Draft

# Environmental Impact Statement / Overseas Environmental Impact Statement

# GUAM AND CNMI MILITARY RELOCATION

## Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force

**Volume 9: Appendices**

November 2009

Comments may be submitted to:

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# Guam and CNMI Military Relocation EIS/OEIS

# Volume 9: Appendices

## Table of Contents

# Appendix D

# Project Description Technical Appendix

# Guam and CNMI Military Relocation EIS/OEIS

# Volume 9: Appendices

### Table of Contents

# CHAPTER 1.
# D: PROJECT DESCRIPTION TECHNICAL APPENDIX

## 1.1 DREDGING - METHODS

There are two general types of dredging operations (Weston Solutions Inc. 2005): mechanical dredging operations and hydraulic dredging operations. The operations vary by the method used to loosen the material from its *in situ* state and transport the material from the seafloor to the water surface. The type of dredging equipment that is used would affect the characteristics of the dredged material. Differences in dredged material characteristics resulting from dredging methods as well as logistical considerations relevant to the use of mechanical and hydraulic dredges are described in the following subsections.

Mechanical dredging excavates in situ sediments with a grab or bucket. One of the most common types of mechanical dredges is the clamshell dredge, which is named for the type of bucket used in the operation. Typically, a large barge is loaded with the bucket dredge and transported to the dredging site with tugs. The barge is then secured in place. The dredging process consists of lowering the bucket to the seafloor, closing the bucket and raising it back to the water surface, and depositing the dredged material into a scow or, if appropriate, directly into an adjoining placement site. The efficiency and capacity of this type of dredging is determined by the capacity of the bucket, which varies between 1.5 and 25 CY (1 and 20 $m^3$), scow capacity, which typically varies from 130 to 3,300 CY (99 to 2,523 $m^3$), and the number of available scows.

An "environmental bucket" is a type of clamshell bucket, but is closed to minimize the release of sediment from the bucket into the water column. Once the material is retrieved from the ocean floor it is managed as described for the clamshell. The only difference between the two dredge methods is the design of the bucket.

Mechanical dredges operate best in consolidated, hard packed material since dredging buckets have difficulty retaining the loose, fine material that is often washed away as the bucket is raised. Depending on scow characteristics, excess water drains off at the dredging site reducing the water content of the dredged material to approximately 10 percent. Mechanical dredges are often used in tightly confined areas, such as harbors, around docks and piers, and in relatively protected channels. This type of dredge is not suitable for rough seas or areas of high vessel traffic. By using numerous scows with one dredge, mechanical dredging can proceed continuously. As one scow is being filled, another can be towed to the placement site.

In hydraulic dredging, material is loosened from its in situ state and lifted in suspension through a pipe system connected to a centrifugal pump. Hydraulic dredging is most efficient when working with fine materials and sands since they are easily held in suspension. Coarser materials, including gravel, may be hydraulically dredged; however, these materials require a greater demand of pump power and can cause excessive wear on pumps and pipes. The two main types of hydraulic dredges are pipeline and hopper dredges.

A cutter suction dredge is a hydraulic dredge that uses a device consisting of rotating blades or teeth, called a cutterhead, to break up or loosen bottom material. A large centrifugal pump removes the material from the bottom of the channel and pumps the sediment-water slurry through a discharge pipeline. Material dredged by a cutter suction dredge is directly placed into the placement area by the discharge pipeline. Since the slurry mixture (10-20% solids to water) has a higher density than the ambient water, it descends to the bottom of the placement area in a manner dependent on the sediment characteristics. Cutter suction dredges operate continuously, and are cost effective if the placement site is in relative close proximity to the dredge area. However, because the pipeline is usually floated on the water surface, pipeline dredges are not suited for work in high traffic areas where they would pose an obstruction to navigation. They are also not recommended for areas with heavy debris that can clog pumps and impair efficiency. To avoid these problems, pipelines can be weighted to the seafloor, however this is commonly problematic.

A hopper dredge is a type of hydraulic dredging employing a vessel having the shape of a conventional ship hull and that is equipped with either single or twin trailing suction pipes. A hopper dredge operates much like a floating vacuum cleaner in that material is lifted through the trailing suction pipes by one or more pumps and then the mixture of water and solids is stored in a hopper contained within the hull of the dredger. A hopper dredge operates best by skimming layers of material in long, narrow runs and is primarily used in open water, such as rivers, canals, and open sea. This type of dredge is unable to get into corners (i.e., Inner Apra Harbor), difficult to maneuver in confined spaces, unsuitable for use in shallow water, and is not effective on hard materials such as stiff clays (Inner Apra Harbor). A hopper dredge can move quickly to a placement area under its own power, but the operation loses efficiency as the transport distance increases.

Once the hopper is full, material may be discharged onto an open-water placement site by opening the hopper doors located in the bottom of the ship's hull or fluidized by jets and hydraulically pumped from the hopper. For bottom dumping, the entire contents of the hopper can be emptied in a matter of minutes. Upon discharge from the hopper dredge, the dredged material falls through the water column as a well-defined jet of high-density fluid. As with the pipeline dredge, the descent and deposition of the slurry mixture is dependent on the material's physical characteristics. Hydraulic pump out can take up to 30–60 minutes and discharge slurry is similar in density to cutterhead slurry.

