dredge equipment, as well as the type of sediment being dredged, affect the degree of adverse impacts during dredging. Sediment loss to the water column reduces the efficiency of the dredging process, increases the size of the residual sediment plume, and compounds the impacts to the marine environment. The source of the suspended sediment plume is the sediment loss that occurs throughout the dredging process. The mechanical disturbance applied to the sediment, the ambient currents, and the composition of the sediment determines the magnitude of this loss (SAIC 2001).

The nature, degree, and extent of sediment re-suspension that occurs during dredging are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size; operational procedures used; and the characteristics of the receiving water in the vicinity of the operation, including seawater density, turbidity, and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing. The relative importance of the different factors varies significantly from site to site (SAIC 2001).

Even under ideal conditions, substantial losses of loose and fine sediments will usually occur. Sediment loss during a typical mechanical dredging operation occurs throughout the water column from the following specific sources: impact of the bucket on the seabed; material disturbance during bucket closing and removal from the bed; material spillage from the bucket during hoisting; material washed from the outer surfaces of the bucket during hoisting; leakage and dripping during bucket swinging; aerosol formation during bucket re-entry; and residual material washed during bucket lowering (SAIC 2001).

Given the coarse nature of Outer Apra Harbor sediments, it is likely that the majority of the suspended sediment would settle out rapidly, resulting in a much shorter turbidity plume than otherwise would be the case. Maximum concentrations of suspended solids in the surface plume should be less than 0.5 parts per thousand (ppt) in the immediate vicinity of the operation and decrease rapidly with distance from the operation due to settling and dilution of the material. Average water-column concentrations should generally be less than 0.1 ppt. The near-bottom plume would probably have higher solids concentrations, indicating that re-suspension of bottom material near the bucket impact point is probably the primary source of turbidity in the lower water column. In typical dredging projects, the visible near-surface plume normally dissipates rapidly within an hour or two after the operation ceases (SAIC 2001). Given the course nature of the samples, the time period for dissipation is anticipated to be similar. It is assumed that because of the proximity of coral reefs to the project area, no barge overflow would be a condition of the WQC. This likely permit certificate condition would help reduce the potential for impacts to nearshore waters by preventing the release of silt laden water during barge loading and transport.

A primary influence on the sediment plume is the composition of the sediment. If the sediment is sand, for instance, material released to the water column quickly settles out. Fine grained, silty sediment produces higher turbidity and would remain suspended in the water column while being subject to advection and diffusion, resulting in a larger plume footprint. It has been demonstrated that elevated suspended solids concentrations are generally confined to the immediate vicinity of the dredge or discharge point and dissipate rapidly at the completion of the operation (SAIC 2001).

Sediment grain size analyses indicate that sediments in the area of the navigation channel and proposed turning basin consist primarily of sand and rubble with silty sediments being found along the proposed berthing areas (NAVFAC Pacific 2006). The coarse grain size of the material to be dredged indicates that the majority of the resuspended sediment would settle out of the water column rapidly. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the *Habitat Equivalency Analysis and Supporting Studies* with a detailed summary included in Appendix E of Volume 9 (Ericksen 2009). Input parameters utilized for the model included: dredging production rate, percent bucket loss (TSS load), current patterns, sediment grain size distribution, water depth, and dredge location. Due to the similarities in site conditions and subsequent anticipation of similar silt curtain effectiveness, the effects of silt curtains on TSS was also considered based on data collected during the previous dredging of Alpha-Bravo wharves. For that dredging project, TSS and turbidity was monitored both inside and outside of the silt curtain for 145 days. The results of the monitoring determined that the average TSS levels outside of the silt curtain were only 10% of the level inside the curtain (i.e., silt curtains retained 90% of the material inside). Possible maximum adverse environmental conditions were simulated by approximating the highest 10% TSS levels recorded outside of the silt curtain during the Alpha-Bravo dredging project, during strong trade wind conditions. As dredging for the proposed project would be conducted continuously, the maximum daily rate of 24 hours was used in the model. Under the maximum potential adverse effect scenario model run, the dredge plume had a maximum length of 328 ft (100 m). The plumes rapidly dissipated following dredging.

Historically, water quality monitoring, silt curtains in the nearshore areas, and other in-water BMPs have been implemented during dredging operations in Outer Apra Harbor in order to protect corals and filter-feeding invertebrates; similar BMPs would be used under Alternative 1. Silt curtains are physical barriers to sediment transport that extend from the water surface to a specified water depth. Silt curtains are designed to contain or deflect suspended sediments or turbidity in the water column and, when properly deployed and maintained, can effectively control the flow of turbid water. Sediment containment within a limited area is intended to provide residence time to allow soil particles to settle out of suspension and reduce flow to other areas where negative impacts could occur. Silt curtains may also be used to protect specific areas (e.g., sensitive habitats, water intakes, or recreational areas) from suspended sediment and particle-associated contamination. The use of silt curtains near sensitive resources in addition to around the dredging area might further reduce the potential impacts from sediments that may be released (see also Chapter 11 of this Volume for a discussion on sediment plume modeling). A number of protective measures would be taken to minimize the distribution of the turbidity plume that would unavoidably be generated by the proposed dredging operations. Silt curtains are one example of these types of protective measures. Silt curtains are commonly utilized to contain sediment plumes near the point of dredging in the nearshore environment. Standard turbidity curtains are approximately 20-30 ft (6-9 m) in length and have a weighted bottom to maintain the effectiveness of the curtain against the movement of currents within the water body. Since the dredge equipment is not stationary for the entire period of dredging, it is impractical to have a silt curtain extending to and being anchored to the bottom of the harbor. The length of time the silt curtains would be in place would be determined through agency coordination and permitting; however, in general terms the curtains would potentially be in place during and after dredging operations until monitoring indicates turbidity levels have returned to pre-dredging concentrations. In the event of silt curtain failure, dredging activity would cease until repairs to the curtain are completed. As the material is being excavated by the mechanical dredge, the heaviest materials fall rapidly to the bottom of the water body with the lighter and more buoyant fraction floating in the upper levels and surface of the water where the curtains are most effective. The majority of the sediment (e.g., >50%) is comprised of larger grained material and, therefore is generally referred to as being "coarse" and would settle quicker than silty materials. The area proposed for dredging is designated as M-2 or area of "Good" water quality. Prior to starting the dredging activity, a water quality monitoring plan would be submitted to the GEPA. Water quality control measures could consist of using silt curtains, water quality monitoring, and other BMP measures to prevent suspended sediments from exceeding GEPA water quality standards, and performing frequent monitoring during construction to ensure the effectiveness of suspended sediment containment. Should exceedances of water quality standards occur, construction activities would be interrupted until turbidity levels returned to acceptable levels. The sedimentation controls would reduce impacts to aquatic communities and water quality outside of the project area.

Chemical Impacts to Nearshore Waters from Dredging

Resuspended sediment plumes may result in a decrease in dissolved oxygen (DO) in the water column by increasing the biological oxygen demand, affecting marine organisms both on the seabed and in the water column. In addition, because contaminants have a tendency to adhere to sediment particles, a portion of the chemical burdens in the sediment would be released into the water column.

DO reduction due to dredging is a function of the amount of resuspended sediment in the water column, the oxygen demand of the sediment, and the duration of resuspension (LaSalle et al. 1991). Studies have indicated wide variations in DO levels associated with dredging, from minimal or no measurable reduction, to large reductions in DO levels (USACE 1998). The release of organic rich sediments during dredging or dredged material disposal can result in the localized removal of oxygen from the surrounding water. The resuspension of this material creates turbid conditions and decreases photosynthesis. The combination of decreased photosynthesis and the release of organic material with high biological oxygen demand can result in short-term oxygen depletion to aquatic resources (Nightingale and Simenstad 2001b in NOAA 2008). Under Alternative 1, it is not anticipated that there would be releases of organic (silty) sediment except close to shore, where there is a higher percentage of organic sediment. According to Herbich (2000), elevated suspended solids concentrations, and subsequent impacts on DO levels, are generally confined to the immediate vicinity of the dredge or discharge point and dissipate rapidly at the completion of the operation.

Contaminants are sequestered in the total organic carbon (TOC) fraction of sediments (USEPA 2003a in NOAA 2008; USEPA 2003b in NOAA 2008; USEPA 2003c in NOAA 2008). Dredging and disposal causes resuspension of the sediments into the water column and the contaminants that may be associated with the sediment particles. The disturbance of bottom sediments during dredging can release metals (e.g., lead, zinc, mercury, cadmium, copper), hydrocarbons (e.g., polyaromatic hydrocarbons), hydrophobic organics (e.g., dioxins), pesticides, pathogens, and nutrients into the water column and allow these substances to become biologically available either in the water column or through trophic transfer (Wilbur and Pentony 1999 in NOAA 2008; USEPA 2000 in NOAA 2008; Nightingale and Simenstad 2001b in NOAA 2008).

Sediment grain size analyses indicate that sediments in the area of the navigation channel and proposed turning basin consist primarily of coarse grained materials with low amounts of TOC (≤ 0.17% dry weight) (NAVFAC Pacific 2006). The coarse grain size of the material to be dredged coupled with the low TOC and contaminant concentrations indicate that dredging would only result in short term and localized impacts to water quality. These impacts would be further reduced by deployment of silt curtains and operational control measures which historically have been implemented during dredging operations in Apra Harbor.

Sediment quality investigations in Outer Apra Harbor were conducted in 2006. Sediment core samples were taken to the proposed dredged depth needed to accommodate visiting aircraft carriers. The proposed dredge footprint was geographically covered by the sediment sampling regime that included a total of fourteen discrete sampling sites. The areas included the proposed turning basin in the Outer Harbor and the berthing areas of Alternative 1 and Alternative 2 (NAVFAC Pacific 2006). The outer entrance channel was not sampled as the sediment in that area is sand and predominately clean. The 2006 reconnaissance level effort was performed consistent with guidance outlined in the Ocean Testing Manual (United States Environmental Protection Agency [USEPA] and United States Army Corps of Engineers [USACE] 1991). The purpose of the investigation was to delineate the distribution and magnitude of chemicals of potential concern within the material to be dredged from these two potential wharf sites and common turning basin area. The 14 sediment sampling sites were evenly distributed around the two alternative wharf locations and within the proposed turning basin area. Sediment samples were taken at depths up to -52 ft MLLW, which translates into sediment core lengths of up to 43 ft, and covers the range of anticipated dredge depths. On average sediment cores were approximately 11 ft long. Sediment sampling cores were not taken in coral areas to avoid impacts to this sensitive habitat. Refer to Figure 2.3-9 in Chapter 2 of this Volume for sediment sample locations.

Water depths in the area of Alternative 1 range from -20 to -80 ft (-6 to -24 m) mean lower low water (MLLW). The Alternative 2 site has water depths that range from -20 to -73 ft (-6 to -22.3 m) MLLW, with the exception of a shallow reef that lies immediately north of the site. Within the logical geographic areas associated with each wharf alternative location and the turning basin, the core samples were composited and the composited samples were analyzed. Composites 1 (six sample locations) and 3 (five sample locations) are representative of the areas to be dredged for the aircraft carrier turning basin and berthing at Alternative 1. Composites 1 (six sample locations) and 2 (three sample locations) were representative of the areas to be dredged for the aircraft carrier turning basin and berthing at Alternative 2.

The results of the sediment quality analysis indicate that, with the exception of Area 3 adjacent to the proposed Alternative 1 site, sediments in Outer Apra Harbor (Areas 1 and 2) were coarser-grained and comprised predominantly of a gravelly sand. In Area 3 (immediately offshore Polaris Point), material was predominantly composed of a finer-grained, silty clay material.

Chemical analyses were conducted according to USEPA and American Society for Testing and Materials standards. The results were compared to Effects Range-Low (ER-L) and Effects Range-Median (ER-M) values, and regulatory levels or total threshold limit concentration (TTLC) values. The results are summarized in Table 4-2.2. The ER-L value represents the concentration below which adverse effects rarely occur and the ER-M value represents the concentration above which adverse effects frequently occur. Samples or study areas in which many chemicals exceed the ER-M values and exceed them by a large degree may be considered more contaminated than those in which none of the sediment quality guidelines were exceeded. Samples in which ER-L concentrations are exceeded, but no ER-M values are exceeded, may be given intermediate ranks. The effects range values are helpful in assessing potential significance of elevated test results related to biological impacts. The ER-L and M values were developed from a large data set of benthic organism effects. ER-L represents the lower 10th percentile of observed effects concentration and ER-M represents the 50th percentile of the observed effects concentrations. These values are useful in identifying sediment contaminants but actual biological testing would be conducted as part of the testing required for ODMDS disposal. General chemistry parameters (i.e., TOC, ammonia, sulfides, oil and grease and total recoverable petroleum hydrocarbons) do not have ER or TTLC values.

Table 4.2-2. Sediment Sampling Summary Table

Analyte	*ER-L/ER-M*	*Composite*		
		Outer Apra Harbor		
		1	*2*	*3*
TOC (%)		0.13	0.17	0.5
Arsenic	8.2/70	3.76	3.76	7.55
Cadmium	1.2/9.6	0.27	0.15	0.10
Chromium	81.0/370	11.50	13.30	53.90
Copper	34.0/270	4.85	23.60	17.90
Lead	46.7/218	4.08	18.60	8.71
Mercury	0.15/0.71	0.04	0.12	0.05
Nickel	20.9/51.6	4.91	5.41	**21.50**
Silver	1.0/3.7	<0.025	<0.025	<0.025
Zinc	150/410	6.96	24.80	26.80
Tributyltin	Not established	<1	<1	<1
Total PAH	4022/44792	34.00	1115.10	129.30
Arochlor 1260	-	<10	22.2	<10

In general, sediment contamination was low throughout all the areas sampled in Outer Apra Harbor. Special handling of dredged material would not be required and it is likely that the dredged material would meet the testing requirements for ocean disposal. None of the composite samples exceeded any of the ER-M values. Composites 1 and 2 did not exceed any of the ER-L values. There were minor exceedences of the ER-L value for one metal (nickel) for Composite 3. Nickel occurs naturally in the environment and this exceedance is not expected to classify the dredged material as unsuitable for ocean disposal.

Other analytes detected at levels lower than the ER-L included polyaromatic hydrocarbons and arochlor-1260 (polychlorinated biphenyl [PCB]) in Composite 2. All other analytes, e.g., PCBs (aroclor and individual congeners), chlorinated pesticides, organotins, phenols, phthalates were either not detected or reported at less than the laboratory detection limits. Composite 3 had the lowest ammonia level. Composite 2 had the lowest total sulfides levels and Composite 7 had the highest (NAVFAC Pacific 2006).

The results from this study, when compared to other recently conducted dredged material evaluations in Outer Apra Harbor, provide sufficient information to suggest the sediments would be deemed suitable for ocean disposal or upland placement (assuming a preferred beneficial use option was not available) and that no special handling of dredged material would be required.

Additional sediment sampling and analyses were conducted in March 2010 to delineate the distribution and magnitude of chemicals of potential concern within the dredge footprint of the two potential CVN berthing sites; Polaris Point and the Former SRF wharf. Material from the proposed CVN turning basin was also evaluated (NAVFAC Pacific 2010a). Refer to Figure 2.3-10 in Chapter 2 of this Volume for sediment sample locations for the March 2010 report. The full report of this study is contained in Volume 9 Appendix K.

Consistent with previous sediment sampling efforts conducted in these locations, sediment samples were analyzed for physical and chemical parameters, including general chemistry, metals, semi-volatile organic compounds (polynuclear aromatic hydrocarbons [PAHs], phenols, and phthalates), organochlorine pesticides, polychlorinated biphenyls (PCBs), and organotins and the results compared to effects range-low (ER-L) and effects range-median (ER-M) sediment quality guidelines, as established. ER-M values were also used to calculate a mean ER-M quotient (ER-Mq). The concentration of each constituent was divided by its ER-M value to produce a quotient, or proportion of the ER-M equivalent to the magnitude by which the ER-M value is exceeded or not. ER-Mq values were calculated for the 2006 Tier II sampling event and compared to the 2010 ER-Mq values as a predictive analysis of sediment suitability for open water disposal.

For the majority of analytes, concentrations in the 2010 samples were either not detected or lower than ER-L values. ER-L exceedances were observed in three metals, two PAH compounds, four organochlorine pesticides and total detectable PCBs. Only two occurrences of a single analyte exceeding the ER-M value occurred (4,4'-DDT).

The results of the ER-Mq analysis determined that all of the ER-Mq's are well below the value of one, suggesting the sediment quality (i.e., contaminant concentrations) is not likely impairing benthic communities. Generally speaking, ER-Mq's for each group of analytes within a given area were similar between the two study years with the exception of PCB ER-Mq's. In 2006, the ER-Mq for PCBs in Area 1 was 0.003; whereas, in 2009, the ER-Mq was 0.123. This difference was due to the fact that in 2006, PCBs were not detected in the Area 3 composite sample; however, in 2009, one of the eight samples had PCB congener detections. The mean ER-Mq for each area was consistent between the 2006 and 2009 investigations (Table 4.2-3).

The 2010 analysis concluded that low chemical concentrations found in the most recently collected sediment samples from Polaris Point, the Former SRF Wharf, and the Turning Basin were consistent with other previous Tier III dredged material evaluations conducted in the same areas of Apra Harbor in the NAVFAC Pacific 2007) study where the material was deemed suitable for ocean disposal. Also similar to the results of this most recent sediment analysis in 2010, sediments from the previous Tier III study had chemical concentrations that were generally low, but some analytes exceeded comparable ER-M values.

Based on these similarities, it is likely if the 2010 sediments from the proposed Polaris Point or SRF Wharf dredge footprints were further evaluated according to guidance outlined in the Ocean Testing Manual (USEPA and USACE 1991) and/or Inland Testing Manual (USEPA and USACE 1998) they would be deemed suitable for ocean disposal or upland placement.

Table 4.2-3. Comparison of ER-Mq's for Each Analyte Group per Area Between Study Years

	2006			*2009*		
	Turning Basin	*SRF Wharf*	*Polaris Point*	*Turning Basin*	*SRF Wharf*	*Polaris Point*
Metals	0.030	0.056	0.086	0.040	0.078	0.079
PAHs	0.000	0.014	0.002	0.001	0.012	0.007
Pesticides	0.044	0.044	0.044	0.017	0.035	0.056
PCBs	0.003*	0.182	0.003*	0.005	0.166	0.123
Mean Overall ER-M Q	0.020	0.074	0.034	0.016	0.073	0.066

* ER-Mq recalculated from 2006 raw data. 2006 study summed all non-detect congeners using 1/2 detection limit resulting in an overestimation of ER-Mq. This study used the total PCB congener value reported by the laboratory

Physical Impacts from Ocean Disposal

A detailed discussion of water quality impacts at the proposed Guam ODMDS is presented in the EIS for the ODMDS designation (USEPA 2010).

In general, there are a number of physical water quality effects resulting from the ocean disposal of dredged material. These effects include elevated suspended material concentration during dredge disposal, resuspension of sediments by currents, and a change in dredged sediment characteristics (size distribution or sorting coefficient) versus adjacent unaffected areas. The extent of suspended materials concentrations increase during and after dredge disposal at open water disposal sites has been studied by transmissometer. NOAA (1974, 1975b, c in Navy 2004) showed that the suspended material concentration returned to ambient levels in both surface and near-bottom waters in under one hour.

As part of the Ocean Current Study conducted by Weston (NAVFAC Pacific 2007), the distribution of sediment during disposal activities was modeled using SSFATE. The modeling of a single disposal event predicted coarse grained material to settle to the seafloor within 32 hours of the disposal event, with gravel material settling directly beneath the disposal site and sand material being deposited within 4.1 nautical miles (nm) (7.6 km), nearly radially, of the disposal site.

As modeled in the ODMDS EIS, the footprint of material deposited on the seafloor would be elongated toward the northeast having a width of 6.5 nautical miles (12.0 kilometers [km]) and a length of 8.1 nm (15.0 km). This would be most evident in the dispersion of fine-grained material that would tend to stay in suspension the longest. At the proposed ODMDS, the footprint of deposits thicker than 0.04 inch (in) (1 millimeter [mm]) would be contained within a bathymetric depression, in depths of approximately 8,530 ft (2,600 m) at the disposal site and shoaling at the northwestern, northeastern and southeastern edges of the footprint to about 7,220 ft (2,195 m).

The possibility of resuspension of dumped sediments has been studied at open water disposal sites (SAIC 1980, 1989) as part of the disposal area monitoring system (DAMOS) monitoring. Generally, these studies have found that ocean disposal mounds sited within depositional areas at proper depth were quite stable even during storm events. As a result, there would be no significant impacts to nearshore waters from the disposal of dredged material at an ODMDS.

Chemical Impacts of Ocean Disposal of Sediment

As part of the DAMOS monitoring studies of disposal sites in Long Island Sound (CT/NY), chemical measurements suggested that only minor and transient alterations in the water column occurred during hopper discharges. As expected the redox potential (Eh), pH, turbidity, DO, suspended or volatile solids all showed some seasonal variation in concentration but no consistent patterns relative to disposal site proximity were noted (NOAA 1974 in Navy 2004; 1975a,b,c,d,e in Navy 2004; 1976a,b in Navy 2004). The DO concentration in near-bottom waters only decreased 30%, returning to pre-disposal levels in less than 40 minutes (NOAA 1975b in Navy 2004). The pH was reduced very slightly after a hopper discharge but returned to pre-placement values in less than 30 minutes. Surface turbidity in the barge wake quickly disappeared. Suspended and volatile solids concentrations increased dramatically in near-bottom waters following a hopper dump but returned to background values in less than 33 minutes (NOAA 1975c in Navy 2004). Occasionally there were transient and slight increases in TOC within 1 mi (1.6 km) of the disposal buoy (NOAA 1975b in Navy 2004). Water column currents aid in the dissipation of any chemical effect. Given relatively high currents in the water column over the proposed ODMDS, any chemical effects of hopper discharge are expected to dissipate rapidly with the ambient conditions returning shortly after disposal.

Dredged material disposal is expected to produce temporary and localized impacts at the proposed ODMDS, including increased turbidity and decreased light transmittance due to the suspension of sediments (finer-grained silts and clays). The degree of suspension of sediments from dredged material disposal depends on four main variables including size, density and quality of the dredged material; method of disposal; hydrodynamic regime of disposal area; and ambient water quality and characteristics of the disposal site. During suspension and settling, changes in physical and chemical conditions may lead to the desorption of particulate-bound contaminants into the water column. Potential toxicity and bioaccumulation may result from biologically available, desorbed heavy metals and anthropogenic organics. Dissolved contaminants may in turn be sequestered from the water column by mechanisms such as the re-adsorption (onto sediment particles which eventually settle out of the water column), precipitation processes, redox transformations, uptake by aquatic life, degradation, and volatilization. The release of organic-rich sediments during disposal into environments adapted to low nutrient conditions can also result in eutrophication effects such as the localized confiscation of oxygen in the surrounding water column.

Numerical modeling may be conducted using chemical concentrations in proposed dredged materials to determine the diluted concentrations of potential contaminants in the water column. These modeled results would be compared to water quality criteria to determine suitability for ocean disposal. Only dredged material deemed suitable under these protocols would be permitted for disposal at an ODMDS. Screening of the dredged material would ensure that no significant effects to water quality would result from the ocean disposal of the dredged material at the ODMDS.

Overall, potential impacts on water quality from suitable dredged material permitted for ocean disposal at the ODMDS site are expected to be transient and localized (i.e., contained within the overall boundary of the disposal site) within four hours of the initial disposal activity (USEPA 2010). Significant dilution is expected to mitigate any potential impacts caused by sediments remaining in suspension beyond the boundary of the disposal site for longer than four hours. The analysis used time series plots of dredge plume concentrations developed for the Master Plan for Deep-Draft Wharf and Fill Improvements at Apra Harbor EIS (July 2007). This analysis shows that during both average and maximum potential adverse effect loading scenarios, the dredge plumes dissipate rapidly, usually 2-3 hours after dredging has stopped. The dilution time of four hours was determined by the USEPA‘s Green Book (USEPA and USACE 1991). The Green Book specifies two criteria related to dilution of dredged material: Criterion I – the maximum concentration of a constituent outside the disposal site boundary at any time after discharge must satisfy applicable water quality standards and Criterion II – the maximum concentration of a constituent within the disposal site four hours after discharge must satisfy the water quality standards. The final concentration of a conservative constituent after mixing is expressed as the initial concentration divided by the dilution factor, assuming an ambient concentration of the constituent of zero.

As noted above, preliminary chemical testing results revealed low concentrations of contaminants in Outer Apra Harbor, indicating the material is likely suitable for ocean disposal. Pursuant to Section 103 Marine Protection, Research, and Sanctuaries Act (MPRSA), all material would be tested for the presence of contaminants as well as the potential for toxicity and bioaccumulation prior to dredging using national testing guidance (USEPA and USACE 1991).

Impacts of Upland Site Placement to Nearshore Waters

The dredged material would be placed in scows, then into sealed end dump trucks for transfer to the upland placement sites. During most rainfall events, stormwater runoff from within the upland placement facilities is not expected except in the rare case such as a typhoon.

The dredged material would be dewatered in accordance with USACE and Guam permitting requirements. Therefore, with the implementation of BMPs as identified in Volume 2, Chapter 4, Table 4.2-1, construction activities associated with Alternative 1 would result in less than significant impacts to nearshore waters.

Radiological Impacts from Dredging

The Navy has conducted radiological environmental monitoring in Apra Harbor for nearly 50 years. The results of this monitoring are discussed in detail in Volume 4, section 18.2.2.6. Trace concentrations of cobalt-60 in Apra Harbor sediment have been detected as a result of historical U.S. Navy nuclear-powered ship operations. This amount of radioactivity is very small when compared to the amount of naturally occurring radioactivity already in the sediment. Cobalt-60 was last detected in 1990 in one Apra Harbor sediment sample at a concentration of 0.015 pCi/g. This concentration would have decayed to about 0.005 pCi/g by 2010, or about a tenth of a percent of the natural concentration of potassium-40 radioactivity in a banana. No cobalt-60 has been detected in any subsequent samples. The routine Navy environmental monitoring samples are taken from the surface layer of sediment.

Sediment cores from Apra Harbor have been analyzed for radioactivity on two occasions. Prior to dredging associated with Alpha and Bravo wharves’ improvements in the inner harbor, core samples from the proposed dredge area were obtained for sensitive analyses using gamma-ray spectroscopy and, in some cases, chemical separation followed by alpha spectroscopy (COMNAV Marianas 2006). Six sediment core composites and 50 sediment samples were analyzed. No cobalt 60 was detected. However, very low levels of non-naturally occurring radioactivity were identified in some samples, documented in Table 4.2-4. Low levels of cesium, plutonium, and americium are detectable throughout the world due to fallout from historical atmospheric weapons testing.

Table 4.2-4. Radiological Test Results for Alpha/Bravo Wharves

Radionuclide	*Range of Specific Activity Low – High (pCi/g)*	*IAEA de minimis Concentration (pCi/g)*
Cesium 137	0.004 – 0.031	33.4
Plutonium 239/240	0.023 – 0.183	96.5
Americium 241	0.028 – 0.049	117.5
Cobalt 60	<0.003 - <0.012	4.5

This trace amount of radioactivity in the sediment is far below the concentration established by the International Atomic Energy Agency for determining whether dredged sediments can be regarded as non-radioactive or de minimis under the Convention on Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London Convention, 1972 (IAEA 2003).

In December 2009, additional sediment cores were obtained from the potential dredging areas in Outer Apra Harbor. Thirty sediment samples from eighteen cores were analyzed. One sample was taken from every two feet of depth in the sediment cores. The number of samples per core ranged from one to three. The results were essentially identical to the results of the inner harbor core samples discussed above. No cobalt 60 was detected. However, very low levels of non-naturally occurring radioactivity were identified in some samples, documented in Table 4.2-5. Low levels of cesium, plutonium, and americium are detectable throughout the world due to fallout from historical atmospheric weapons testing.

Table 4.2-5. Radiological Test Results for Outer Apra Harbor

Radionuclide	*Range of Specific Activity Low – High (pCi/g)*	*IAEA de minimis Concentration (pCi/g)*
Cesium 137	0.009 – 0.013	33.4
Plutonium 239/240	0.007 – 0.026	96.5
Americium 241	0.005 – 0.017	117.5
Cobalt 60	<0.003 - <0.005	4.5

The results of these two sets of core samples indicate that there is no concern for elevated radioactivity concentrations in deeper layers of sediment, either from nuclear-powered ships or operations associated with past nuclear weapons testing, in either the Inner Apra Harbor or Outer Apra Harbor. In accordance with the IAEA guidance, any dredged sediment from Apra Harbor may be disposed of without any need for special considerations regarding radioactivity.

<u>Operation</u>

Nearshore Waters

Currently, sediment plumes occur as a result of propeller wash from tugboats and aircraft carriers while docking and getting underway. Under the proposed action, transient aircraft carriers would dock in Apra Harbor for a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. Similar to dredging operations, the extent of the turbidity plume generated from propellers would be a function of bottom current velocities and sediment grain size as well as propeller jet flow velocities. Ambient water conditions would return shortly after ship movement ceases in the harbor. The proposed dredging would increase the distance between propellers and the sea floor, which is expected to reduce but not eliminate sediment resuspension by ship propellers. This reduction would have a beneficial impact on water quality as there would be fewer incidents of sediment resuspension from propeller wash with less sediment being resuspended. Should sediment resuspension occur, any potential impact to the nearby high quality coral resources of Big Blue Reef would be lessened because of the distance between that reef and Alternative 1.

Leachate from hull coatings commonly discharges into surrounding seawater from vessels, including Navy aircraft carriers. Vessel hulls that are continuously exposed to seawater are typically coated with a base anti-corrosive coating covered by an anti-fouling coating. This coating system prevents corrosion of the underwater hull structure and through leaching action releases antifouling compounds. These compounds inhibit the adhesion of marine organisms to the hull surface. The coatings on most Navy vessels are copper based ablative paints. Tributyl tin-based paints have been phased out by the Navy (Booz Allen 1999). The increase in proposed aircraft carrier visits to Apra Harbor would not be expected to increase substantially the amount of hull coating leachate. Aircraft carriers and other Navy vessels routinely visit Apra Harbor. Results of sediment sampling in Outer Apra Harbor indicate that levels of copper range from 4.85 to 23.60 parts per million, below the NOAA sediment quality environmental risk levels of 34 parts per million for copper in marine sediment (NAVFAC Pacific 2006). Adding 47 visit days per year is not anticipated to increase the amount of hull coating leachate sufficiently to present an increase in environmental risk in coastal waters and/or marine sediments.

With implementation of the proposed upgrades, the existing wastewater collection system at Apra Harbor Naval Complex would be sufficient to handle the wastewater requirements of either a CVN 68 (Nimitz Class) or CVN 78 (Ford Class) aircraft carrier for a duration of 21 days. Proposed improvements to the wastewater system at Naval Base Guam, which have been previously discussed, would result in a minor beneficial impact to the treatment of wastewater and thus nearshore receiving waters.

Nearshore waters may also be affected by point-source discharges resulting from accidental spills. The CWA prohibits the discharge of oil and hazardous substances in such quantities as may be harmful into or upon the navigable waters of the United States, including the contiguous zone, exclusive economic zone and adjoining shorelines. Under the CWA, EPA published oil pollution prevention regulations in 1973 (amended in 1974, 1976, 2002 and 2004). These regulations include requirements for both oil spill prevention and response. The Navy has developed operations manuals and spill contingency plans, provides personnel training, and conducts testing of transfer equipment to comply with these regulations. OPVAVINST 5090.1C Environmental Readiness Manual Section 22-2.2.7.1 requires all hands to receive environmental training. This training includes oil and hazardous substance management, handling, minimization, and spill response. Chapter 22 also requires ships to strictly comply with fuel transfer and ballasting procedures to ensure ballast water does not become contaminated with oil or any other waste. Ships using self-compensating fuel tanks are required to ensure adequate margin is preserved to prevent inadvertent discharges of oil with the compensating water. Compliance with the aforementioned laws and procedures would ensure that no significant impact to nearshore water would occur from point-source discharges under the proposed action.

Therefore, operations associated with Alternative 1 would result in less than significant impacts to nearshore waters.

4.2.2.3 Summary of Alternative 1 Impacts

Table 4.2-6 summarizes the potential construction and operational impacts associated with implementation of Alternative 1.

Table 4.2-6. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	• SW: temporary increase in stormwater runoff, erosion, and sedimentation; potential for water to accumulate in the upland placement sites • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from proposed action site
	Operation	• SW: increase in stormwater volume and intensity • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from proposed action site
Offshore	Construction	• NW: minor increase in runoff volume and pollutant loading potential; minor increase in wharf-construction related suspended sediment and floating debris; localized and temporary increases in turbidity and total suspended solids from dredging; sediment plumes; short-term reduction in DO concentrations; re-suspension of sequestered contaminants; decreased light transmittance; minor and transient chemistry alterations in the water column
	Operation	• NW: minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants

Legend: SW = surface water/stormwater, GW = groundwater, NW = nearshore waters, WL = wetlands, ac = acre, ha = hectare, DO = dissolved oxygen

With the implementation of dredging-related BMPs and any project-specific mitigation measures identified during the USACE permitting process for the dredging of Apra Harbor, there would be no reduction in the amount of wetlands on Guam; there would be less than significant reductions in the availability or accessibility of water resources and. impacts to water quality resulting from dredging would be mitigated to less than significant. No impacts to usable groundwater would occur as no groundwater aquifers used for production are located in the project area. Increases in stormwater would be managed by stormwater infrastructure. Through the development and implementation of site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) and LID measures, and facility-specific plans and procedures, there would be no increased risk from environmental hazards to human health. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, GovGuam, and Navy environmental guidance (hazardous materials and oil spill management), laws, and regulations (Table 3.1-1, Volume 8). Therefore, Alternative 1 would result in less than significant impacts to water resources.

4.2.2.4 Alternative 1 Proposed Mitigation Measures

Dredging of Apra Harbor and subsequent handling of the dredged materials and fill of jurisdictional waters of the U.S. would require Section 404(b) and Section 10 of the Rivers and Harbors Act permits from the USACE and WQC from the GEPA. These permits would stipulate procedures and mitigation requirements in addition to BMPs.

The practice of no barge overflow during dredging and disposal operations would help maintain water quality both near the point of dredging and en route to the disposal site.

Where practicable, additional silt curtains may be installed in deep water portions of the harbor during channel and/or harbor dredging operations to maintain water quality and protect sensitive aquatic resources by shielding sensitive resources from the sediment plume and/or directing the plume away from areas containing sensitive aquatic resources.

Water quality monitoring during pile driving or dredging activities would be conducted. If a visible plume is observed over sensitive coral habitat outside the silt curtains, the construction activity would stop, be evaluated, and corrective measures taken. Construction would not resume until the water quality returned to ambient conditions.

A detailed description of resource protection measures, including BMPs, potentially required by regulatory mandates is in Volume 7 and Volume 2, Chapter 4 Table 4.2-1 of. A more detailed explanation of potential regulatory permitting requirements is available in Volume 8 (refer to Table 3.1-1).

4.2.3 Alternative 2 Former Ship Repair Facility (SRF)

4.2.3.1 Onshore

<u>Construction</u>

Surface Water/Stormwater

Proposed activities under Alternative 2, Former SRF (referred to as Alternative 2), are the same as those described under Alternative 1, except that the Former SRF would be the project area. Thus, potential construction impacts to surface water resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1.