In addition, hopper dredging is typically used as an alternative to hydraulic cutterhead dredging when bottom dumping or when a large distance between the dredge site and upland placement area precludes the use of a cutterhead dredge.

The dredging method historically used in Guam is mechanical dredging with a barge-mounted crane attached to clamshell buckets to retrieve the sediment and deposit it on a scow (barge). It is likely that this method would be used for the proposed dredging; however, the decision would not be made until the final design. The project would likely be a design/build contract that would not be awarded until the Record of Decision on this EIS/OEIS is complete. Mechanical dredging is assessed as the environmentally conservative method of dredging in the EIS/OEIS. Should the contractor choose to use an alternative method, informal consultation with agencies and approval by U.S. Army Corps of Engineers (USACE) would be required.

A Rivers and Harbors Act, Section 10 (33 USC 403), Clean Water Act, Section 404 (33 USC 1344), and Marine Protection Research and Sanctuaries Act (MPRSA) Section 103 USC 1413 permit application would be submitted to the USACE for approval and would be reviewed by other regulatory agencies.

USACE Section10/404/103 permit is the abbreviated reference for the three permits that are reviewed under one application.

### 1.2 DREDGING BEST MANAGEMENT PRACTICES

All dredges resuspend sediment; however, resuspension is primarily near field and can be controlled (at least partially). Depending on the specific performance standards for the project, BMPs that may be implemented to control the movement of resuspended sediment and minimize the impacts of dredging in Apra Harbor include operational and engineered controls. Operational controls include actions that can be undertaken by the dredge operator to reduce the impacts of the dredging operations. Engineered controls require a physical construction technology or modification of the physical dredge plant to cause the desired change in conditions. Examples of engineered controls for turbidity might include installation of dredgehead shrouds, silt curtains, sheet-pile enclosures, and pneumatic (bubble) curtains, etc. Usually, an attempt will be made to implement an operational fix prior to using the engineered method because of the higher costs of engineered controls (USACE 2005).

Application of operational and engineered controls is potentially expensive and can significantly reduce overall production rates and efficiency. Further, the improper use of controls can have direct negative impacts on a project and the environment (e.g., through increased sediment resuspension or increasing the time needed to complete the project). The degree of controls needed is a site-specific or area-specific decision. Therefore, controls should be applied only when conditions clearly indicate their need and should not be set as a requirement solely because they can be applied (USACE 2005). Operational controls for resuspension of sediment may include changes in dredging methods and/or in operation of the equipment. Examples of operational controls that have been tested on a limited basis include:

- Reducing the dredging rate to slow down the dredging operation (this is especially important with respect to bucket speed approaching the sediment surface and bucket removal from the surface after closing).
- Reducing bucket over-penetration, which can cause sediment to be expelled from the vents in the bucket or cause sediment to become piled on top of the bucket, then eroded during bucket retrieval.
- Eliminating overflow from barges during dredging or transport.
- Changing the method of operating the dredge, based on changing site conditions such as tides, waves, currents, and wind.
- Modifying the depth of the cutterhead for hydraulic dredging, rate of swing of the ladder and of the rotating cutterhead, and reducing the speed of advance of the dredge.
- Modifying the descent or hoist speed of a wire-supported bucket, employing aprons to catch spillage, and using a rinse tank to clean the bucket each cycle.
- Sequencing the dredging by moving upstream to downstream.
- Varying the number of dredging passes (vertical cuts) to increase sediment capture.
- Using properly sized tugs and support equipment.

Unfortunately, few data are available to support the effectiveness of most of the above operational modifications in reducing resuspension (USACE 2005). Experienced dredge operators are often challenged to find an optimal rate and method of operation for a given set of conditions. For hydraulic dredging, resuspension is generally minimized at the same point that production is optimized. If the rate of operation is slowed or accelerated, the resuspension and release may be increased (USACE 2008). In addition to controls placed on operation of the basic dredging equipment, other operational control measures may be considered for mechanical dredging. These include use of submerged trays or plates to catch or contain spillage from buckets as they are raised and slewed to the barge, and use of wash tanks to remove adhering sediments from a bucket prior to start of the next cycle (Lane et al. 2005 in USACE 2008). Such measures would slow the overall dredging process, and the advantages with respect to reduction of resuspension should be considered in light of the disadvantages with respect to production. The use of an enclosed bucket (e.g. environmental bucket) may also be beneficial in minimizing sediment loss from the ascending bucket if the substrate is soft enough for its effective use.

Engineered resuspension controls for environmental dredging can be defined as designed controls or containments deployed around or in conjunction with the dredge plant (USACE 2008). Transport of resuspended contaminated sediment released during dredging can be reduced by using physical barriers around the dredging operation. Under favorable site conditions, these barriers help limit the areal extent of particle-bound contaminant migration resulting from dredging resuspension and enhance the long-term benefits gained by the removal process. Conversely, because the barriers contain resuspended sediment, they may increase, at least temporarily, residual contaminant concentrations inside the barrier compared to what it would have been without the barriers (USACE 2008). Physical barriers may be appropriate when site conditions warrant minimal transport of suspended sediment and can be used individually, in a series (i.e., multiple silt curtain barriers) or in conjunction with each other (i.e. silt curtain and bubble curtain).