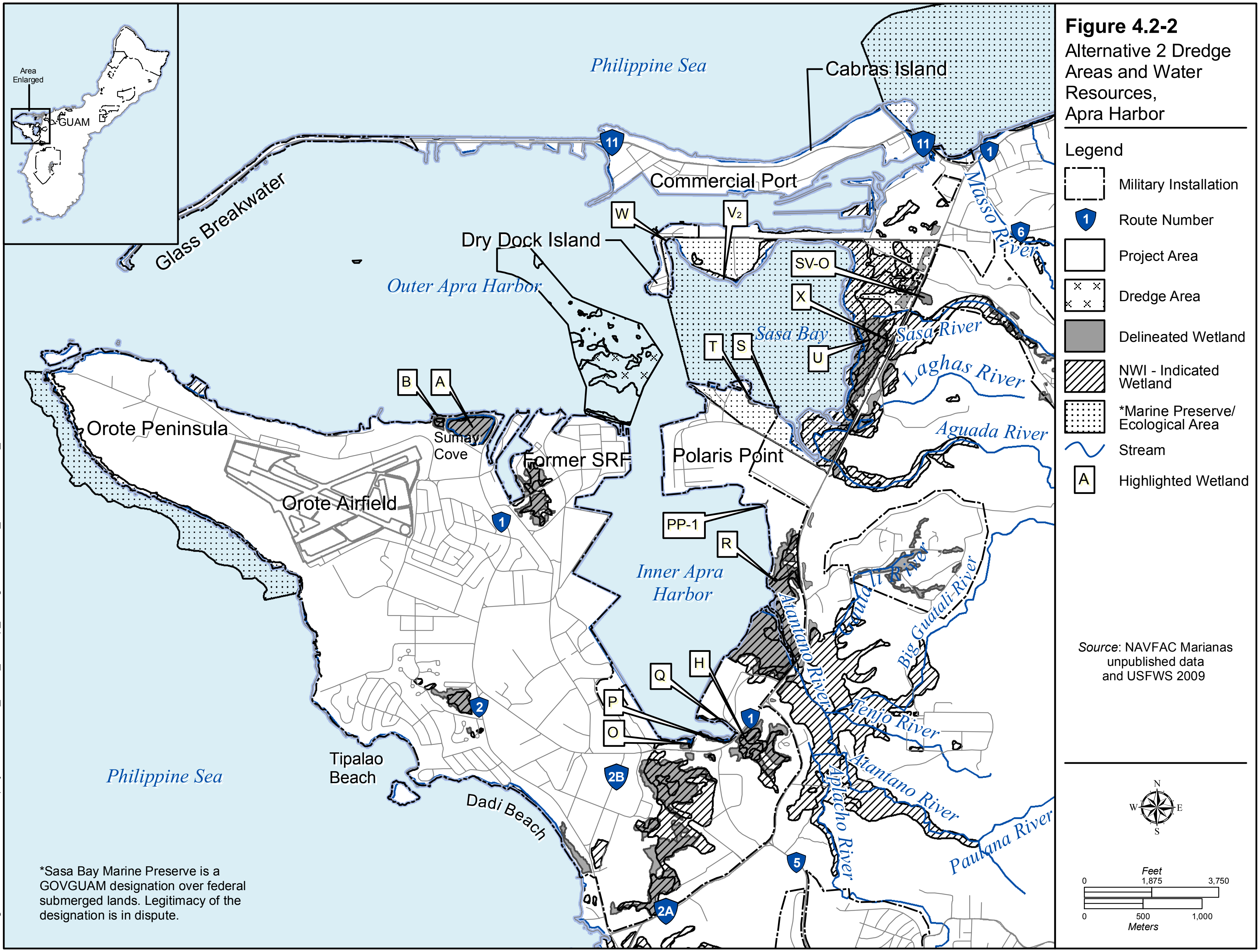
Potential dredging impacts to surface water resulting from implementation of Alternative 2 would be less than the potential impacts discussed under Alternative 1 as the volume of dredged material would approximately 27 % (129,000 cy [98,628 m^3]) less under Alternative 2. Please refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 would result in less than significant impacts to surface water.

Groundwater

Proposed activities under Alternative 2 are the same as those described under Alternative 1, except that the Former SRF would be the project area. Thus, potential construction impacts to groundwater resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 would result in less than significant impacts to groundwater.

Wetlands

Proposed activities under Alternative 2 are the same as those described under Alternative 1, except that the Former SRF would be the project area. Under Alternative 2, construction and dredging activities would occur at about the same distance from the identified wetland areas to the east of the dredging area associated with Alternative 1 (at least 2,000 ft [610 m]) (Figure 4.2-2). With the dredging in front of the SRF, Wetland Areas A and B would be approximately 2,600 ft (792 m) west of the nearest extent of dredging operations, slightly closer than under Alternative 1 (Figure 4.2-2). While dredge operations would be slightly closer, the dredge volume under Alternative 2 would be approximately 27% less than under Alternative 1, resulting in a slightly smaller potential suspended sediment volume in the water column. Thus, potential construction impacts to nearshore waters resulting from implementation of Alternative 2 would be slightly less than the potential impacts discussed under Alternative 1.



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Water quality monitoring, silt curtains and other BMPs would be used, consistent with past dredging operations in Apra Harbor, in order to protect sensitive areas including wetlands. BMPs and any proposed mitigation measures identified during the permitting process, distance to the wetlands, and the prevailing currents (i.e., the prevailing surface water motion in Apra Harbor is generally westward, away from the majority of wetland areas in Apra Harbor and Sasa Bay) would minimize impacts. Therefore, construction activities associated with Alternative 2 would not affect wetlands.

Operation

Surface Water/Stormwater

Potential operational impacts to surface water resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 would result in less than significant impacts to groundwater.

Groundwater

Potential operational impacts to groundwater resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 would result in less than significant impacts to groundwater.

Wetlands

Potential operational impacts to wetlands resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 would not affect wetlands.

4.2.3.2 Offshore

Construction

Nearshore Waters

Potential impacts of construction to nearshore waters resulting from implementation of Alternative 2 would be similar to those discussed under Alternative 1; however, due to the proximity of Alternative 2 to Big Blue Reef, effects would be greater to this high quality coral reef habitat and its associated Endangered Species Act (ESA)-listed species (see Chapter 11 of this Volume for additional details).

Under Alternative 2, the total dredged volume anticipated for the SRF would be approximately 479,000 cy (366,222 m^3), including the overdredge; approximately 27% (129,000 cy [98,628 m^3]) less than Alternative 1. As is also the case under Alternative 1, under Alternative 2, the dredged sediments would be placed upland at Naval Base Guam (refer to Figure 4.2-2 in Volume 2, Chapter 4) for dewatering and reuse, disposed of in a USEPA-approved ODMDS for Guam, or disposed of via a combination of these approaches (i.e., ocean disposal, upland placement, and beneficial reuse).

Three sediment samples collected along the SRF wharf during the 2006 characterization effort indicated that sediments in that area were predominantly coarse grained consisting mostly of sand and gravel (85%) and had low TOC (0.17%). Although sediments in that area contained the highest concentrations of total polyaromatic hydrocarbons, lead, and mercury when compared to the other composite samples, none of the analytes exceeded their respective ER-L values. The coarse grain size of the material to be dredged coupled with the low TOC and contaminant concentrations indicate that dredging and disposal would not have significant impacts on water quality and impacts would be similar to those described under Alternative 1. Thus, potential dredging impacts to nearshore waters resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. An additional amount of fill would also be needed for Alternative 2 for the water areas between the slips of the finger piers that would be incorporated into the construction of the wharf area. The additional amount of clean fill required for the finger piers for Alternative 2 would be approximately 20,000 cy (15,291 m^3). Please refer to Section 4.2.2.2 for discussion of potential impacts of dredging and fill similar to both alternatives. With the implementation of BMPs identified in Volume 2, Chapter 4, Table 4.2-1 and any proposed mitigation measures identified during the permitting process, construction activities associated with Alternative 2 would result in less than significant impacts to nearshore waters.

Operation

Nearshore Waters

Potential operational impacts to nearshore waters resulting from implementation of Alternative 2 would be similar to those discussed under Alternative 1; however, due to the proximity of Alternative 2 to Big Blue Reef, effects of resuspended sediments would result in greater long-term impacts (see Chapter 11 of this Volume for additional details).

4.2.3.3 Summary of Alternative 2 Impacts

Table 4.2-7 summarizes the potential construction and operational impacts associated with implementation of Alternative 2.

Table 4.2-7. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	• SW: temporary increase in stormwater runoff, erosion, and sedimentation; potential for water to accumulate in the upland placement sites • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from wetlands
	Operation	• SW: increase in stormwater volume and intensity • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from wetlands
Offshore	Construction	• NW: minor increase in runoff volume and pollutant loading potential; minor increase in wharf construction-related suspended sediment and floating debris; localized and temporary increases in turbidity and total suspended solids from dredging; sediment plumes; short-term reduction in DO concentrations; re-suspension of sequestered contaminants; decreased light transmittance; minor and transient chemistry alterations in the water column
	Operation	• NW: minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants

Legend: SW = surface water/stormwater, GW = groundwater, NW = nearshore waters, WL = wetlands, ac = acre, ha = hectare, DO = dissolved oxygen

With the implementation of dredge-related BMPs and any project-specific mitigation measures identified during the USACE permitting process for the dredging of Apra Harbor, there would be no reduction in the amount of wetlands on Guam, and there would be less than significant reductions in the availability or accessibility of water resources. No impacts to usable groundwater would occur as no groundwater aquifers used for production are located in the project area. Increases in stormwater would be managed by stormwater infrastructure. Through the development and implementation of site-specific BMPs (Volume 2, Chapter 4, Table 4.2.1) and LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards to human health. Furthermore, all actions associated with Alternative 2 would be implemented in accordance with all applicable federal, GovGuam, and Navy environmental guidance (hazardous materials and oil spill management), laws, and regulations. Therefore, Alternative 2 would result in less than significant impacts to water resources.

4.2.3.4 Alternative 2 Proposed Mitigation Measures

Under Alternative 2, the same proposed mitigation measures as described under Alternative 1 would be implemented (see Section 4.2.2.4).

4.2.4 No-Action Alternative

4.2.4.1 Surface Water/Stormwater

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing surface water conditions would remain.

There are limited surface water resources flowing into or adjacent to Apra Harbor. Threats to surface water adjacent to Apra Harbor would continue to be monitored by federal and Guam agencies, and appropriate regulatory action would continue to occur in order to maximize surface water quality and availability. In time, surface water quality is expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to surface waters is reduced. Not berthing the carrier in Apra Harbor would not change the on-going water quality concerns or protection actions for surface waters; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to surface water.

4.2.4.2 Groundwater

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing groundwater conditions would remain.

There are no local usable groundwater resources in or adjacent to Apra Harbor. However, regional threats to groundwater availability and quality would continue to be monitored by federal and Guam agencies to minimize potential impacts, and appropriate regulatory action would continue to occur in order to protect groundwater resources. Monitoring for saltwater intrusion and coordination amongst water users, as well as potential designations for groundwater resources is expected to ensure there is a dependable, safe supply of groundwater for Guam users. Not berthing the carrier in Apra Harbor would not change the on-going groundwater availability and quality concerns or the protection actions for Guam nearshore waters; these conditions and actions would continue. Therefore, implementation of the no-action alternative would result in no impacts to groundwater.

4.2.4.3 Nearshore Waters

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing nearshore conditions would remain.

The identified nearshore water quality concerns for the marine waters of Apra Harbor (copper, aluminum, nickel, *enterococci* bacteria, total residual chlorine, biochemical oxygen demand and total suspended solids) would persist. These threats to nearshore water quality would continue to be monitored by federal and Guam agencies to minimize potential impacts, and appropriate regulatory action would continue to occur to protect nearshore waters. In time, nearshore water quality is expected to slowly improve as point and non-point sources of pollution (e.g., the former Orote Landfill) are identified and removed or otherwise managed. As a result, a reduction in pollution loading to nearshore waters from upland sources would occur. Not berthing the carrier in Apra Harbor would not change the on-going nearshore water quality concerns or the protection actions for Guam nearshore waters; these conditions and actions would persist. Therefore, implementation of the no-action alternative would result in no impacts to nearshore waters.

4.2.4.4 Wetlands

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing wetland conditions would remain.

The identified primary threats to wetlands in and adjacent to Apra Harbor (human disturbance, non-native plants species, sedimentation, and erosion) would persist. These threats to wetland area and function are of concern and are therefore monitored by federal and Guam agencies to protect wetland areas. The absence of berthing the carrier in Apra Harbor would not change the on-going threats or protection actions for wetlands on Guam; these conditions and actions would continue. Therefore, implementation of the no-action alternative would result in no impacts to wetlands.

4.2.5 Summary of Impacts

Table 4.2-5 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Implementation of either Alternative 1 or Alternative 2 would have the potential to impact the quality and quantity of stormwater runoff during both the construction and operational phases of the project. Construction activities would have the potential to cause erosion and sedimentation which could degrade surface water quality. However, the development and implementation of BMPs (Volume 2, Chapter 4, Table 4.2.1), site-specific BMPs, LID IMP measure, and facility-specific plans and procedures, would minimize impacts to water resources. An SPCC Plan would be implemented under the action alternatives to reduce the potential for leaks and spills from contaminants. In addition, roadway-specific BMPs would be included in the planning, design, and construction of all roadways. Increases in stormwater would be managed by stormwater infrastructure. Proposed construction activities within the 100-year flood zone would incorporate flood protection measures.

Under Alternatives 1 and 2, the dredged material upland placement sites would be located several miles/kilometers from the NGLA; any effluent that percolates into the underlying soils would not affect groundwater drinking quality or quantities. Nearshore water quality would be temporarily degraded by turbidity and suspended sediments. However, with implementation of dredging-related BMPs and any project-specific mitigation measures identified during the USACE permitting process (see Section 4.2.2.4) for the dredging of Apra Harbor, there would be less than significant impacts to nearshore waters from dredging or ocean disposal. There would be no impacts to wetlands under either alternative.

Alternatives 1 and 2 would be implemented in compliance with all federal, local, and Navy environmental guidance (hazardous materials and oil spill management), laws, and regulations (Volume 8, Table 3.1-1), and would include the implementation of BMPs, LID measures, and monitoring. Implementation of Alternative 1 would result in less than significant impacts to water resources. Similarly, implementation of Alternative 2 would also result in less than significant impacts to water resources. Existing conditions would remain the same under the no-action alternative; therefore, there would be no impacts to water resources under the no-action alternative.

Table 4.2-5. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Construction Impacts		
SW: LSI • temporary increase in stormwater runoff and sedimentation; temporary discharge of ponded rainwater GW: LSI • increased potential for local groundwater contamination NW: SI-M • minor increase in runoff volume and pollutant loading potential; minor increase in wharf-construction related suspended sediment and floating debris; localized and temporary increases in turbidity and total suspended solids from dredging; sediment plumes; short-term reduction in DO concentrations; re-suspension of sequestered contaminants; decreased light transmittance; minor and transient chemistry alterations in the water column WL: NI • no impact due to distance from wetlands	SW: LSI • temporary increase in stormwater runoff and sedimentation; temporary discharge of ponded rainwater GW: LSI • increased potential for local groundwater contamination NW: SI-M • minor increase in runoff volume and pollutant loading potential; minor increase in wharf-construction related suspended sediment and floating debris; localized and temporary increases in turbidity and total suspended solids from dredging; sediment plumes; short-term reduction in DO concentrations; re-suspension of sequestered contaminants; decreased light transmittance; minor and transient chemistry alterations in the water column WL: NI • no impact due to distance from wetlands	Water Resources: NI
Operation Impacts		
SW: LSI • increase in stormwater volume and intensity GW: LSI • increased potential for local groundwater contamination NW: LSI • minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants WL: NI • no impact due to distance from wetlands	SW: LSI • increase in stormwater volume and intensity GW: LSI • increased potential for local groundwater contamination NW: LSI • minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants WL: NI • no impact due to distance from wetlands	Water Resources: NI

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, ,SW = surface water/stormwater, GW = groundwater, NW = nearshore waters, WL = wetlands, DO = dissolved oxygen

4.2.6 Summary of Proposed Mitigation Measures

Table 4.2-6 summarizes the proposed mitigation measures.

Table 4.2-6. Summary of Proposed Mitigation Measures

Alternative 1	*Alternative 2*
Construction	
• Physical Barriers: Deep water silt curtains • No barge overflow during dredging operations • Water quality monitoring	• Same as Alternative 1
Operation	
• None identified	• None identified

4.3 LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE (LEDPA)

This section focuses on compliance with the Section 404(b)(1) guidelines of the CWA. In addition to being the preferred alternative, Alternative 1, as the proposed aircraft carrier berth project is currently defined, is considered the *least environmentally damaging practicable alternative* (LEDPA). Specifically, Section 404(b)(1) of the CWA stipulates that no discharge of dredged or fill material into waters of the United States, which include wetlands, shall be permitted if there is a practicable alternative which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences. Furthermore, an alternative is considered practicable if it is available and could be implemented after taking into consideration cost, existing technology, and logistics in light of overall project purposes. Section 404 permitting is applicable to the proposed new berthing of the aircraft carrier at Guam for the proposed work within Apra Harbor. Permitting decisions are based on guidelines ("404(b)(1) Guidelines") developed jointly with the USEPA that are now part of the Code of Federal Regulations (40 CFR 230). A Section 404 Permit would be applied for and obtained prior to construction. This analysis is to show that the screening and selection process used in the development of this EIS has identified the LEDPA consistent with the Section 404(b)(1) guidelines. As part of the regulatory review process, the USACE will prepare the final findings of fact and factual determinations pursuant to Section 404(b)(1) of the CWA which support selection of the LEDPA.

The Section 404(b)(1) analysis below follows the legal guidelines with regard to content and format; thus, the various subparts and section headings can readily be cross referenced with the regulations. The list of subparts that are discussed include:

- Subpart A: General
- Subpart B: Compliance with the 404(b) Guidelines
- Subpart C: Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem
- Subpart D: Potential Impacts on Biological Characteristics of the Aquatic Ecosystem
- Subpart E: Potential Impacts on Special Aquatic Sites
- Subpart F: Potential Effects on Human Use Characteristics
- Subpart G: Evaluation and Testing
- Subpart H: Actions Taken to Minimize Adverse Effects

This section ends with a brief comparative summary of the two alternatives carried forward for analysis in this EIS and highlights the reasons why Alternative 1 is considered the LEDPA. Table 4.3-1 at the end of this discussion identifies the corresponding sections within the Section 404(b)(1) guidelines analysis that follows.

Throughout this analysis, other Chapters (particularly Chapters 4 and 11) within the Volume are referenced to minimize redundancy. While the intent of this analysis is to provide sufficient data to show that Polaris Point is the LEDPA, it is not the intent to be all inclusive. Therefore, as noted in the text throughout this section, other Chapters should be reviewed for additional details.

SECTION 404(B)(1) GUIDELINES ANALYSIS

Subpart A. GENERAL:

Location. Outer Apra Harbor, Guam (See Figure 2.3-1, Volume 4).

Project Purpose.

The proposed project is the construction and operation of a new deep-draft wharf with outer harbor and shoreside infrastructure improvements, creating the capability to support a transient nuclear powered aircraft carrier in Apra Harbor, Guam.

General Description.

Two wharf locations Alternative 1 (preferred) and Alternative 2 are carried forward for analysis (see the following section for more information on alternatives considered and dismissed).

Under the proposed action with a transient-capable port, the new aircraft carrier berth would support a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. This capability is required to support increased aircraft carrier operational requirements in the Western Pacific. The longer transient visits would interfere with existing munitions operations and therefore require a new deep-draft wharf that can accommodate the transient aircraft carrier. Additionally, due to the length of a transient visit, shoreside infrastructure for utilities (i.e., power, wastewater management, potable water supply) must be improved to minimize or eliminate reliance on shipboard systems while in port.

The primary project components include wharf construction and dredging. Although final designs are not available, impact analysis for wharf construction is based on steel pile construction. Final design, using refined data, analyses, and costs, may indicate that one of the other design alternatives, especially the concrete caissons, is better suited. Dredging is required within the area near the channel bend, portions of the turning basin, and areas alongside the proposed wharf structure to accommodate the aircraft carrier at either wharf location. Dredging is required to deepen these areas to the required -49.5 ft (-15 m) plus 2 ft (0.6 m) of overdredge. Approximately 608,000 cy (464,850 m^3) of dredged material would be removed for Alternative 1 and approximately 479,000 cy (366,222 m^3) would be removed for Alternative 2. Approximately 30% of the dredged material would be generated at the shoreline area of either alternative to provide an appropriate slope for the wharf structure. The dredge footprint area for Alternative 1 is 53 ac (21.4 ha) and 44 ac (17.8 ha) for Alternative 2.

The dredging method historically used in Guam is mechanical dredging with a barge-mounted crane with attached clamshell buckets to retrieve the sediment and deposit it on a scow (barge). Mechanical dredging using a traditional clamshell bucket is assumed for this EIS analysis because it represents the maximum adverse environmental impact in terms of short-term water quality impacts. It is likely that this method would be used for the proposed dredging; however, the decision for the type of dredge to be used would not be made until final design. Further discussion of dredging methodologies is located in Chapter 2 of this Volume and Volume 9, Appendix D.

<u>Alternatives Considered, Dismissed, and Carried Forward.</u> As previously discussed in Section 2.3.1, Chapter 2, the analysis and selection of reasonable alternatives and options for: 1) wharf location, 2) wharf alignment, 3) navigation channel, and 4) turning basin options for transient carrier visits were based on consideration of the following criteria:

- Practicability (with sub-criteria)
  - Meets security/force protection requirements
  - Meets operational/navigational characteristics
  - Meets cost, technology, and logistics requirements
- Avoids and/or minimizes environmental impacts to the extent practicable

Although the criteria are not specifically weighted, it is imperative that security/force protection or operational requirements not be compromised. Therefore, these two criteria represented the first level of screening for the alternatives analysis and any alternative that did not meet these basis requirements were automatically dismissed.

Section 2.3 of Volume 4 provides a detailed overview of the reasons why numerous options including 10 individual wharf locations, 4 wharf alignments, 2 navigation channel alignments, 1 turning basin option, and 2 structural wharf design options were dismissed from further study in this EIS. A short summary is provided below.

Wharf Location. Ten individual wharf locations were considered (see Table 2.3-1, Section 2.3.6 of this Volume). Following is the list of locations in italics considered and dismissed and the criteria why they were dismissed. Section 2.3 contains a detailed discussion of this elimination process.

Guam Commercial Port – security/force protection and operational/navigational

Glass Breakwater – security/force protection and operational/navigational

Dry Dock Island – operational/navigational and environmental

Bravo Wharf/pier – security/force protection, operational/navigational

Lima Wharf – security/force protection, operational/navigational

Delta and Echo Wharves – security/force protection, operational/navigational

Sierra Wharf (and all Inner Apra Harbor Wharves) – security/force protection

Kilo Wharf – operational/navigational

Polaris Point – retained (Alternative 1)

Former SRF – retained (Alternative 2)

As discussed previously in Section 2.3.1 of this Volume, during the public comment period on the Draft EIS, the public provided a new site location between Kilo Wharf and Sumay Cove, in an area adjacent to San Luis beach and design alternatives for Delta/Echo pier. These alternatives were evaluated and dismissed from further analysis in the EIS.

Alternative 1 (preferred) and Alternative 2 are the only two sites that meet the screening criteria and are therefore carried forward for analysis in this EIS. See Section 2.3 of this Volume for a detailed analysis.

Wharf Alignment. Section 2.3 of this Volume describes in detail the various wharf alignments that were considered and dismissed. Two wharf alignments were assessed for Polaris Point: parallel to shore (east-west) and a diagonal alignment from Polaris Point across the bay (southwest to northeast). For the parallel to shore (east-west) alignment, two options for aircraft carrier approach were considered, one with a full clearance area and one with a reduced clearance area. The diagonal alignment was dismissed because of the potential direct impacts to coral, it would be most exposed to storm waves, and it would require additional cost to implement. The full clearance, parallel to shore alignment was also dismissed because a land outcrop north of Polaris Point would have to be removed, which would also result in greater direct coral impacts than the reduced clearance option under consideration. A reduced clearance was approved by port operations, harbor pilots and Commander, U.S. Pacific Fleet to ensure that the reduction was acceptable from a navigation and operations perspective. Therefore, the parallel to shore (east-west), reduced clearance is carried forward for analysis in the EIS.

Three wharf alignments were considered for the Former SRF, all of which were parallel to shore. Two options were dismissed, one of which would permanently block access to the dry dock, even when the aircraft carrier is not present and the second of which would require significant amounts of excavation of existing land area. The wharf alignment alternative retained for further consideration in this EIS at the Former SRF follows the current shoreline as it extends from the end of the finger pier at Lima Wharf in a north-northwesterly direction toward the current location of the floating dry dock.

Navigation Channel. Three navigation channel options were considered, including a channel with a sharp bend (54 degrees), a straight channel, and slight bend option. As discussed in Section 2.3 of Volume 4, the straight channel and slight bend option were dismissed because of their direct impacts to high quality coral. The sharp bend option, which has been retained for analysis in this EIS, is the least favorable for navigation but the least environmentally damaging because it minimizes direct impacts to coral in the vicinity of Jade and Western Shoals and requires less dredging than the other two options.

Turning Basin. The minimum radius turning basin option was retained for analysis in this EIS because it met the minimum radius needed to safely maneuver the aircraft carrier while minimizing dredging and impacts to corals. See Section 2.3 of this Volume for additional details.

Wharf Design. Structural design options include vertical steel pile supported wharf on armored slope embankment, tied-back steel sheet pile bulkhead (including solid fill), and concrete caissons. All design options would disturb the same area, but there are structural and environmental impact advantages (alters but retains open water and intertidal habitat under the wharf) to a steel pile supported wharf, as described in Section 2.3. Also, due to the need to have a level foundation for the full width of the caisson alternative, additional dredging would be needed for the caisson design alternative increasing its potential environmental impacts as well as cost. Final design is not available for inclusion in this EIS. The impact analysis is based on steel pile construction.

Subpart B. COMPLIANCE WITH THE 404(b) GUIDELINES

230.10. Restrictions on Discharge

Description of the Proposed Discharge Site(s). Discharge sites regulated by Section 404(b)(1) associated with the proposed action would be located at the site of construction for the new wharf. As discussed in

Section 2.3, this EIS assumes that steel pile construction would be used; however, final design is not yet available. A typical steel pile wharf design is shown on Figure 2.5-5 of this Volume. Fill would be in the form of a sloped marine revetment that would be placed under the wharf and along the shoreline to support the vertical steel piles and stabilize the shoreline. In comparison to other wharf construction methods, steel pile construction would require less fill than sheet pile bulkhead wharves and less dredging than caisson-based wharves.

Because the proposed dredging is also an integral part of this project, a discussion of dredged material disposal is included here. The EIS assumes five disposal scenarios: 100% ODMDS (ocean) disposal, 100% upland placement, 100% beneficial reuse, 20-25% beneficial reuse/75-80% ocean disposal, and 50% beneficial reuse/ 50% ocean disposal.

Under the 100% upland placement scenario, five upland placement sites on Navy land were initially identified in the Draft EIS for potential use in support of the proposed dredging action. These sites are referred to as Field 3, Field 4, Field 5, PWC Compound and Polaris Point and are described in detail in Appendix D of Volume 9. Fields 3 and 5 and Polaris Point have been proposed for other dredging projects and have already been addressed in a NEPA document. Field 4 and PWC Compound sites are addressed in this EIS in Volume 2 and Volume 9, Appendix D. Polaris Point, Field 5, and PWC Compound sites were noted in the Draft EIS to each individually have sufficient capacity to accommodate all of the anticipated dredged material from either alternative action. Recent preliminary information from the upland placement study supplemental review has indicated that there may be substantially less upland capacity available on the five confined disposal facilities on Navy lands. Due to land use changes, Field 4, the PWC Compound, and the Polaris Point CDFs may not be available for upland placement. Capacity may be reduced in Field 5 due to cell construction to separate different types of materials. Field 3 remains a suitable option for upland placement. Used in combination with the ODMDS and beneficial reuse, only a portion of the candidate sites would be required to accommodate the dredged material. Upland dewatering, which occurs through evaporation and infiltration of the dredged material, is planned to contain all of the mechanically-removed dredged material and does not involve an effluent discharge of slurry water from the upland placement sites.

As noted above, the Navy is in the process of developing a detailed dredged material management plan as a supplement to the Navy's 2008 upland placement study that will incorporate the disposal options, specific plans for beneficial reuse to the extent possible, and include specific monitoring efforts required for each disposal option.

As noted in Section 2.3, USEPA is pursuing the final designation of an ODMDS approximately 11 to 14 nm (20 to 26 km) from the west coast of Apra Harbor. The designation is anticipated in 2010 and the ODMDS EIS has been prepared concurrent with this EIS. Volume 9, Appendix D provides the details regarding the dimensions, dike heights, and volume capacities of the five upland placement sites noted above. The upland placement sites are enclosed by earthen berms of 16 to 30 ft (5-9 m) in height. The dredged material would always be at or below the berm height. The berms would have an exterior horizontal to vertical slope of 2:1. No soil or fill would be brought to the site for construction. Vegetation would be cleared and soil compacted. Non-hazardous dredged material water would be allowed to evaporate or percolate through the ground. However, during extended periods of intense rain such as would occur with a typhoon, infiltration rates may be exceeded and, although unlikely, temporary discharge of stormwater may occur. All of the sites considered for dewatering are uplands and no wetland impacts would occur from their use. Only the Polaris Point upland placement facility would be located in the 100-year flood zone.

Types of discharge sites. Open water and upland disposal.

i) Type(s) of Habitat. The proposed wharf construction in-water area is designated as M-2 or an area of "Good" water quality. The existing upland sites contain previously disturbed upland vegetation and for Field 5 previously dredged materials; the proposed ODMDS open-water sites are deep water bottom and are being addressed in a separate EIS (NAVFAC 2009).

ii) Timing and duration of discharge. Wharf construction would take approximately three and one half years to complete, which includes the time needed for dredging. The dredging project is expected to take approximately eight to eighteen months to complete. Further refinement of the dredging timeframe would occur during the permitting process.

Description of discharge. Pile driving equipment would be used for wharf construction. Impacts to marine resources from pile driving are discussed in Chapter 11 of this Volume. Placement of the quarry stone and riprap stone for the marine revetment for shoreline protection would involve the use of clamshell loaders or similar bucket loaders to place the rock along the slope of the shoreline beneath where the wharf would be constructed for either alternative. The overall area of the concrete deck for both alternatives is 90 ft (27 m) wide by up to approximately 1,325 ft (404 m) long except where the storm bollards are installed where the width would be approximately 115 ft (35 m). For Alternative 1, the marine revetment would be placed under the deck on the existing surface at a slope of 1 vertical to 1.5 horizontal to a depth of 3 ft (1 m). Approximately 42,000 cy (32,111 m^3) of quarry stone would be placed as fill and 19,815 cy (15,150 m^3) of riprap stone placed as fill. The affected surface area would be approximately 3.6 ac (1.5 ha) that would represent a loss of open water/intertidal habitat. For Alternative 2 an additional amount of fill would be needed for the water areas between the slips of the finger piers that would be incorporated into that structure. The additional amount of clean fill required for the finger piers for Alternative 2 would be approximately 20,000 cy (15,291 m^3). Alternative 1 does not have this additional fill requirement. As part of the construction of the pile supported structure, there would be temporary resuspension and redistribution of sediments in the construction area. For purposes of the EIS, it has been assumed that the material would be removed using a mechanical (bucket) dredge with placement of the dredged material into scows for disposal.

230.11. Factual Determinations

A. Physical Substrate Determination. Dredging is required within the area near the channel bend, portions of the turning basin, and areas alongside the proposed wharf structure to accommodate the aircraft carrier at either wharf location. Dredging is required to deepen these areas to the required -49.5 ft (-15 m) plus 2 ft (0.6 m) of overdredge. Approximately 608,000 cy (464,850 m^3) of dredged material would be removed for Alternative 1 and approximately 479,000 cy (366,222 m^3) would be removed for Alternative 2. Approximately 30% of the dredged material would be generated at the shoreline area of either alternative to provide an appropriate slope for the wharf structure. The dredge footprint area for Alternative 1 is 53 ac (21.4 ha) and 44 ac (17.8 ha) for Alternative 2.

The proposed dredging activities under either alternative would significantly impact coral and coral reefs, including live/hard bottom "live rock" communities. For a discussion of corals, see Section 230.44 coral reefs below. Potential impacts to non-coral benthic organisms include direct impacts to those organisms residing in the immediate dredge areas. Organisms residing in the area adjacent to and outside the dredged impact area could experience indirect impacts due to increased sedimentation from dredging activities. The impacts to non-coral substrate would be temporary and localized, however significant due to the quantity removed. Sessile (permanently attached or immobile) organisms such as marine floral communities (macroalgae) have been found to be the predominant benthic community at 40% (almost twice the overall coral cover [22%]) within the area to be dredged. Approximately 46 acres [22 ha] of non- coral substrate and approximately 10 acres of algae bed habitat would be removed. Due to the intensity of the impact (large area removed), and cumulative impacts associated with dredging of a variety of habitats (refer to Section 11.2.1.2, in this volume) a "more than minimal" significant effect on marine flora and sessile invertebrate habitat was determined, however effects are temporary as described below.

Under Alternatives 1 and 2, dredging activities would have direct, semi-permanent impacts to non-coral benthic organisms, particularly to sessile organisms. Although mortality would occur to marine flora and sessile invertebrates, new recruits would replenish these populations. The rate of re-colonization and the type and abundance of benthic invertebrates re-colonizing the bottom would depend on both abiotic and biotic factors. Abiotic factors include physical substrate conditions, water temperature, DO content, and salinity. Biotic factors include succession, recruitment, competition, and biogeography.

It is anticipated that the communities may return within a year of being dredged. Therefore, early dredge zones would recover as the staggered 18 month dredging process moves through the harbor channel. Considering, maintenance dredging would take place approximately every 10 years, the fast-growing, non-coral benthic community would have time to recover and provide those ecological services temporarily lost. Therefore, no long-term adverse impacts on the benthic marine flora and invertebrate community in Apra Harbor are expected. Impacts to non-coral benthic organisms would be less than significant as a result of implementing the offshore dredging component of Alternatives 1 and 2. See Volume 4, Chapter 2 and 11 for full impact analysis.

Actions have been taken to avoid and minimize adverse impacts to coral by the selection of alternatives that reduce the direct potential impacts to coral utilizing the sharp bend alternative for access to the proposed turning basin for each alternative. The potential impacts to corals have been further reduced by minimizing the turning basin radii for each alternative under consideration. The potential impacts to coral of Alternative 1 were minimized by dismissal of the full clearance, parallel to shore alignment because under that alignment a land outcrop north of Polaris Point would have to be removed, which would also result in greater direct coral impacts.

Considering that both of the alternative areas have been previously dredged and that dynamic physical conditions dominate the areas, pre-construction conditions would return relatively quickly except where changed by the presence of pilings and riprap beneath the wharf or where slow-growing corals have repopulated the area since the last dredging event 60 years ago. Those structures associated with wharf construction are likely to provide additional benthic settlement areas for sessile organisms as well as refuge for Apra Harbor fish species.