Types of physical barriers may include:

- Cofferdams.
- Removable dams (e.g., Geotubes).
- Sheet-pile enclosures.
- Silt curtains.
- Silt screens.
- Pneumatic (Bubble) curtains.

Cofferdams and removable dams are generally associated with “dry excavation” remedies as compared to the other types of containments for resuspended sediments around a dredging operation (USACE 2008).

#### 1.2.1 Silt Curtains

The most recognized engineered control for managing resuspended sediment at dredging projects is the “silt curtain.” Although the terms “silt curtain,” “turbidity curtain,” and “silt screen” may frequently be used interchangeably, there are fundamental differences. Curtains are made of impervious materials, such as coated nylon, and primarily redirect all water flow around the enclosed area. In contrast, screens are made from synthetic geotextile fabrics, which allow water to flow through, but retain a large fraction of the suspended solids inside the screened area (USACE 2008). Silt curtains and screens are designed to contain or deflect suspended sediments or turbidity in the water column. 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. Suspended solids can also conceivably be diverted from areas where environmental damages could occur from the settlement of these suspended particles. 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. Silt curtains and silt screens are flexible barriers that hang down from the water surface. Both systems use a series of floats on the surface and a ballast chain or anchors along the bottom. Silt curtains are vertical, flexible structures that extend downward from the water surface to a specified water depth. (Figure 1-1).

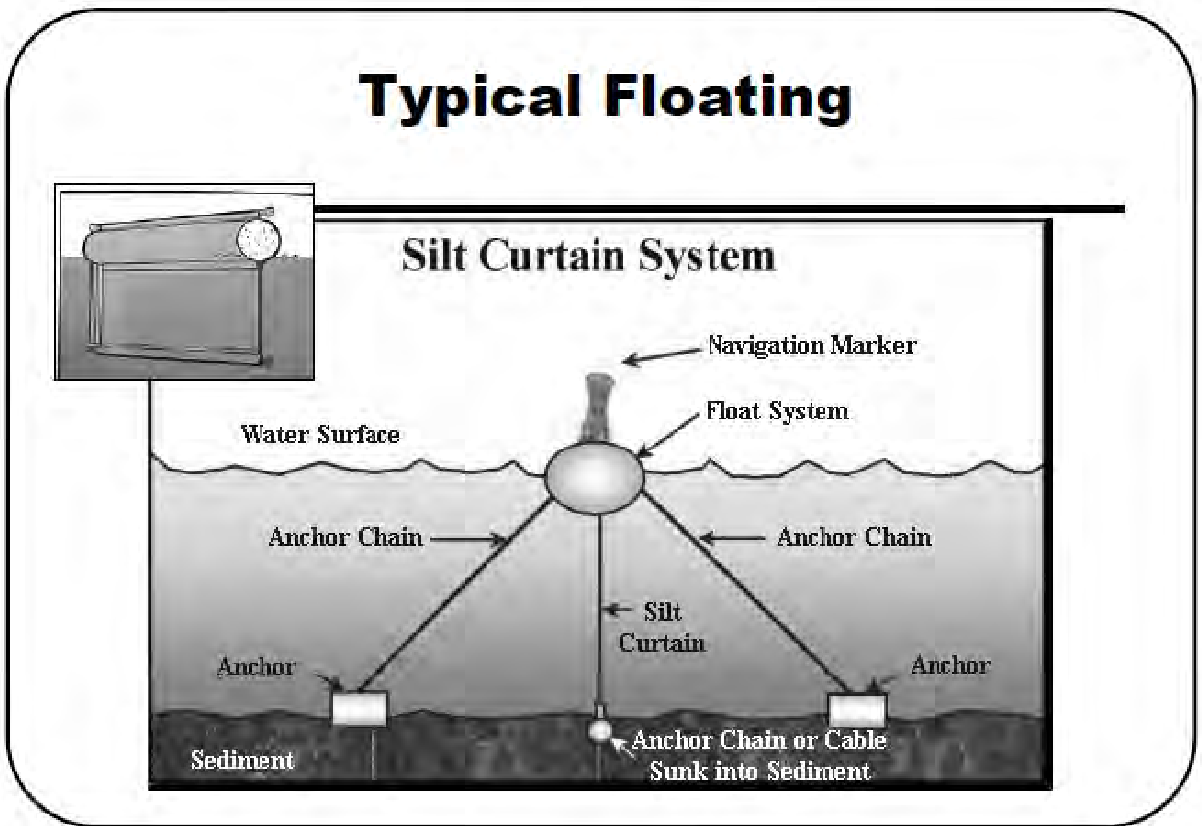


**Figure D-1. Typical Hanging Silt Curtain System**

A tension cable is often built into the curtain immediately above or just below the flotation segments (top tension) to absorb stresses imposed by currents and hydrodynamic turbulence. The curtains are usually manufactured in standard sections (e.g., up to 50 ft) that can be joined together at a particular site to provide a curtain of specified length. Curtains are generally deployed to extend to 1-2 ft above the bottom to allow mudflow to pass beneath them. Anchored lines hold the curtain in a deployed configuration that can be U- or V-shaped, or circular or elliptical, depending upon the application (USACE 2005).