A suite of proposed mitigation options are being proposed to offset the loss of corals (see Section 230.44).

B. <u>Water Circulation, Fluctuation and Salinity Determination.</u> No significant change to water circulation, fluctuation, or salinity is expected to occur.

C. <u>Suspended Particulate/Turbidity Determinations.</u> During dredging and construction of the proposed wharf for either alternative, nearshore water quality would be temporarily impacted by turbidity and suspended sediment generated during the dredging process and construction activities as described in Section 4.2 of this Volume. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the *Habitat Equivalency Analysis and Supporting Studies* with a detailed summary is included in Appendix E of Volume 9 (Ericksen 2009). Input parameters utilized for the model included: dredging production rate, percent bucket loss (TSS load), current patterns, sediment grain size distribution, water depth, and dredge location. Due to the similarities in site conditions and subsequent anticipation of similar silt curtain effectiveness, the effects of silt curtains on TSS was also considered based on data collected during the previous dredging of Alpha-Bravo wharves. For that dredging project, TSS and turbidity was monitored both inside and outside of the silt curtain for 145 days. The results of the monitoring determined that the average TSS levels outside of the silt curtain were only 10% of the level inside the curtain (i.e., silt curtains retained 90% of the material inside). Possible maximum adverse environmental conditions were simulated by approximating the highest 10% TSS levels recorded outside of the silt curtain during the Alpha-Bravo dredging project, during strong trade wind conditions. As dredging for the proposed project would be conducted continuously, the maximum daily rate of 24 hours was used in the model. Under the maximum potential adverse effect scenario model run, the dredge plume had a maximum length of 328 ft (100 m). The plumes rapidly dissipated following dredging.

Given the coarse nature of the majority of Outer Apra Harbor sediments, it is likely that the suspended sediment would settle out rapidly, resulting in a much shorter turbidity plume than fine grained sediments in Inner Apra Harbor. Turbidity control measures such as the installation of silt curtains would be implemented to prevent suspended sediments from exceeding water quality standards outside the work area, and frequent monitoring during construction to ensure the effectiveness of suspended sediment containment would be performed. Dredging operations would be halted if the turbidity plume is visible outside the silt curtain (see Volume 7).

D. <u>Contaminant Determinations.</u> Sediment quality investigations in Outer Apra Harbor were conducted at three locations at Apra Harbor in 2006. The sites were being considered as potential locations for berthing an aircraft carrier, including the vicinity of Alternatives 1 and 2. Figure 2.3-9 in Chapter 2 of this Volume provides the location of the sediment samples for the 2006 testing. Sediment contamination was low throughout all the areas sampled.

Additional sediment sampling and analyses in Outer Apra Harbor were conducted in March 2010 to delineate the distribution and magnitude of chemicals of potential concern within the dredge footprint of the two potential aircraft carrier berthing sites; Polaris Point and the Former SRF wharf. Material from the proposed aircraft carrier turning basin was also evaluated (NAVFAC Pacific 2010a). Figure 2.3-10 in Chapter 2 of this Volume provides the location of the sediment samples for the March 2010 testing. The full report of this study is contained in Volume 9 Appendix K.

Consistent with previous sediment sampling efforts conducted in these locations, sediment samples were analyzed for physical and chemical parameters, including general chemistry, metals, semi-volatile organic compounds (polynuclear aromatic hydrocarbons [PAHs], phenols, and phthalates), organochlorine pesticides, polychlorinated biphenyls (PCBs), and organotins and the results compared to effects range-low (ER-L) and effects range-median (ER-M) sediment quality guidelines, as established. The 2010 analysis concluded that low chemical concentrations found in the most recently collected sediment samples from Polaris Point, the Former SRF Wharf, and the Turning Basin were consistent with other previous Tier III dredged material evaluations conducted in the same areas of Apra Harbor in the NAVFAC Pacific 2006 study where the material was deemed suitable for ocean disposal. Details of this additional testing and results are presented in Chapter 4 of this Volume 4.

Special handling of dredged material would not be required and it is likely that the dredged material would meet the testing requirements for ocean disposal.

E. <u>Aquatic Ecosystem and Organism Determination.</u> As described in Volume 4, Section 11.2, the proposed dredging activities under either alternative would have a long-term, significant impact on essential fish habitat (EFH), specifically coral reefs and some live/hard bottom communities. Proposed compensatory mitigation, as described in Section 230.44, would be required. The proposed construction of the aircraft carrier wharf would change the bottom habitat for either alternative location. Under Alternatives 1 and 2, dredging activities would have direct and semi-permanent impacts to non-coral benthic organisms particularly to sessile (non-mobile) organisms. Some mortality would occur to marine flora and sessile invertebrates, other such organisms are anticipated to quickly colonize the area once project activities cease, as described further in Chapter 11 of this Volume. Unavoidable, short-term adverse direct impacts to marine flora, non-coral invertebrates and associated EFH (i.e. submerged aquatic vegetation [SAS]) from physical removal would occur within the dredged footprint. Although, these organisms are anticipated to reestablish themselves from adjacent areas after construction, considering the size of the impact area and due to the context and intensity, and cumulative effects (see Section 11.2.1.2), these impacts would be "more than minimal", therefore significant, but temporary in nature. So, the implementing the offshore dredging component of Alternatives 1 and 2 may adversely affect EFH.

Those mobile organisms in the region of influence that are not directly subjected to removal or fill activities could sustain impacts as a result of transport, suspension and deposition of dredging-generated sediments. Removal of soft bottom substrate overlying hard substrate would provide additional potential habitat for coral and non-coral benthic organisms.

Two additional special-status species known to occur in the region include the bumphead parrotfish (NMFS candidate species and EFH management unit species [MUS]) and the spinner dolphin (protected under the Marine Mammal Protection Act [MMPA]). The bumphead parrotfish is reported nearby within Piti Bomb Holes Reserve (NOAA 2005); however, it has not been observed in Apra Harbor. Spinner dolphins are rarely reported in Outer Apra Harbor. There would be no significant impacts to or no adverse effects on special-status species (i.e., the action would not "jeopardize" or result in a "take" of an ESA-listed species or a species listed under the MMPA).

F. Proposed Disposal Site Determinations. Under the 100% upland placement scenario, five upland placement sites on Navy land were identified in the Draft EIS for potential use in support of the proposed dredging action. These sites are referred to as Field 3, Field 4, Field 5, PWC Compound and Polaris Point and are described in detail in Appendix D of Volume 9. Three of the alternative upland placement sites, Polaris Point, Field 5, and the PWC Compound sites were noted in the Draft EIS to each individually have sufficient capacity to accommodate all of the anticipated dredged material from either alternative action. Recent preliminary information from the upland placement study supplemental review has indicated that there may be substantially less upland capacity available on the five confined disposal facilities on Navy lands. Due to land use changes, Field 4, the PWC Compound, and the Polaris Point CDFs may not be available for upland placement. Capacity may be reduced in Field 5 due to cell construction to separate different types of materials. Field 3 remains a suitable option for upland placement. For the upland placement site(s) used, there would be no discharge of effluent associated with the upland placement at any of the possible upland sites and therefore no mixing zones are necessary for this disposal option.

G. Determination of Cumulative Effects on the Aquatic Ecosystem. The proposed action is not expected to have significant cumulative adverse impacts. Dredging and disposal of dredged material has and would continue to cause temporary increases in turbidity in dredged areas. Ongoing and future dredging projects in Apra Harbor would have additive impacts with the dredging proposed under either alternative. The majority of these impacts would be temporary in nature and/or would be minimized through the implementation of mitigation measures and BMPs.

Potential cumulative anthropogenic impacts on non-coral benthic organisms include potential releases of chemicals attached to suspended sediment into the ocean; introduction of debris into the water column and onto the seafloor; and mortality and injury of marine organisms near the areas of impact. Implementation of the proposed action, when considered cumulatively with the past, present and future projects, would have no significant long-term effects or changes to species abundance or diversity; or result in significant loss or degradation of sensitive habitats. The majority of these impacts would be temporary in nature and/or would be minimized through the implementation of BMPs None of the potential impacts would affect the sustainability of resources, the regional ecosystem, or the human community. Therefore, cumulative impacts to non-coral benthic organisms on Guam would be less than significant.

Regarding threatened or endangered species, green and hawksbill turtles are known to utilize Apra Harbor, but there are few records documenting use of beaches for nesting in the proposed project area. It is anticipated that implementation of Alternative 1 and 2 may affect, but is not likely to adversely affect the ESA-listed green sea turtles with regards to dredging associated forage habitat loss, nesting and physical injury. The pile driving components of Alternative 1 and 2, although not likely to take sea turtles, due to limited visibility from elevated turbidity of waters in the action area, may potentially expose sea turtles to noise levels that exceed the NOAA’s criterion for Level B Take, and therefore may affect, and likely to adversely affect the green sea turtle and the hawksbill sea turtle. As a result, the Navy will be requesting an Incidental Take Permit for the pile driving action associated with the CVN MILCON. Therefore, Alternative 1 and 2 would result in significant impacts on special-status species.

Increased vessel movements associated with the aircraft carrier and MEU embarkation operation and commercial shipping traffic have the potential for increased sea turtle disturbances and strikes in route to and from Sasa Bay (a high turtle concentration area) within Apra Harbor. However this increase (approximately 3 extra trips per year) is considered negligible in regards to impacts on the sea turtle population.

Potential cumulative impacts to essential fish habitat (EFH), when considered cumulatively with the past, present and future projects would include potential release of pollutants into the nearshore environment; introduction of debris into the water column; mortality and injury of marine organisms (including coral reef ecosystems) near the dredging impact areas; physical and noise impacts from increased vessel activity, and indirect impacts from recreational activities and WWTP loading directly related to increased on-island population growth. Direct and indirect impacts have been documented to marine biological resources, including EFH and ESA-listed species from past projects.

The cumulative impacts to nearshore waters from the various aspects of the proposed action include temporary increases in suspended sediments and turbidity in Apra Harbor and at the existing ODMDS from dredging and disposal activities; potential changes in hydrodynamics from deepening the harbor; increases in stormwater runoff from upland development in the south; and increased sedimentation from construction-related ground disturbance. The majority of these impacts would be temporary in nature and/or would be minimized through the implementation of BMPs, LID measures, permit requirements, sustainability measures, and compliance with federal and local regulations. Cumulative impacts on coral and coral reef MUS present in the EFH of Apra Harbor would be long-term and significant. This significant impact to corals would be mitigated by DoD through the implementation of an approved

Compensatory Mitigation Plan. The compensatory mitigation plan would meet the requirements of the compensatory mitigation rule and include a suite of mitigation projects. Both watershed management and artificial reef projects are being considered. Final determination may not be made until after the ROD on this EIS and during the USACE regulatory process. It is possible that a combination of the mitigation efforts would be appropriate. The various options are listed by categories below and described in detail in Volume 4, Chapter 11, Section 11.2.3).

- Category 1: Watershed Restoration and Management
- Category 2: Coastal Water Resource Management
- Category 3: Apra Harbor Water Resource Management
- Category 4: In-Lieu Fee or Mitigation Banking Program

H. Determination of Secondary Effects on the Aquatic Ecosystem. The proposed action is not expected to have significant secondary effect on the aquatic ecosystem. Implementation of BMPs, monitoring during construction activities, permit compliance, and proposed mitigation of unavoidable impacts would reduce the secondary impacts of the proposed action to a less than significant impact.

230.12. Findings of compliance or non-compliance with the restrictions on discharge.

A. No significant adaptation of the guidelines was made relative to this evaluation.

B. There is no practicable alternative to the proposed action that does not involve the discharge of fill material into waters of the United States.

C. The discharges of fill materials would not cause or contribute to violations of any federal or Guam EPA water quality standard with the implementation of BMPs to control turbidity and giving consideration to the low concentrations of contaminants found in sediment samples for the project area in previous site characterizations.

D. The placement of fill materials would not result in significant adverse impacts to human health and welfare, including municipal and private water supplies, recreational and commercial fisheries, or special aquatic sites. Significant impacts to coral reefs would occur but this impact would be compensated by appropriate mitigation.

E. The upland placement scenario would not result in the discharge of effluent or suspended sediments from the upland site(s) which would require a specified mixing zone or restriction on their discharge.

The proposed action is therefore found to be in compliance with the 404(b)(1) Guidelines.

Subpart C. POTENTIAL IMPACTS ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

230.20. Physical Substrate. As described in Volume 4, Section 11.2, the proposed dredging activities under either alternative would significantly impact coral reefs, live/hard bottom, and submerged aquatic vegetation EFH MUS. For a discussion on corals, see Section 230.44 coral reefs below. The impacts to non-coral substrate would be short-term and localized, however significant. Potential impacts to non-coral benthic organisms include direct impacts to those organisms residing in the immediate dredge areas. Organisms residing in the area adjacent to and outside the dredged impact area could experience indirect impacts due to increased sedimentation from dredging activities. Sessile (permanently attached or immobile) organisms such as marine floral communities (macroalgae) have been found to be the predominant benthic community at 40% (almost twice the overall coral cover [22%]) within the area to be dredged. Under Alternatives 1 and 2, dredging activities would have direct and permanent impacts to non-coral benthic organisms particularly to sessile organisms. Although some mortality would occur to marine flora and sessile invertebrates (specifically live/hard bottom and SAS), other such organisms are anticipated to quickly reestablish once project activities cease, as described further in Chapter 11 of this Volume (NOAA Benthic Habitat Mapping 2007; DOER 2005; Atlantic States Marine Fisheries Commission 2002; and U.S. Army Corps of Engineers Coastal Engineering Research Center 1982). Although, these organisms are anticipated to reestablish themselves (temporary effect) from adjacent areas after construction, considering the size of the impact area and due to the context and intensity, and cumulative effects (see Section 11.2.1.2), these impacts would be "more than minimal", therefore significant. Removal of soft bottom substrate overlying hard substrate would provide additional potential habitat for coral and non-coral benthic organisms. Therefore, impacts to non-coral benthic organisms would be less than significant as a result of implementing the offshore dredging component of Alternatives 1 and 2.

230.21. Suspended Particulate/Turbidity. During dredging and construction of the proposed wharf for either alternative, nearshore water quality would be temporarily impacted by turbidity and suspended sediment generated during the dredging process and construction activities as described in Section 4.2 of this Volume. Given the coarse nature of the majority of Outer Apra Harbor sediments, it is likely that the suspended sediment would settle out rapidly, resulting in a much shorter turbidity plume than fine grained sediments in Inner Apra Harbor (see Chapter 4 of this Volume). Maximum concentrations of suspended solids in the surface plume should be less than 0.5 parts per thousand (ppt) in the immediate vicinity of the operation and decrease rapidly with distance from the operation due to settling and dilution of the material. Turbidity control measures such as the installation of silt curtains would be implemented to prevent suspended sediments from exceeding water quality standards, and frequent monitoring during construction to ensure the effectiveness of suspended sediment containment would be performed. The Navy would monitor for any exceedances of water quality standards. If any exceedances occur, construction activities would be interrupted until turbidity levels returned to acceptable levels. The sedimentation controls would prevent significant impacts to aquatic communities and water quality outside of the project area. According to the modeling results noted in Section 230.60, the turbidity plumes rapidly dissipated following dredging resulting in less than significant impacts.

230.22. Water. Ambient conditions in the project area are designated as M-2 or an area of "Good" water quality as described in Volume 2, Section 2.4, Least Environmentally Damaging Practicable Alternative for Waterfront Functions, and Section 4.2 of this Volume, which addresses water quality impacts from the proposed dredging and construction activities under both alternatives. There would be temporary minor increases in the resuspension of sequestered contaminants (attached to sediments), decreased light transmittance, and minor transient chemistry alterations in the water column during dredging and wharf construction.

230.23. Current Patterns and Circulation. Circulation patterns within the area are controlled by astronomical tides, winds, and to a lesser degree, freshwater discharge from upland water resources. The proposed dredging project and wharf construction would have no effect on circulation patterns, current velocities, or water stratification in Outer Apra Harbor.

230.24. Normal Water Fluctuation. No change in water fluctuation consisting of daily, seasonal, annual tidal and flood fluctuations in water level would occur as a result of the proposed dredging and wharf construction.

230.25. Salinity Gradients. Salinity gradients in Outer Apra Harbor are not expected to change from either alternative.

Subpart D. POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

230.30 Threatened and endangered species. Special-Status Species in the project area include sea turtles. Green and hawksbill turtles are known to utilize Apra Harbor, but there are only historic records documenting use of beaches for nesting near the project area. Noise impacts from in-water construction activities would be the main focus for sea turtles. As identified in Volume 2, Chapter 11, the available data on sea turtle hearing suggests a hearing in the moderately low frequency range, and a relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999; Ketten and Bartol 2006). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 μPa-m (Lenhardt 1994).

The ability of sea turtles to detect noise and slow moving vessels via auditory and /or visual cues would be expected based on knowledge of their sensory biology (Navy 2009a). Noise from dredging activities (87.3 dB at 50 ft [15 m]) and pile driving (average 165 dB at 30 ft [9 m] would occur. Sound levels would decline to ambient levels (120 dB) within approximately 150 ft (45.8 m) from in-water construction activities (NMFS 2008c). It is anticipated that NMFS-trained monitors would perform visual surveys prior to and during in-water construction work as part of the USACE permit conditions. If sea turtles are detected (within a designated auditory protective distance), in-water construction activities would be postponed until the animals voluntarily leave the area (see detailed mitigation listings in Volume 7).

The Navy recognizes that there are many on-going and recent past studies on the subject of potential exposures to sea turtles and other marine species from pile driving actions. Further research and validation of these studies are necessary prior to being able to determine the applicability of the methodologies and results to the proposed action within this EIS. The Navy would continue to research these studies and where appropriate, incorporate and apply methodologies, analysis, and results to the on-going impact analysis to sea turtles from the proposed action. Applicability of these studies would also be coordinated through consultations with the National Marine Fisheries Service.

To further protect sea turtles, the contractor performing work in Apra Harbor would be directed to stop work when there is a positive visual sighting of a turtle anywhere near the project. The contractor can resume work fifteen minutes after the turtle submerges and is no longer seen. This instruction is the same for turtles within or outside of the silt curtains.

Additionally, the Navy would comply with USACE permit conditions, which include resource agency recommended BMPs for sea turtle avoidance and minimization measures and protocols during in-water construction activities (dredging and pile driving) and vessel operations. These measures may include look outs, stop work policies when turtles approach the area, and “ramping up” on pile driving activities, and others, are described in detail in the Mitigation Measures section, Volume 7. Formal consultation with NOAA in the context of Section 7 consultation includes these species. Informal consultations between the Navy and these agencies have been ongoing since June 2007 concerning the activities associated with the proposed action.

Potential indirect impacts from construction and operation include noise and activity, which would be less than significant for the reasons discussed in Chapter 10, Terrestrial Biological Resources and Chapter 11, Marine Biological Resources. Direct impacts from incidental boat strikes would be very uncommon and less than significant. Spills, should they occur, could significantly impact the sea turtle nesting area at Sumay Cove and possibly others. However, with implementation of BMPs, SPCC Plans, and with adequate spill equipment and response capabilities, impacts would be less than significant. BMPs and Mitigations are listed in Volume 7.

Three additional special-status species known to occur in the region include the Napoleon wrasse and bumphead parrotfish (a NMFS species of concern and candidate species, respectively), and spinner dolphin (protected under the MMPA). The bumphead parrotfish is reported nearby within Piti Bomb Holes Reserve, approximately 4 mi (6.4 km) from the Outer Apra Harbor Entrance Channel (NOAA 2005), but has not been observed in Apra Harbor. Spinner dolphins are rarely reported in Outer Apra Harbor. When they are sighted, it is only near the outer entrance channel several times a year for short durations. The location of these sightings range from 7,500 - 11,250 ft (2,286 – 3429 m) away from the proposed area of dredging depending upon the stage of dredging. Therefore, a no effects determination for spinner dolphins and bumphead parrotfish are applicable. Effects on the Napoleon wrasse are expected to be short-term and localized, and therefore there would be no adverse affects to this species.

In summary, it is anticipated that implementation of Alternative 1 and 2 may affect, but is not likely to adversely affect the ESA-listed green sea turtles with regards to dredging associated forage habitat loss, nesting and physical injury. The pile driving components of Alternative 1 and 2, although not likely to take sea turtles, due to limited visibility from elevated turbidity of waters in the action area, may potentially expose sea turtles to noise levels that exceed the NOAA's criterion for Level B Take, and therefore may affect, and likely to adversely affect the green sea turtle and the hawksbill sea turtle. As a result, the Navy will be requesting an Incidental Take Permit for the pile driving action associated with the CVN MILCON. Therefore, Alternative 1 and 2 would result in significant impacts on special-status species.

Increased vessel movements associated with the aircraft carrier and MEU embarkation operation and commercial shipping traffic have the potential for increased sea turtle disturbances and strikes in route to and from Sasa Bay (a high turtle concentration area) within Apra Harbor. However this increase (approximately 3 extra trips per year) is considered negligible in regards to impacts on the sea turtle population.

230.31 <u>Fish, crustaceans, mollusks, and other aquatic organisms in the food web.</u> As described in Volume 4, Section 11.2, under Marine Flora, Invertebrates, and Associated EFH, those mobile organisms in the region of influence that are not directly subjected to removal or fill activities could sustain impacts as a result of transport, suspension, and deposition of dredging-generated sediments. Mobile finfish and some invertebrates would likely vacate the area due to the increased disturbance. Under Alternatives 1 and 2, dredging and construction activities would have direct and permanent impacts to non-coral benthic organisms, particularly to sessile organisms, and some site attached reef fish and mobile macro-invertebrates. Although some mortality would occur to marine flora and sessile invertebrates (i.e. live/hard bottom and SAS), other such organisms are anticipated to quickly recolonize the area once project activities cease. Although there would be no loss of unique species (Dollar 2009), and these organisms are anticipated to reestablish themselves from adjacent areas after construction, considering the size of the impact area, and due to the context and intensity, and cumulative effects (see Section 11.2.1.2), these impacts would be "more than minimal", therefore significant. Impacts to marine flora, invertebrates, and associated EFH would significant as a result of implementing either Alternative 1 or 2, and therefore may adversely affect associated EFH.

Essential Fish Habitat

As discussed in Volume 2, Chapter 11, all of Apra Harbor is considered EFH and Jade Shoals is a Habitat Area of Particular Concern. Four sensitive MUS associated with EFH include Napoleon or humphead wrasse (NMFS species of concern and EFH-Currently Harvested Coral Reef Taxa [CHCRT]); bigeye scad (EFH-CHCRT); scalloped hammerhead shark (EFH-Potentially Harvested Coral Reef Taxa [PHCRT]); and sessile MUS (EFH-PHCRT), including stony corals (NMFS candidate species present) , soft corals, sponges, algae, etc.

The proposed construction of the aircraft carrier wharf would change the bottom habitat of both alternative locations. Considering that both of the alternative areas have been previously dredged and the dynamic physical conditions that dominate the area, pre-construction conditions would return relatively quickly, except in the area changed by the presence of pilings and riprap beneath the wharf. Those structures associated with wharf construction likely would provide additional benthic settlement areas for sessile organisms (albeit probably non-native species) as well as refuge and forage for Apra Harbor fish species.

Dredging impacts to EFH would be greatest for all life stages of coral and sessile reef species, and some crustacean MUS. Site-attached reef fish and pelagic egg/larval stages of bottomfish and pelagic MUS may also be adversely affected. Coral reef habitat would be permanently lost and would be mitigated through the preparation and implementation of an approved compensatory mitigation plan. Dredging activities would cause turbidity plumes and underwater noise that would temporarily disturb EFH MUS. Indirect impacts to EFH would include initial adverse effects within 40 ft. (20 m) of the dredge site due to cumulative exceedance of 6 mm sedimentation to less than significant effects from the temporary degradation of water quality as a result of suspended solids, reduction of light penetration and interference with filter-feeding benthic organisms out to approximately 144 ft (44 m). The increase in turbidity would be short-term and localized.

BMPs such as the use of silt curtains and proposed mitigation measures as identified in Volume 7 would minimize impacts to this EFH resource through a reduction in sedimentation associated with dredging activities.

230.32 <u>Other wildlife (migratory birds for this analysis).</u> The indigenous grey-tailed tattler and Pacific reef heron utilize food resources within Apra Harbor shoreline areas. A small amount of shoreline habitat that is not currently developed would be removed at the proposed aircraft carrier project area. The amount removed would be very small in relation to the total amount available. Similar areas of habitat are common in the area and any individuals affected would move to these other areas so that there would be less than significant impacts to populations of these shorebirds from removal of habitat.

Potential indirect impacts include noise and activity, pollutants, and dredging sedimentation. Only common migratory bird species widespread on Guam are known within the Polaris Point and Former SRF terrestrial area. Noise and activity from construction could force them to move temporarily but there are other areas of suitable habitat nearby. Existing commercial and Navy activity in Apra Harbor generates substantial background noise and lighting; however, migratory birds still frequent the area. Any noise associated with the temporary construction and dredging would not contribute substantially to the overall background noise and light levels nor significantly impact migratory birds.

Fueling of project-related construction or operation vehicles, watercraft, and equipment could result in accidental releases of petroleum products that would migrate within Apra Harbor. The Sasa Bay mangrove area is over 4,000 ft (1,219 m) from the aircraft carrier dredging location. Required BMPs during construction would make it unlikely for a major spill to occur. There would be a containment boom around the dredging operation to guard against fuel spills. Additionally, Navy oil response units would be present nearby. Pursuant to Navy response plans, small spills would be quickly contained and unlikely to reach environmentally sensitive areas. Potential impacts would be less than significant.

Proposed dredging and construction of the proposed wharf for either alternative location would result in suspension of sediments that could be mitigated. However, resuspended plume modeling results show that sediments would largely be contained within silt curtains employed for the dredging; any sediment plume would not migrate into Sasa Bay or only a very short distance into the bay under all scenarios modeled (Ericksen 2009). Use of silt curtains is part of standard procedures to minimize suspended sediment migration. The two alternatives are located within the confines of Outer Apra Harbor, well away from high wind and wave action, thus increasing the effectiveness of the silt curtains. Impacts would be less than significant.

Subpart E. POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

230.40 Sanctuaries and refuges. Dredging and construction activities would not significantly affect any of the fish and wildlife resources that are designated for preservation or refuges on Guam.

230.41 Wetlands. The onshore impacts to wetlands are discussed in Volume 4, Section 4.2 for both Alternatives 1 and 2. There would be no direct filling or dredging of wetlands with either alternative. Indirect impacts to coastal wetlands as a result of the release of sediment into the water column is unlikely to reach any wetlands. As noted in Section 4.2, for Alternative 1, the nearest wetland to the proposed dredging activity would be Wetland Area T, located approximately 2,500 ft (762 m) east of the nearest extent of proposed dredging (Figure 4.2-1). Other wetland areas (W, V2, U, S, X, and SV-O would be located even further away from the proposed dredging areas. To the west, Wetland Areas A and B would be located over 3,000 ft (914 m) from the nearest extent of proposed dredging (Figure 4.2-1). For Alternative 2, Section 4.2 notes that the closest wetland area is the same distance from the identified wetland areas to the east of the dredging area associated with Alternative 1 (at least 2,000 ft [610 m]) (Figure 4.2-2). With the dredging in front of the SRF, Wetland Areas A and B would be approximately 2,600 ft (792 m) west of the nearest extent of dredging operations. Potential impacts would be unlikely due to the implementation of dredging BMPs, distance to the wetlands, and the prevailing currents (i.e., the prevailing surface water motion in Apra Harbor is generally westward, away from the majority of wetland areas in Apra Harbor and Sasa Bay). Therefore, construction activities associated with Alternative 1 or 2 would not impact wetlands.

230. 42 Mudflats. No effect.

230.43 Vegetated shallows. No effect.

230.44 Coral reefs. The interaction of sediment removal and resuspended sediment with benthic communities, particularly corals, is of considerable importance in estimating the effects of the proposed dredging and wharf construction activities. Section 11.1, Volume 4, addresses non-coral benthic organisms. Section 11.2 addresses the impacts of Alternatives 1 and 2 to corals. Under Alternatives 1 and 2, dredging activities would have significant direct, permanent impacts to coral reefs. The coral reef habitat is an important component of the EFH within Apra Harbor, providing habitat necessary to fish for spawning, breeding, feeding, or growth to maturity. In addition to the significance determination described in Section 11.2, the following Habitat Equivalency Analysis (HEA)-related approach was utilized in assessing potential impacts (Navy 2009a). Under the 2008 USACE compensatory mitigation rule, permit applicants are required to mitigate to no net loss of ecological services and function. HEA is a modeling tool that has been used in a variety of legal and technical contexts to quantify impacts to natural resources and the services/functions they provide, and quantify the amount of restoration/mitigation required to offset documented losses. A HEA model was conducted for both aircraft carrier alternatives and a report entitled *Habitat Equivalency Analysis (HEA) Mitigation of Coral Habitat Losses* was prepared. It is included in Volume 9, Appendix E, Section F of this EIS.

The HEA addresses direct and indirect impacts to coral habitat arising from dredging to support aircraft carrier berthing and maneuvering in Outer Apra Harbor. The basic HEA steps include:

1. Loss calculation: Document and estimate the duration and extent of injury from the time of injury until the resource recovers to baseline, or possibly to a maximum level below baseline.
2. Restoration calculation: a) Document and estimate the services provided by the compensatory project over the full life of the habitat, and b) Calculate the size of the replacement project for which the total increase in services provided by the replacement project equals the total interim loss of services due to the injury.

The HEA analysis focuses on the coral habitat expected to be either permanently lost due to direct dredging, initial adverse indirect effects, or temporarily affected by sedimentation. Much of the habitat within the dredge footprint is previously dredged and unconsolidated soft sediment with no coral cover (Smith 2007; Dollar et al. 2009). Due to the short-term and localized impacts associated with dredging on soft bottoms and the anticipated quick recolonization of the benthic community, those habitats were not included in the HEA model.

The total area of removal by dredging (two dimensional view) of habitat with some coral coverage is approximately 25 ac (10.1 ha) for the Alternative 1, and approximately 24 ac (9.7 ha) for the Alternative 2. These acreages represent approximately 1% of the coral habitat of Apra Harbor. When looking within the 200 m study area , each alternative has approximately the same amount of potential coral impact of approximately 71 ac (29 ha). The total area (three dimensional view) of habitat with some coral coverage is approximately 33 ac (13 ha) for Alternative 1 and approximately 32 ac (13 ha) for Alternative 2.

In addition, an estimate was made of the discounted service acre-years expected to be lost due to aircraft carrier dredging-related activities. The "acre-year" metric allows the analysis to consider not only the number of ac lost, but also injury severity and recovery over time. A loss of one acre-year equates to a complete loss of ecological function provided by the identified habitat for one year. Such a loss could be arrived at in numerous ways (e.g., 50% degradation of two ac of habitat for one year, 10% degradation of five ac of habitat for two years, 5% degradation of one acre of habitat for 20 years, etc.).

The simplified examples above do not take into account the effects of discounting, which is applied in the HEA methodology to convert losses occurring in different years into a single, common year. A 3% annual discount rate is applied to the calculations, which is the most common discount rate used in HEA applications and one that research indicates reasonably reflects society's general preference for current use and enjoyment of resources, compared to future resource use and enjoyment (NOAA 1999, Freeman 1993). The sum of these discounted losses across years represents the present value acre-years of ecological services lost.

Alternative 1 would require the dredging of approximately 608,000 cy (464,850 m^3) of dredged material to obtain the desired -49.5 ft (15 m) MLLW plus 2 ft (0.6 m) water depth to accommodate the aircraft carrier. The total dredge footprint for Alternative 1, with coral, is estimated at 53 ac (21.5 ha). Alternative 2 would require the dredging of approximately 479,000 cy (366,222 m^3) of dredged material. Approximately 30% of the dredged material would be generated at the shoreline area of either alternative to provide an appropriate slope for the wharf structure. The total dredge area for Alternative 2, with coral, is estimated at 44 ac (17.9 ha). Table 11.2-19 summarizes the direct and indirect impacts of dredging to corals based on coral coverage category with the implementation of Alternatives 1 and 2. Areas with the greatest coral abundance (>70 to ≤ 90%) would comprise the smallest portion (10%) of the total coral coverage category that would be lost due to proposed dredging. Areas with the least amount of coral coverage (0 – ≤10%) would comprise the largest portion (approximately 36%) of the total coral coverage category that would be lost due to proposed dredging. About two thirds (62%) of the area proposed for dredging contains corals with a coverage of less than 30%. Approximately 3% of the total area proposed for dredging contains corals in the 70-90%, coverage category and 10% for the 50-90% range of coverage.

In general, approximately 35% of the proposed dredge area contains some coral coverage and virtually all of the area consists of reefs that were dredged 60 years ago during the creation of Inner Apra Harbor, Polaris Point, and Dry Dock Island. Therefore, there would be unavoidable permanent significant impacts to coral reefs from a dredging of approximately 25 ac (10.1 ha) of live coral (all classes [>0% to ≤90%]) and an initial indirect adverse effects due to cumulative sedimentation of greater than 6 mm out to 40 ft (12 m) beyond the dredge footprint.

Chapter 11 of Volume 4 summarizes the data used in the HEA calculations to estimate aircraft carrier-related coral habitat impacts and the resulting loss estimates. As shown in these tables, Alternative 1 is expected to result in a loss of approximately 1,048 discounted service acre-years (DSAYs) of coral habitat (across all coral habitat categories), approximately 996 DSAYs due to direct impacts and 52 DSAYs due to indirect impacts. Alternative 2 is expected to result in a loss of approximately 1,023 DSAYs (969 DSAYs due to direct impacts and 54 DSAYs due to indirect impacts).

The HEA was used to develop an estimate of the DSAYs gained per acre of artificial reef, discounted in the same manner as HEA loss calculations. Given a total expected loss of 1,048 DSAYS, a total of approximately 123 ac (49.8 ha) of artificial reef would be required to compensate for coral habitat impacts expected due to the Alternative 1. Results indicate that each acre of artificial reef would provide approximately 22.1 DSAYs. Approximately 121 ac (49.0 ha) of artificial reef would be required for proposed mitigation of impacts due to Alternative 2.

The Navy is considering a suite of options for compensatory mitigation for the loss of ecological service provided by corals being adversely impacted in Outer Apra Harbor as shown below. The Council for Environmental Quality (CEQ) has provided a number of potential Mitigation Projects to be considered that are included in the list below and discussed in detail in section 11.2.2.4. Specific projects are discussed in the compensatory mitigation impact analysis section 11.2.2.7 in Chapter 11 of this volume.