An engineered control such as a silt curtain does not treat turbidity resulting from sediment resuspension; depending on the deployment configuration of the curtain, it merely contains or directs the movement of resuspended sediment. Partial depth deployments, normally extending from the surface to a set depth, will act to contain the resuspended sediment and reduce spreading in the upper water column; however, the resuspended material is free to move beneath the partial curtain. A full depth deployment will act to further contain and prevent spreading, and further limit resuspended sediment movement. However, there are potential releases from full-depth deployments due to ineffective seals along the bottom, tidal fluctuations, or movement of vessels through gaps in the curtains, etc. Even with an effective containment, the result may be an increase in concentrations of both suspended solids and dissolved contaminants within the curtain containment area that have the potential for being released when the curtain is relocated or removed during demobilization (Francingues and Thompson 2006 in USACE 2008). Whereas properly deployed and maintained silt curtains can effectively control the distribution of turbid water, they are not designed to contain or control fluid mud. In fact, when the accumulation of fluid mud reaches the depth of the ballast chain along the lower edge of the skirt, the curtain must be moved away from the discharge; otherwise sediment accumulation on the lower edge of the skirt can pull the curtain underwater and eventually bury it. Consequently, the rate of fluid mud accumulation relative to changes in water depth due to tides must be considered during a silt curtain operation.

The effectiveness of a silt curtain installation is primarily determined by the hydrodynamic conditions at the site. Conditions that will reduce the effectiveness of the silt curtain include:

- Strong currents (For all practical purposes, silt curtains are not very effective at current velocities > 1 ½ knots [2.5 ft/sec]).
- Excessive depths (At depths greater than 10-15 ft, loads or pressures on curtains and mooring systems become excessive and could result in failure of standard construction materials).
- High winds.
- Changing water levels.
- Excessive wave height (including ship wakes).
- Drifting ice and debris.
- Movement of equipment into and out of the curtained area.

As a generalization, silt curtains are most effective in relatively shallow, quiescent water, without significant tidal fluctuations. As water depth increases and turbulence caused by currents and waves increases, it becomes increasingly difficult to isolate the dredging operation from the ambient water effectively. The effectiveness of silt curtains is also influenced by the quantity and type of suspended solids, the mooring method, and the characteristics of the barrier (JBF Scientific Corp. 1978 in USACE 2008). Ideally, the silt curtain should remain in place until the dredging is completed; allow for traffic in and out; and allow relocation as the dredge moves to a new site. Care must also be taken so that the curtains do not impede navigation traffic. As a result, the use of silt curtains to minimize the impacts of dredging in Apra Harbor may be more effective if used to protect specific areas (e.g., valuable habitat, water intakes, or recreational areas) from suspended sediment contamination (USEPA 1994 in USACE 2008). Protecting sensitive areas with curtains as opposed to enclosing the dredging area may provide the required protection with less impact to the dredging operation.

### 1.2.2 Pneumatic (Bubble) Curtains

The pneumatic barrier is a containment method designed to reduce sedimentation by reducing the ability of suspended sediments to settle in the protected area. A specially engineered pattern of pipes is installed on the aquatic bed and air is forced through the pipes to create "bubble curtains." The current is produced by air flowing through a perforated manifold laid on the bed of the water body. The air is supplied from a compressor that is located onshore.

The pneumatic barrier is composed of two parts, a compressor and a perforated pipe. The compressor must be sized to create sufficient air flow to overcome hydrostatic pressure, frictional losses, and expel water from the pipe (Applicability of an Air Barrier, 1992). The pipe may be constructed from steel, aluminum, rubber, PVC, or polyethylene. Each of these materials have properties making them suitable to be used as the manifold. However, polyethylene or rubber can withstand the water pressure, are flexible, and resist corrosion in the sea. For these reasons they are more highly recommended. Water currents and frequent barge traffic over the pipe make it necessary to anchor the pneumatic barrier to the bottom. Anchoring methods may be simple or complex depending on the anticipated currents and overhead traffic. In many instances, cinder blocks or other weights are suitable for anchoring the manifold. These weights should be easy to remove if dredging operations make it necessary to remove the manifold from the water. The pneumatic barrier uses a physical flow mechanism to produce the desired surface current and has been effectively demonstrated to prevent sedimentation in Kill Van Kull and Bayonne, NJ . The effectiveness of the barrier occurs when the air bubbles are released from the manifold under pressure. The bubbles rise and expand as the hydraulic pressure decreases. The rising air column causes an upward water flow. As the vertical flowing water reaches the surface it is diverted into the horizontal direction causing a surface current extending in both directions away from the vertical stream of bubbles. This generated surface current effectively redirects the movement of suspended sediment away from sensitive resources (Figure 1-2).