Compensatory mitigation for unavoidable coral community impacts includes the following options:

Category 1: Watershed Restoration and Management

- Afforestation
- Stream bank stabilization
- Riparian restoration
- Road stormwater BMPs
- Erosion control
- Wetland enhancement
- Land/submerged land acquisition/easement for conservation

- Education

Category 2: Coastal Water Resource Management

- Road stormwater control at a range of sites on Guam
- Shallow water reef enhancement within non-DoD federal property (e.g. National Parks)
    - Land acquisition
    - Erosion control
    - Wetland restoration
    - Artificial reefs
    - Coral transplanting
    - Boundary marking & enforcement
    - Monitoring
    - Education

Aquaculture (e.g. fish hatchery) for native herbivorous species

Support for enhanced enforcement of fishing and recreational diving regulations

Protection and conservation actions

- Marine debris removal
- Nuisance algae removal
- Installation of recreational mooring buoys

- Establishment of marine protected area(s) (MPAs)
- Upgrades/Improvements Wastewater Management Systems

Category 3: Apra Harbor Water Resource Management

- Erosion control
- Stormwater management (roads, wharves, industrial facilities)
    - Artificial reefs
    - Coral transplantation
    - Glass breakwater modifications
    - Wetland enhancement
    - Revise Navy management plans
    - Support for enhanced enforcement of fishing and recreational diving regulations
    - Education
- Protection and Conservation Actions
    - Marine debris removal
    - Nuisance algae removal
    - Installation of recreational mooring buoys

Category 4: In-Lieu Fee or Mitigation Banking Program

The final conceptual determination would not be made until the Record of Decision on this EIS. More detailed identification of mitigation would be done during the USACE permit process. Both artificial reefs and watershed management projects would be considered as potential compensatory mitigation, and it is possible that a combination of those mitigation efforts that are listed below would be appropriate. The Navy has not advanced a proposal at this time and specific mitigation measures would be subject to the permitting action/mitigation decision of the USACE.

The effectiveness of either upland watershed management or artificial reefs schemes to replace coral loss have been studied and conclusions concerning success differ. Section A of the *HEA and Supporting Studies* report (Volume 9, Appendix E, Section A) summarizes key points of discussion that were raised during review of the draft HEA, including relative merits (pros and counterpoints/cons) of artificial reefs and watershed management projects (HEA Section A, 3.3.4, Table 2 and 3, respectively). Compensatory mitigation for unavoidable coral community impacts includes the following options.

Category 1: Watershed Restoration and Management

Watershed restoration and management is a collective term to describe a variety of projects that would remove or diminish anthropogenic stresses on receiving coastal waters in order to improve water quality, resulting in recolonization or improved growth of existing coral in those coastal waters. Restoration of a watershed returns the ecosystem to as close an approximation as possible of its state prior to a specific incident or period of deterioration and restores the ability of the ecosystem to function. Watershed restoration can be complicated because an ecosystem has a myriad of interactions. These include interactions between the watershed's inhabitants, water level and flow, nutrient cycling, and the inevitable, natural changes that occur over time that change ecosystem dynamics (e.g., soil erosion and replacement). When deterioration of a watershed occurs gradually, restoration can require rigorous scientific protocols and involve lengthy, complicated, and costly investigations.

The approach to watershed restoration/conservation is to address reef degradation from discharge of eroded sediments from upland sources. Restoring vegetation to barren areas to reduce soil runoff and subsequent discharge into coastal waters is a major step in watershed restoration and improvement of coastal waters. Most potential watershed restoration projects would involve planting native seedlings in grasslands and badland areas as well as in fertile valley areas of watersheds. Other important elements of a successful watershed restoration project include but are not limited to animal control, monitoring and continuous watershed management.

EPA looks at the watershed restoration process as consisting of the following major steps: (1) build partnerships, (2) characterize the watershed to identify problems, (3) set goals and identify solutions, (4) design an implementation program, (5) implement the watershed plan, (6) measure progress and make adjustments (GEPA 2008)

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for watershed restoration:

Afforestation. *Coastal marine waters and associated rivers and watersheds on Guam have been recommended by resource agencies for potential compensatory mitigation for coral reef impacts. The approach to restoration/conservation of sites rather than a detailed assessment is described to address on-going problems of reef degradation from discharge of eroded sediments from upland sources.*

The Navy has held several conversations with federal and Guam resource agencies on coral impact assessment and compensatory mitigation methods associated with the Guam Military Relocation EIS. Resource agencies have recommended coastal marine waters and associated rivers and watersheds as restoration candidates for potential compensatory mitigation for coral reef impacts. USFWS has recently provided the following potential sites for a watershed aforestation coral reef restoration option (USFWS 2009). The information below is also supplemented by information from GEPA (2008).

- Achugao Subwatershed – Coastal waters and beach south of Achugao Point located in the southwestern portion of Guam. This beach is the discharge point for *Agaga River* associated with the Cetti Watershed.
- Fouha Subwatershed – Coastal waters at the head of Fouha Bay, located south of Cetti Bay, in the southwestern portion of Guam. Fouha Bay is the discharge point for the *La Sa Fua River* associated with Umatac Watershed in the southwestern portion of Guam.
- Geus Watershed – Coastal waters and marine bay (5 mi^2 [13 km^2]) associated with Cocos Lagoon located at the southern tip of Guam. The *Geus River,* associated with the Geus Watershed, discharges into the Cocos Lagoon.
- Ajayan Subwatershed – Coastal waters and intermittent beach at Ajayan Bay located east of Cocos Lagoon. The *Ajayan River,* associated with the Manell Watershed, discharges into Ajayan Bay.

The recommended watersheds have not been fully evaluated to determine their suitability, but are being considered by the Navy as options for mitigation. These watersheds are associated with reefs that are degraded by sedimentation, but were healthy a few decades ago (USFWS 2009).

Additional restoration/enhancement projects as recommended in Guam Bureau of Statistics and Plans (BSP) (2009) include the following Project Locations: Apra, Tumon, Tamuning, Piti, Asan, Fonte, Southern Agat, Togcha, Ylig, Pago, and Ugum. Project objectives would be to improve water quality and forest habitat restoration in these watersheds as they flow into waters that host marine preserves and other valuable marine resource areas. Most of the potential restoration projects would involve the planting of native seedlings in grasslands and badland areas as well as in fertile valley areas of watersheds. Other important elements of a successful watershed restoration project include but are not limited to animal control, monitoring and continuous watershed management.

Guam BSP (2009) provided figures delineating the boundary of the watershed area in which the listed projects would occur (refer to Figures 11.2-5 through 11.2-8 in Chapter 11 of this Volume). The watershed area on the figures is approximately 4,694,980 ac (1,900,000 ha) along the southwestern coast of Guam, extending from south of Naval Base Guam to the southern point of Guam and Cocos Island. The watershed area was selected because there is evidence that coral communities have previously existed in the receiving coastal waters. Under improved water quality conditions, these coral communities could be restored.

The Talofofo watershed associated with the Main Cantonment is located on Navy-owned land. The watershed currently suffers from soil erosion which manifests itself in sediment transfer to various streams that feed into Talofolo Bay. The Main Cantonment Watershed of savanna grassland vegetation would be restored and protected within the northeastern portion to address an on-going problem of reef degradation in Talofofo Bay from the transport of eroded sediments.

The potential for watershed restoration on privately owned lands would be limited as these types of projects require full control of the land and its uses to be successful. A Sella Bay watershed restoration project was proposed as compensatory mitigation for coral loss at Kilo Wharf. Because land use was not totally controlled and management agreements could not be concluded, the project had to be moved to Cetti Bay. It may be possible, however, to have a combination of reforestation/aforestation on some smaller scale when done in conjunction with watershed restoration project on Navy-owned or GovGuam lands, artificial reef installation within Apra Harbor or other areas, and/or riparian enhancement that would benefit fish, corals, and other marine organisms.

A direct and predictable relationship between a specific watershed project(s) and replacement of coral function is difficult to determine. Therefore, it would be difficult to predict how many watershed projects and of what type would be required to restore the productivity lost due to dredging. On the other hand, the effectiveness of artificial reefs would be more readily quantified as to its success in replacing lost coral function and value. However, all mitigation options are under consideration at this time.

Stream bank stabilization. This option would involve stabilization of stream banks within watersheds that would involve the placement of vegetative and/or mechanical rip rap revetment on banks of rivers and streams to minimize erosion and sediment laden run-off from entering sensitive riverine systems. The design would include major factors including: a) capability of conveying peak runoff flows produced by major storms and b) maintenance crew accessibility to structural BMPs for vegetation maintenance (i.e., through cutting vs. spraying) and rip rap/revetment repair.

Riparian restoration. This option would include mangrove and/or wetlands enhancement associated with the Philippine Sea. This may be based on Guam BSPs developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

Category 2: Coastal Water Resources Management

Coastal water resource management is a collective term to describe a variety of projects that would improve the quality or diminish anthropogenic stresses on nearshore coastal waters in order to improve management efforts and water quality, resulting in recolonization or improved growth of existing coral in those coastal waters. Addressing upland watershed issues (Option 1) prior to coastal efforts is important process.

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for coastal water resources management:

Shallow Water Reef Enhancement – coral transplanting within non-DoD federal property (e.g. National Parks). This option would include the transplanting of a significant quantity of coral that would be removed by the proposed dredging project. The objective of shallow water reef enhancement is to minimize coral colony mortality by transplanting coral to several new sites on Navy submerged lands. Transplantation site selection criteria would include physical, chemical, and biological factors. Studies have shown that larger intact colonies survive transplanting much better than small or fragmented colonies. Larger colonies also have far greater reproductive potential than small ones. Therefore, these types of projects often focus on transplanting large specimens. A detailed transplantation plan would be prepared which would include methods for moving large colonies, techniques for stabilizing the colonies at the transplant site, and monitoring protocols.

Wetland/mangrove restoration. This option would include mangrove and/or wetlands enhancement in the *Philippine Sea coastal areas*. This may be based on Guam BSPs developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

Establishment of Marine Protected Areas. This option would include the addition of special conservation areas associated with federally-owned submerged lands in and around Guam and the possibility of land swaps between GovGuam to keep these areas contiguous. This option may also include the expansion of existing ERA Marine or Terrestrial Units of Navy-owned submerged lands around Guam, including the beaches and limestone forest area inland from the Marine Unit. The expanded Marine Unit would include shallow water benthic habitat that contains both hard and soft corals. The management plans for these ERAs would be modified to prohibit fishing and other types of consumptive activities that could potentially adversely affect EFH.

Additional information would be provided in the compensatory mitigation plan prior to issuance of the DA permit.

Upgrades/Improvements Wastewater Management Systems. This option would involve upgrading Guam treatment plants and ocean outfalls to have refurbished primary and/or upgraded to secondary treated effluent to improve coastal water quality that would in turn enhance coral health in the coastal zone of Guam. This option is an alternative for the Northern District Wastewater Treatment Plant under consideration within this EIS.

Category 3: Apra Harbor Water Resource Management

This option includes a variety of projects that would improve the overall quality or diminish anthropogenic stresses on Apra Harbor in order to improve water quality and result in improved conditions and growth for the coral reef ecosystems present.

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for Apra Harbor water resources management:

Artificial reefs.

An artificial reef is a man-made, underwater structure, typically built for the purpose of promoting marine life in areas of generally featureless bottom. Artificial reefs can be created by a number of different methods. Many reefs “are built” by deploying existing materials in order to create a reef (e.g., sinking oilrigs, scuttling ships, or by deploying rubble, or construction debris). Other artificial reefs are purpose built (e.g., the reef balls) from PVC and/or concrete. Regardless of construction method, artificial reefs are generally designed to provide hard, 3-dimmentional surfaces to which algae and invertebrates attach, which in turn attracts fish species providing food habitat for fish assemblages. Car and Hixon (1997) “identified that methods used to evaluate the performance of an artificial reef will vary according to the purpose for which the reef was built. They found that artificial reefs with structural complexity and other abiotic and biotic features similar to those of natural reefs would best mitigate in-kind losses of reef fish populations and assemblages from natural reefs – specifically they compared colonization and subsequent assemblage structure of reef fishes on coral and artificial (concrete block) reefs where reef size, age, and isolation were standardized. Although species richness and fish abundance (all species combined) were greater on natural reefs vs. artificial structures, substantial differences in species composition were not detected.”

This option would be a direct application of a HEA derived artificial reef project in Apra Harbor. The Navy would install an artificial reef in approximately 80+ ft (24.4 + m) of water (to ensure its survival even in a super-typhoon) using one or more agreed upon artificial reef concepts. Reef alternatives may include “Z blocks” (used in Hawaii), Biorock, and Reefballs. Suggestions of other artificial reef options would be welcomed. Placement would be on the harbor floor and would not affect hard substrate. A mitigation site would be located within the ESQD arc of Kilo Wharf (to prevent the reef from being used as a Fish Aggregation Device that would invite recreational or commercial fishing or diving activities). As part of the artificial reef proposal, the HEA restoration project would include the potential use of transplanted coral as part of its compensation strategy.

Success criteria would be based on a replacement of benthic structure and one percent coral cover, as a proxy to ecosystem function. Long-term monitoring would be implemented to measure success. Potential Guam INRMP projects associated with the artificial reef could include assessment of functions these structures provide. Artificial reefs, though quantitatively easier to scale for a ratio between replacement and function lost than watersheds, have been criticized as being primarily fish aggregating devices that do not increase coral community productivity. In other words, the replacement of structure does not necessarily equate to a restoration of coral community function.

Shallow water reef enhancement – coral transplanting. This option may include transplantation of a significant quantity of coral that would be impacted by the propose dredging action. The objective of shallow water reef enhancement for Option 3 is to minimize coral colony mortality by transplanting coral to several new sites on Navy submerged lands within Apra Harbor. Transplantation site selection criteria would include physical, chemical, and biological factors.

Wetland/Mangrove enhancement. This option would include mangrove and/or wetlands enhancement in Apra Harbor. This may be based on Guam BSPs developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

Category 4: In-Lieu Fee or Mitigation Banking Program

Within the HEA Administrative Working Group, DoD, and the Military Civilian Task Force on Guam, there is support for the use of In-Lieu Fee or mitigation banking programs to manage, implement and monitor the success of natural resource compensatory mitigation projects on Guam. Revised regulations by the USACE and EPA in March 2008 govern compensatory mitigation for authorized impacts to waters of the U.S. under Section 404 of the CWA. In-lieu fee mitigation and mitigation banks would be included in this 2008 compensatory mitigation rule as endorsed federal programs. These programs have not yet been established on Guam.

Under mitigation banks, units of restored, created, enhanced, or preserved resources are expressed as "credits" which may subsequently be withdrawn to offset "debits" incurred at a project development site. Ideally, mitigation banks are constructed and functioning in advance of development impacts, and are seen as a way of reducing uncertainty in the USACE Regulatory program by having established compensatory mitigation credit available to an applicant.

In-Lieu-Fee mitigation occurs in circumstances where a permittee provides funds to an In-Lieu-Fee sponsor instead of either completing project-specific mitigation or purchasing credits from an approved mitigation bank. The program sponsor periodically funds a consolidated mitigation project from the proceeds of the accumulated In-Lieu-Fees. A Memorandum of Understanding would be executed among DoD, regulators and stakeholders that establishes an In-Lieu-Fee Mitigation Sponsor (typically a non-government organization) and a Review Team to determine how the bank would work.

The In-Lieu-Fee amount is based upon the compensation costs that would be necessary to restore, enhance, create or preserve coral ecosystems or other habitats with similar functions or values to the one affected. The fee is banked in an investment account until a project is approved for implementation. The In-Lieu-Fee mitigation bank would be managed by the In-Lieu-Fee Mitigation Sponsor (Sponsor) that uses the accumulated funds to implement projects that restore, enhance, or preserve ecosystems with similar functions and values that are located within the same biophysical region as the permitted disturbance. Key stakeholders, including regulatory agencies, DoD and the Sponsor, form an advisory committee that determines the projects that would be implemented. The Sponsor is responsible for implementing the project according to an approved work plan.

Development of Compensatory Mitigation Plan

The preparation and implementation of an approved Compensatory Mitigation Plan is the Navy's mitigation for adverse impacts to coral. A USACE permit would be required for the construction of the aircraft carrier wharf due to alteration of navigable waters and discharge of fill materials into the water. This permit would be the vehicle through which compensatory mitigation would be implemented. The project would be designed to avoid coral reef impacts and to minimize any unavoidable impacts. Unavoidable impacts would be mitigated through implementation and/or funding of mitigating measures to compensate for the resulting loss of ecological functions and/or services. Selection, scaling, and implementation of appropriate compensatory mitigation actions are being carried out in consultation with USACE, NOAA, USFWS, USEPA and GovGuam resource agencies. The HEA presented is a tool designed to equate impact habitat services to mitigation habitat services. The financial aspect does not come into consideration until after the mitigation project has been selected (e.g., execution costs of the mitigation project). As more information is gathered on the likely impacts and costs of the compensatory mitigation projects under consideration, a more detailed mitigation plan would be developed to comply with requirements of the USACE-EPA 2008 Compensatory Mitigation Rule.

230.45 Riffle and pool complexes. Not applicable.

Subpart F. POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS

230.50 Municipal and private water supplies. No effect.

230.51 Recreational and commercial fisheries. No effect on commercial fisheries. There may be temporary effects on recreational fisheries as a result of construction and operation. The impact would not be significant on recreational fisheries but would temporarily displace recreational fishing to other areas. See Section 11.1.4.2 in this Volume

230.52 Water-related recreation. The effects on water related recreation by both alternatives would be the same as described in Volume 4, Section 9.2. for Alternatives 1 and 2. This impact would not be significant and would involve the temporary displacement of recreational divers from the Western Shoals dive sites but these divers could relocate and utilize other dive sites for recreational purposes and return once the dredging and wharf construction were completed. Other users that could be affected include recreational users such as jet skiers, tour operators, and commercial tour submarines. Impacts would be temporary and less than significant.

230.53 Aesthetics. The aesthetic environment would be altered by the construction of the site and presence of the aircraft carrier when it visits. Additionally, there would be temporary impacts to the visual environment as a result of the physical presence of heavy equipment during construction causing a temporary degradation of the aesthetic environment.