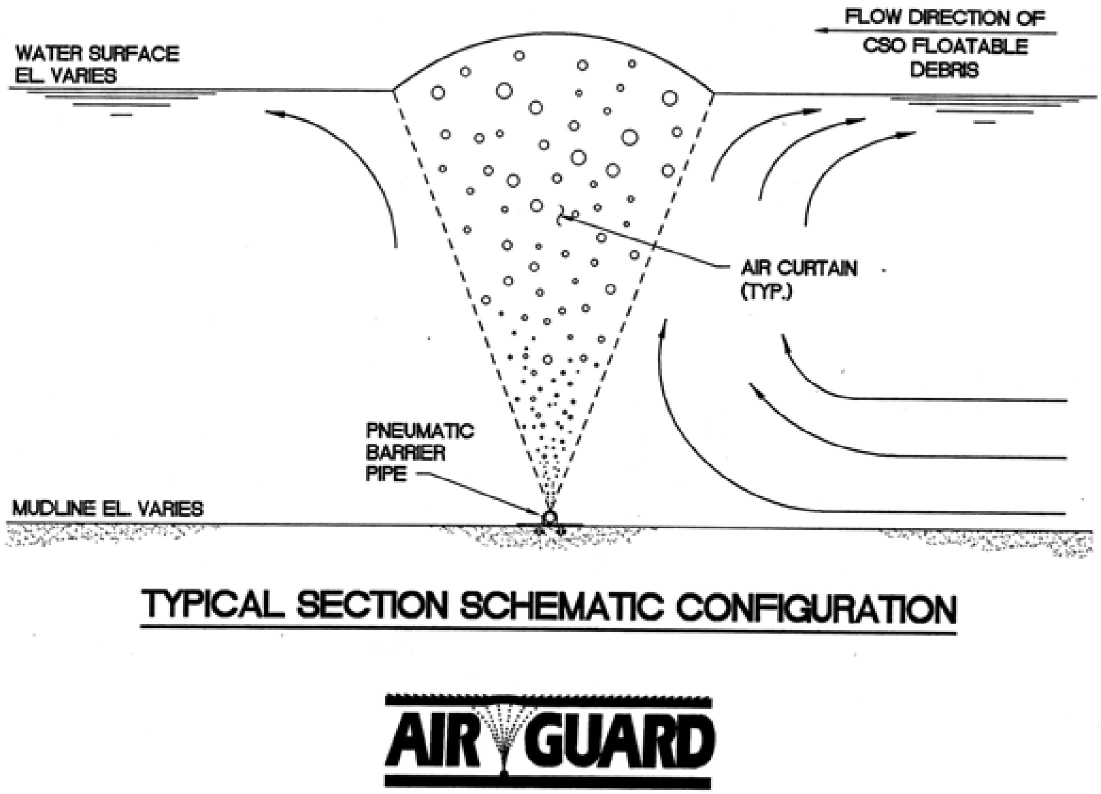


**Figure D-2. Typical Bubble Screen Schematic Configuration**

The proper air flow required to form an effective barrier is related to the following three factors: 1) The maximum surface current required to overcome wind forces and natural tidal currents. 2) The amount of air to overcome loss through the pipes orifices. 3) The amount of air to overcome frictional loss.

The benefits of the pneumatic barrier include; ease of operation and environmental benefits. The ease of operation is due to the relatively labor free deployment and the environmental benefits are the result of increased dissolved oxygen that can help restore life to the lower depths of heavily polluted waterbodies. However, the pneumatic barrier is limited by tidal currents. Pneumatic curtains become less effective in tidal currents exceeding 1.5 fps (feet per second). Additionally, added costs are incurred with compressor maintenance and operation as are air emissions.

Site-specific Best Management Practices (BMPs) would be developed in coordination with federal agencies and incorporated in the EIS/OEIS as they become available and included in the USACE permit application. The USACE issued a Public Notice "Reissuance of Nationwide Permits and Final Regional Conditions for Honolulu District" (Public Notice Number: POH-206-351, August 31, 2007). The public notice is applicable to Hawaii, Guam and Samoa projects. Regional conditions are not site–specific and provide additional protection for the aquatic environment and will be conditions of the USACE permit. The relevant ones are as follows:

### 1.2.3 Regional Condition 12, Endangered Species

A survey of the project area shall be performed just prior to commencement or resumption of construction activity to ensure that no protected species are in the project area. If protected species are detected, construction activities shall be postponed until the animal(s) voluntarily leave the area.

If any listed species enters the area during conduct of construction activities, all activities shall cease until the animal(s) voluntarily depart the area.

All on-site project personnel shall be apprised of the status of any listed species potentially present in the project area and the protections afforded to those species under Federal laws.

Any incidental take of marine mammals shall be reported immediately to NOAA Fisheries' 24-hour hotline at 1-888-256-9840. Information reported must include the name and phone number of a point of contact, location of the incident, and nature of the take and/or injury.