230.54 Parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves. No effect. See Chapter 9, Volume 4.

Subpart G. EVALUATION AND TESTING

230.60 General evaluation of dredged or fill material. Section 4.2., Volume 4, discussed the dispersion modeling of turbidity from dredging activities in Apra Harbor in March 2009 as part of the *Habitat Equivalency Analysis and Supporting Studies* with a detailed summary included in Appendix K of

Volume 9 (Ericksen 2009). The results of the modeling were that surface turbidity plumes exceeding background levels of 3 mg/L were generally predicted to occur only directly at the dredge site. According to the modeling results, the plumes rapidly dissipated following dredging resulting in less than significant impacts. See also 230.61 below.

230.61 <u>Chemical, biological and physical evaluation and testing.</u>

Section 4.1, Volume 2 and Volume 4, discuss historical testing of sediments including their chemical, biological, and physical evaluations. Sediment quality investigations in Outer Apra Harbor were conducted at three locations at Apra Harbor in 2006. The sites were being considered as potential locations for berthing an aircraft carrier, including the vicinity of Alternatives 1 and 2. The three sites were: 1) former Charlie Wharf located at Polaris Point 2) the Former SRF site, and 3) the turning basin common to each in Outer Apra Harbor. Fourteen discrete samples of sediment to the proposed dredge depth were taken. The area samples were combined into three composites. Composite 1 (six sample locations) was of the turning basin; Composite 2 (three sample locations) was of the area in front of the Former SRF site; and Composite 3 (five sample locations) was representative of the area to be dredged for Polaris Point. Sediment contamination was low throughout all the areas sampled. Special handling of dredged material would not be required and it is likely that the dredged material from Outer Apra Harbor would meet the testing requirements for ocean disposal.

Additional sediment sampling and analyses were conducted in March 2010 to delineate the distribution and magnitude of chemicals of potential concern within the dredge footprint of the two potential CVN berthing sites; Polaris Point and the Former SRF wharf. Material from the proposed CVN turning basin was also evaluated (NAVFAC Pacific 2010a). The 2010 analysis concluded that low chemical concentrations found in the most recently collected sediment samples from Polaris Point, the Former SRF Wharf, and the Turning Basin were consistent with other previous Tier III dredged material evaluations conducted in the same areas of Apra Harbor in the NAVFAC Pacific 2006 study where the material was deemed suitable for ocean disposal. Also similar to the results of this most recent sediment analysis in 2010, sediments from the previous Tier III study had chemical concentrations that were generally low, but some analytes exceeded comparable ER-M values. Based on these similarities, it is likely if the 2010 sediments from the proposed Polaris Point or SRF Wharf dredge footprints were further evaluated according to guidance outlined in the Ocean Testing Manual (USEPA and USACE 1991) and/or Inland Testing Manual (USEPA and USACE 1998) they would be deemed suitable for ocean disposal or upland

As noted above, preliminary chemical testing results indicate the low concentrations of contaminants, indicating the material is likely suitable for ocean disposal. Pursuant to Section 103 MPRSA, all material would be tested for the presence of contaminants as well as the potential for toxicity and bioaccumulation prior to dredging using national testing guidance (USEPA and USACE 1991). Testing would be accomplished within three years of the start of the proposed construction dredging.

Subpart H. ACTIONS TAKEN TO MINIMIZE ADVERSE EFFECTS

230.70 <u>Actions concerning the location of the discharge.</u> The effects of the discharge of the dredged material would be minimized by locating and confining the upland placement sites with no return effluent discharge. Impacts would be further reduced by utilizing previously used upland placement sites so that the substrate would be composed of similar material to that of the dredged material. With the high probability that a mechanical dredge would be used, the upland placement sites would not have large areas of standing bodies of water that could potentially drain into adjoining areas. Silt curtains and other

BMPs and mitigation measures, as described in Volume 7, would be used to control silt plumes at the construction and dredging sites.

230.71 Actions concerning the material to be dredged. Information provided in Section 230.21 noted that the materials to be dredged from Outer Apra Harbor are predominantly coarse materials and sand. Sediments of this type are less likely to contain high concentrations of contaminants versus sediments composed of fine materials such as silts. As noted in Section 4.1 of Volume 2, no special treatment of these dredged materials is expected.

230.72 Actions concerning the material after discharge. Selection of diked upland placement sites would minimize the potential impacts of the material after discharge. The materials would be isolated from the surrounding areas by the dikes which would be maintained using grassed slopes to prevent erosion as noted in Appendix D of Volume 9. As the dredged materials have not been found with limited testing to be contaminated and the historical test results as noted in Section 4.1, Volume 2 provided similar results regarding a lack of high concentrations of contaminants, no special measures such as liners or special treatment of the materials after discharge would have to be utilized.

230.73 Actions concerning the method of dispersion. The environmental effects of the material to be dredged would be minimized as the proposed dredging would include the use of silt curtains and other protective measures to minimize the distribution of suspended sediment in the water column during dredging. The dredged materials would be placed in scows and not be allowed to overflow into the water minimizing potential turbidity impacts. There would be no return effluent from the upland placement site into Apra Harbor.

230.74 Actions related to technology. Section 4.2 of Volume 4 presents possible equipment and machinery that can be used to minimize the impacts during dredging and disposal/dewatering activities. Section 4.2 of Volume 2 and Appendix D of Volume 9 present operational controls of the dredging equipment that can be employed to minimize impacts to the environment. Silt curtains and similar devices can also be placed around areas of specific concern such as coral to provide them with additional measures of protection.

230.75 Actions affecting plant and animal populations. As noted in Section 2.3 in Volume 4, the channel option carried forward was the option that reduced dredging impact to corals to the greatest extent possible versus the other two channel options considered and dismissed. Selection of existing upland sites would further reduce potential impacts to plant and animal populations. As noted in Section 11.2, Volume 4, mitigation measures including restrictions on dredging during stony coral spawning periods which occur in Apra Harbor during the full moon phases in June, July, and August would be considered.

230.76 Actions affecting human use. As described in Chapter 9 of this volume, there would be some impacts to recreational users from both alternatives. To assist the public in planning its offshore recreational activities near the project area, public notice of dredging activities would be provided. Dredging would proceed as rapidly as practicable to minimize the impact.

Although the impacts to the existing on-base recreational resources would be short-term, recreational resource users—existing and new—would experience crowding and increased competition for the available recreational resources. To mitigate the potentially significant impacts to the existing recreational resources at Polaris Point, the Navy would consider providing additional shuttle bus services and taxis to be made available on-base to offer transportation services for the Sailors to the most popular sites on the island including Tumon/Tamuning villages, which offer recreational, shopping, and entertainment resources. Comparable and alternate marine activities, such as diving (snorkeling, SCUBA, free diving), boating, kayaking, marine tours (dolphin watching, cruise, catamaran rides), and beachcombing are some of the recreational resources popular in these regions.

230.77 **<u>Other actions.</u>** As noted above, there is no proposed return flow effluent from the upland placement site as part of the dredging cycle.

The total area of removal by dredging (two dimensional view) of habitat with some coral coverage is approximately 25 ac (10.1 ha) for the Alternative 1, and approximately 24 ac (9.7 ha) for the Alternative 2. Cumulative impacts on coral and coral reef MUS present in the EFH of Apra Harbor would be significant. This significant impact would be compensated following the implementation of an approved compensatory mitigation plan. The total area (three dimensional view) of habitat with some coral coverage is approximately 33 ac (13 ha) for Alternative 1 and approximately 32 ac (13 ha) for Alternative 2. A discussion of compensatory mitigation proposals to offset the above impacts to coral reefs is presented in Volume 4, Section 11.2.2.7.

ALTERNATIVES COMPARISON SUMMARY AND LEDPA DETERMINATION

There are several reasons why Alternative 1 is considered both the Navy preferred alternative and the LEDPA. Under the LEDPA analysis, it is assumed that both alternatives are practicable and are therefore differentiated by which alternative is the least environmentally damaging. These reasons are highlighted below and identified in Table 4.3-1.

<u>Alternative 1 (Preferred, LEDPA)</u>

As discussed throughout Chapter 2 of this Volume, Alternative 1 is considered the Navy preferred alternative wharf location for the aircraft carrier. Both alternatives are located within the same general area of the base, but Polaris Point has several advantages. Radionuclear response times can be met at either alternative, but the proximity to the existing radionuclear response facilities and personnel at Polaris Point reduces the challenge of meeting response times at Former SRF. The Former SRF is located approximately 3.2 mi (5.1 km) away from the radionuclear response facilities. It is more efficient to consolidate the radionuclear facilities at one location. From a land use planning perspective, it is preferred to co-locate nuclear powered vessels and the nuclear powered submarines that are berthed at adjacent wharves on Polaris Point.

Another benefit of Alternative 1 is that this alternative would not impact dry dock operations and would not require a reduction in the Guam Shipyard lease area that would be required under Alternative 2. Further discussion may be found in Chapter 2, Section 2.5 of this Volume. Although the Navy would compensate for work days lost, Alternative 2 would impact Guam’s dry dock operations. The Guam Shipyard lease area would have to be renegotiated to reduce the footprint and provide room for the aircraft carrier. The lease is scheduled for renegotiation, but the aircraft carrier wharf would impact the lease area. Security and force protection requirements can be met at the Former SRF; however, the proximity of the civilian Guam Shipyard personnel adds an additional security consideration requiring greater perimeter setbacks. Further discussion may be found in Chapter 2, Section 2.5.

The Polaris Point site borders recreational areas and is less industrial than the Former SRF. There is more space for recreational activities near the wharf for military personnel while the carrier is at the transient port. Recreational and retail opportunities are within walking distance of the Former SRF, but there are no facilities near the wharf for the military personnel on the carrier while at the transient port. Further discussion may be found in Chapter 9, Recreational Resources and Chapter 13, Visual Resources in this Volume.

An advantage of Alternative 1 is that access to Polaris Point does not require transit through the Main Gate to Naval Base Guam. Short-term aircraft carrier visit traffic is characterized as predominantly to off-base destinations. This Alternative would minimize the traffic impacts on the Main Base, specifically the Main Gate, representing a benefit to permanent personnel at the base. There would be some increase in traffic on base but most of the traffic would be outside the Main Base. Commercial vendor supply trucks also could make deliveries to Polaris Point without Main Base access. Traffic impacts are assessed in Volume 6.

Alternative 1 would have higher costs for wastewater upgrades, but costs would be offset by the added benefit of improved reliability for other Polaris Point facilities. The power and communications costs for Alternative 1 would be lower than for Alternative 2.

Environmental Factors Contributing to Polaris Point Being the LEDPA

Dredging and Fill. Alternative 1 requires a greater volume of dredged material than Alternative 2 to accommodate the aircraft carrier. Alternative 1 would require a dredge volume of 608,000 cy (464,850 m3) while Alternative 2 would require a dredge volume of 479,000 cy (366,222 m3). However, even though the total dredged material volume is higher, the difference is due to coastal excavation compared to open water dredging, where coral habitat is located. There is some coral located at the shoreline at Polaris Point, but the large majority of material is fill material and not coral. Because of the wharf alignment needed to accommodate the aircraft carrier, Alternative 1 would require less fill than Alternative 2. Both alternatives would result in approximately 3.6 ac (1.5 ha) of fill below the wharf structure, with an additional amount of fill required at Alternative 2 for the water areas between the slips of the finger piers that would be incorporated into that structure (approximately 20,000 cy [15,291 m3]). Alternative 1 does not have this additional fill requirement.

Sensitive Resources. As shown in Table 2.8-1, the impacts to coral under both alternatives are comparable. The advantage of Alternative 1 is that although there would be greater short-term impacts to coral from dredging, over the long term there would be fewer impacts to sensitive resources from operations, especially to areas containing high quality coral such as Big Blue Reef, because Alternative 1 is located further away from Big Blue Reef than Alternative 2.

A substantial percentage of the coral at all depth contours off Polaris Point was growing on metallic and/or concrete debris, was of marginal quality, and showed the greatest signs of stress (Smith 2007). This stress appeared to be due in part to high levels of total suspended solids (TSS) coming from Inner Apra Harbor. Some colonies with hemispherical growth forms (e.g., *P. lobata*) at survey sites within the dredge footprint (Polaris Point, Fairway, and Turning Basin) were observed secreting copious amounts of mucus. As these areas are within the active ship transit lanes, the mucous secretion may be a sediment rejection response related to increased sediment resuspension from current ship activities (Smith 2007).

Additional coral and coral reef community survey data by Smith are provided in detail in Chapter 11 of this volume (Smith 2007). In general, coral development varies dramatically between sites and at different depths, with some locations supporting well developed complex coral reefs and other areas supporting only small patch reefs or sparsely scattered corals. Seventeen coral families were observed throughout the study area. Only one site (Big Blue Reef east) contained all of the observed coral families which is closest to Alternative 2.

When reef survey zones were ranked according to variables that included coral coverage, diversity, rugosity, health, and size-frequency distribution, the areas within the proposed dredge footprint (Turning Basin, shoal areas and Polaris Point) ranked lowest on the scale, and were ranked consistently lower than the sites that are outside the project footprint. The highest ranking was given to Big Blue Reef west, owing to protection from exposure to poor water quality factors associated with Inner Apra Harbor and ship-induced sediment resuspension.

The Polaris Point area, turning basin, Big Blue Reef east, navigation channel and Delta/Echo Wharves areas do not meet any of the Habitat Areas of Particular Concern criteria (see Volume 2, Section 11.1). However, Big Blue Reef west provides significant ecological function and is sensitive to human induced environmental degradation, thereby meeting two of the four criteria for HAPC designation.

The turning basin for Alternative 1 is further from Big Blue Reef and this distance may decrease the risk of construction and operation sediment resuspension impact on this valued coral community and threatened and endangered species such as sea turtles; Big Blue Reef is a resting and foraging area for sea turtles. Pile driving activities associated with Alternatives 1 and 2 may affect, and are likely to adversely affect ESA-listed sea turtles, hence the Navy will be requesting an Incidental Take Permit for these activities associated with the CVN MILCON.

The northwest limits of the channel widener for the turning basin for Alternative 1 is further east of the Middle Shoals Reef coral system than Alternative 2. Figures 11.1-10 and 11.1-11 in Chapter 11, Volume 4 show that Alternative 1 would impact less coral than Alternative 2 in the Middle Shoals due to the location of this widener.

Further discussion of impacts to water quality and marine resources may be found in Chapter 4, Water Resources and Chapter 11, Marine Biological Resources of this Volume.

Based on the above discussion, Alternative 1 is considered the NEPA preferred alternative and the LEDPA. Impacts to the aquatic ecosystem would be avoided or minimized to the greatest extent possible. Implementation of Alternative 1 would have less high quality coral removed by a percentage comparison (42% for Alternative 1 and 46% for Alternative 2); its construction and operational phases are further away from Big Blue reef having both short-term and long-term environmental protection advantages when compared to Alternative 2; and fewer impacts to threatened and endangered species are anticipated due to increased distance to resting and foraging areas. BMPs and compensatory mitigation would be provided as described in Volume 7 and at the end of each chapter in Volume 4. Once final impacts through complete design are identified, a final mitigation plan would be prepared.

. Table 4.3-1. Comparison of Alternative 1 and Alternative 2s

LEDPA Analysis Reference	*Characteristic*	*Alternative 1 (NEPA Preferred and LEDPA)*	*Alternative 2*
Subpart A	Navigation channel: Generally follows existing channel to minimize dredging	Same	Same
Subpart A	Wharf design – steel pile	Same	Same
Subpart A	Dredge method - mechanical	Same	Same
Subpart B (230.10)	Dredged Material Disposal: Beneficial Reuse/ODMDS/Upland Combination	Same	Same
Subpart A	Turning Basin Radius	Same	Same

. Table 4.3-1. Comparison of Alternative 1 and Alternative 2s

LEDPA Analysis Reference	*Characteristic*	*Alternative 1 (NEPA Preferred and LEDPA)*	*Alternative 2*
Subpart A	Turning Basin Location	**Further away from Big Blue Reef (high quality coral and coral reef habitat)**	Closer to Big Blue Reef
Subpart E (230.44)	Coral Reef Impacts (2 Dimensional) Coral Impact (Direct) Coral Impact (Indirect - 200 m buffer around dredged area) Coral Reef Impacts (total) Coral Reef Impacts (3 Dimensional)	 25 ac (10.1 ha) 46 ac (18.6 ha) 71 ac (29 ha) 33 ac (13 ha)	 24 ac (9.7 ha) 47 ac (19.0 ha) 71 ac (29 ha) 32 ac (13 ha)
Subpart E (230.44)	Coral Reef Removal	**Less high quality coral removed by percentage (see Table 11.1-3 in Chapter 11 of this Volume)**	More high quality coral removed by percentage (see Table 11.1-3 in Chapter 11 of this Volume)
	Proximity to Big Blue Reef (nearest named reef)	**Greater distance to Big Blue Reef-less likely to impact the reef and threatened and endangered species from dredging and regular operations**	Adjacent to Big Blue Reef
Subpart D (230.30)	Threatened and Endangered Species Significant impacts from pile driving	**Fewer impacts to threatened and endangered species due to increased distance from foraging and resting areas**	Greater potential impacts to threatened and endangered species
Subpart D (230.31)	EFH (May adversely affect EFH)	Same	Same
Subpart C (230.21, 230.22, 230.23, 230.24, 230.25)	Water Quality Increased turbidity during dredging; would be minimized by silt curtains and other proposed mitigation measures.	Same	Same
Subpart E (230.41)	Wetlands: No dredge/fill of wetlands.	Same	Same
Subpart A	Dredge Volume (including 2 ft overdredge)	608,000 cy (464,850 m^3) (difference due to coastal excavation not open water dredging)	479,000 cy (366,222 m^3)
Subpart A	Dredge Footprint Area Fill	53 ac (21.5 ha) 3.6 ac (1.5 ha)	44 ac (17.8 ha) 3.6 ac (1.5 ha) plus additional for finger piers
NA	Impact by Vessel Operation (i.e. resuspension of sediments associated with berthing movements)	**Greater distance to sensitive habitat**	Closer to sensitive habitat