Note: Conditions 12.1-12.4 pertain to projects within waters that may support listed marine mammals and/or sea turtles. Additional requirements may be designated by the Corps as appropriate for specific projects.

Pursuant to the Endangered Species Act, any take of federally protected species (other than marine mammals) must be reported to the U.S. Fish and Wildlife Office of Law Enforcement in Honolulu at 1-808-861-8525.

### 1.2.4 Regional Condition 13, BMPs

Turbidity and siltation will be minimized through the use of effective silt containment devices. The silt control devices will be installed properly and maintained for the duration of the in-water work.

Work will be postponed during adverse tidal or weather conditions.

Dredging and filling will be scheduled to avoid coral spawning and recruitment periods.

Project design will minimize unavoidable loss of special aquatic sites and compensatory mitigation will be provided for unavoidable losses.

Project related equipment that is in contact with the water will be cleaned prior to use.

No contamination (trash) of nearby properties is permitted.

Fueling will take place away from the shoreline and a spill contingency plan will be prepared. Absorbent pads and containment booms would be kept onsite for emergencies.

Underlayer fills and soil exposed during construction will be protected from erosion by use of appropriate materials (e.g., pre-cast concrete armor, plastic sheeting).

The scows would be tied to the dredging barge and not require anchors or chains on the ocean floor.

Chiseling may be required to roughen the substrate prior to dredging to facilitate the ability of the clamshell to grab hold of the material. No blasting would be required.

In Apra Harbor, silt curtains have historically been a condition of dredging permits. Typically, the silt curtain contains the sediment within the project area and the curtain moves with the dredging operation. Another proposal has been the use of silt curtains to protect the specific notable resource areas (e.g., Jade Shoals and Western Shoals) in the vicinity. The silt curtains would remain in place throughout the project.

The ROD may not include a decision on dredging methodology, because the final design may not be available in time for the Final EIS. Environmental worst case is generally believed to be mechanical dredging. It has the greater combined potential for environmental impacts from direct and indirect impacts to coral reefs due to sediment redistribution. Pipeline dredges have direct adverse impact potential due to removal of coral by the cutterhead assembly and due to occasional misplacement of the pipeline carrying dredged sediments to the approved disposal area but much less turbidity and indirect impacts occur from this method of dredging. Representing a worst case scenario, mechanical dredging is used in the impact analysis.

### 1.3 DREDGE MATERIAL DISPOSAL OPTIONS

Three dredged material management options would likely be available on Guam in 2010. The existing options are beneficial reuse and upland placement site. The U.S. Environmental Protection Agency (USEPA) is pursuing the designation of an ocean dredged material disposal site (ODMDS) approximately 11 to 14 nm (20.4 to 26 km) from the west coast of Apra Harbor. The designation is anticipated in 2010 and the ODMDS EIS is being prepared concurrent with this EIS/OEIS. An ODMDS would provide Guam a third option for dredged material management.

Ocean disposal is regulated under Title 1 of the MPRSA (33 USC 1401 et seq). Formal designation of an ODMDS in the Federal Register does not constitute approval of dredged material for ocean disposal. Designation of an ODMDS provides one additional dredged material management option for consideration in the review of each proposed dredging project. Ocean disposal is only allowed when USEPA and USACE determine, on a case-by-case basis, that the dredged material: 1) is environmentally suitable according to testing criteria (40 CFR Parts 225 and 227), as determined from physical, chemical, and bioassay/ bioaccumulation testing that is briefly described in Section 2.7 (USEPA and USACE 1991), 2) does not have a viable beneficial reuse, and 3) there are no practical land placement options available.

Preliminary sediment characterization data for the Sierra Wharf and aircraft carrier alternative wharf sites suggest most, if not all, of the material would meet the testing criteria and be suitable for dewatering on land, or ODMDS disposal (NAVFAC Pacific 2006). No Navy dredging project on Guam has required designation of an upland site for the treatment or remediation of sediment. None is anticipated for this project. The DEIS relies on the existing sediment characterization results to assess impacts. Results from additional analysis per 40 CFR Part 227 would be used to develop a dredge material management plan that would be included in the USACE Section 404/10/103 permit application. It is possible that multiple disposal methods would be appropriate for the project.

The EIS/OEIS impact analysis considers four scenarios for the placement of dredged material: 100% disposal in a proposed ocean dredged material disposal site (ODMDS), 100% disposal upland, 100% beneficial reuse, and 15-20% beneficial reuse/75-80% ocean disposal.

### 1.3.1 Beneficial Reuse

Beneficial reuse is the preferred disposal option for clean dredged material when practical. The material must meet engineering specifications for the specific beneficial reuse. A number of opportunities for beneficial use have been identified, including backfill for a commercial port expansion, construction material for roads, or daily landfill cover. Prior to beneficial use, the dredged material must be tested to ensure it meets the engineering specifications for the proposed reuse. If a beneficial reuse is not identified for this dry material it would occupy valuable space that could otherwise be available for more dredged material. Beneficial reuse may require additional NEPA review.

NAVFAC Pacific prepared a Phase 1 Dredged Material Management Plan in 2005 that presented findings on an evaluation of potential beneficial use projects for dredged material in anticipation of Apra Harbor dredging projects (NAVFAC Pacific 2005). The findings were revisited and an updated report was prepared in 2008 (NAVFAC Pacific 2008). Factors used to evaluate beneficial use included identifying local opportunities, the distance from the dredge site, capacity of beneficial use relative to material available, and site accessibility. Beneficial use must meet other measures of practicability such as timeliness, geotechnical and chemical requirement of the reuse and cost. The viable dredge material beneficial reuse options on Guam include:

- Construction material – specifically munitions storage construction and fill.
- Landfill cover
- Fill for the planned PAG commercial port expansion

The Military Relocation construction contractor would have existing stockpiled dried dredged material available for use and would have newly dredged material available for consideration. Other reuse options would be evaluated as the final designs for the projects are developed. No specific beneficial reuse projects are addressed in this EIS/OEIS, but it remains an important option. Supplemental NEPA documentation and permitting may be required, especially for in-water projects like shoreline restoration. The Navy encourages GovGuam to develop a dredged material management plan for Guam that identifies specific projects, timing and the physical requirements for each reuse.

The Navy and GovGuam entered into a Memorandum of Understanding (MOU) (April 2001) whereby dredged material generated by the Navy would be made available to GovGuam. The MOU was specifically prepared for the reuse of Inner Apra Harbor maintenance dredge material at the Commercial Port. Although the maintenance dredging is completed, the MOU continues to be valid. GovGuam would be responsible for 1) laboratory analyses that verify the physical suitability of the material, and 2) NEPA documents and permits required for the reuse, just as the Navy would be required to meet the documentation for the reuse of dredged material on DoD land. To date, it has not been practical to transfer material to PAG because they have not been prepared to receive and store the material because the Commercial Port improvement projects have not been programmed for funding. Ideally, the material would be transported by barge directly to PAG during the dredging operation. The reasons for not reusing the material include:

- The physical characteristics of the dredged material may not meet the standards for the specific beneficial use alternative.

- The timing of the beneficial use project may not coincide with the availability of appropriate dredged material.

### 1.3.2 ODMDS

Currently, there is no ODMDS for Guam but there may be one designated in 2010 and available for use during construction of the proposed action. The ODMDS would be located greater than 9 nm from the west coast of Apra Harbor (Figure D-1) (USEPA 2009). Surface currents at this site tend to be highly variable during most of the year, with periods of strong and consistent southward flowing pulses during the wet weather season. Consistent with the pattern observed at the regional scale, intermediate layer currents (1,300 ft. [400 m] to 6,550 ft. [2,000 m]) at the this site tend towards the northeast with decreasing variability with increasing depth. Current speeds are about 0.10-0.16 ft/s (3–5 cm/s) in the intermediate layer. On a regional scale, the bottom currents were highly variable; however, in the area of the potential ODMDS, the bottom currents below 8,200 ft. (2,500 m) are more consistent, trending in a north-northwesterly direction at a speed of approximately 0.07 ft/s (Weston 2007).

The dredged material would be loaded directly onto scows during dredging and proceed directly to the ODMDS for disposal. The established shipping lanes would be used and the vessels would be subject to standard rules of Navigation and a Notice to Mariners would be issued. For maximum efficiency, two 4,000 CY (3,058 $m^3$) barges are assumed to used to allow one barge to be loaded while another is transiting to or from the ODMDS.

There will always be the need for upland placement of some dredged material, but the ODMDS would result in less land area being used for dredged material dewatering and stockpiling.

USACE may issue ocean disposal permits for dredged material if USEPA concurs with the decision (MPRSA Section 103). If USEPA does not agree with a USACE permit decision, a waiver process under Section 103 allows further action to be taken. The permitting regulations promulgated by the USACE, under the MPRSA, appear at 33 CFR Parts 320 to 330 and 335 to 338. Roles and responsibilities associated with the ODMDS are as follows:

- USEPA (and USACE for federal projects in consultation with EPA) would conduct surveillance, monitoring, and site management at the ODMDS
- USACE issues the permits for specific dredging activities with USEPA concurrence
- USCG is responsible for vessel traffic-related tracking and monitoring
- Permittee is responsible for implementing and financing all permit conditions

All dredging permits require compliance with a Dredge Operation Plan that addresses all phases of a specific dredging project, including reporting and monitoring requirements, environmental protection measures, safety precautions, and requirements for dredged material screening (e.g., unexploded ordnance, size), if necessary. During dredging activities, agencies would have remote access to a real-time GPS automated vessel location system. The system allows agencies to monitor the location and weight of the vessel transporting the dredged material. If the vessel loses weight (i.e., dredged material) prior to reaching the ODMDS, it is readily apparent in the graphical representation viewed on a computer screen.

Alarms can be set through the remote system to notify supervising agencies when thresholds are not met for weight or travel route. Agencies can respond quickly to halt the disposal and investigate the situation. The remote tracking software is available under various names (e.g., eTracs™) by different vendors has been successfully used to monitor dredging operations at various USEPA designated ODMDS.

A Site Management and Monitoring Plan (SMMP) was prepared for the Guam ODMDS (USEPA 2009). The SMMP outlines requirements for monitoring specific disposal operations and long-term site conditions. Should the monitoring reveal unanticipated adverse environmental impacts, management actions would include modification of the site use/disposal procedures, additional site monitoring or site closure. The SMMP is updated every 10 years and public notice is required for each SMMP update.

The vessel carrying the dredged material from Apra Harbor would travel along existing shipping lanes and be subject to USCG rules and regulations. USCG primary roles consist of promoting maritime safety, supporting national defense, providing maritime security, protecting natural resources, and facilitating maritime transport and commerce. It enforces federal laws on the high seas and waters within U.S. territorial jurisdiction. The USCG is part of the Department of Homeland Security, but from 1967 to 2003 it was under the jurisdiction of the Department of Transportation.

Navigation rules are codified in International Navigational Rules Act of 1977 (Public Law 95-75, 91 Stat. 308, or 33 U.S.C. 1601-1608), and, the Inland Navigation Rules Act of 1980 (Public Law 96-591, 94 Stat. 3415, 33 U.S.C. 2001-2038).

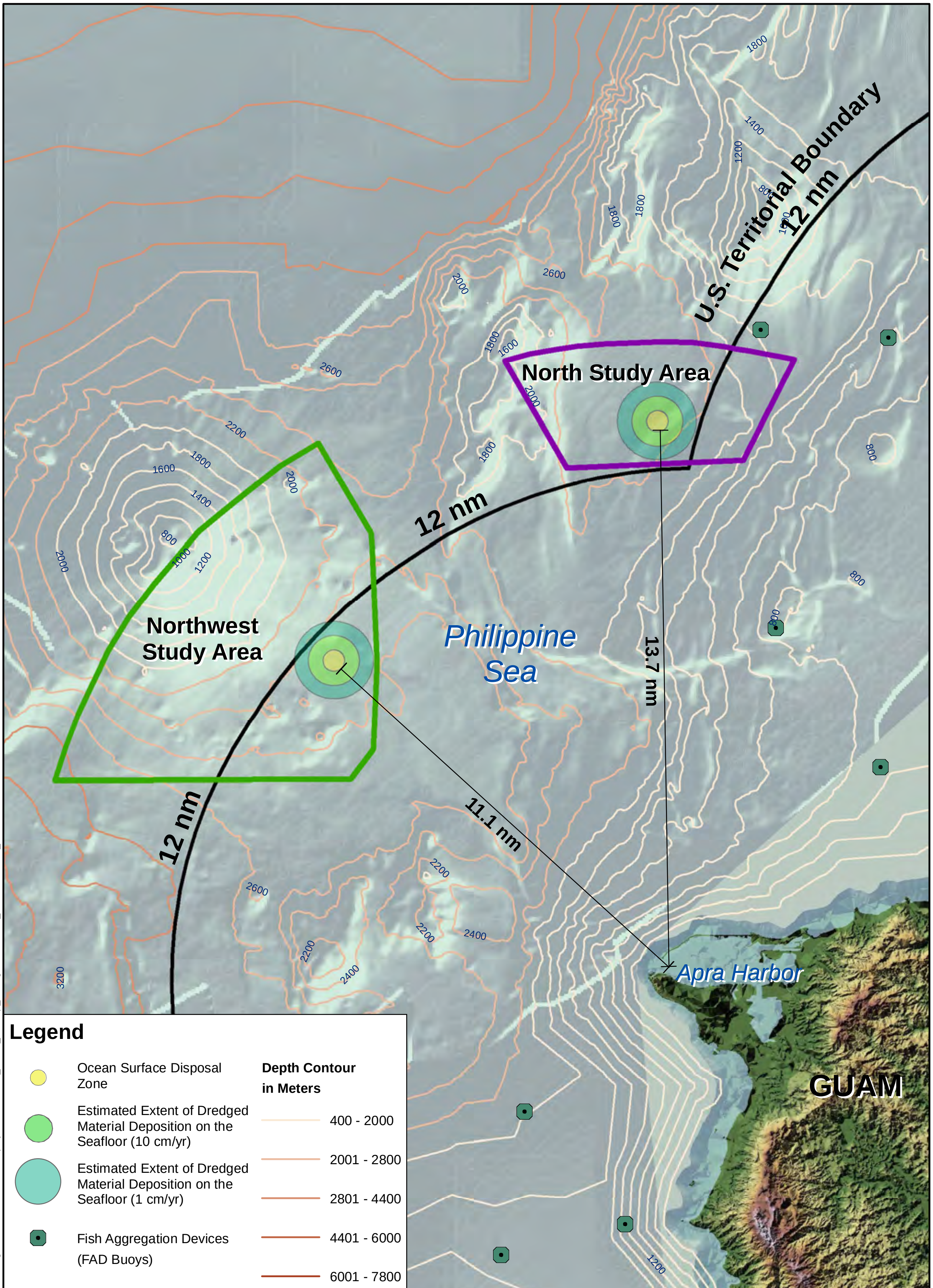


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**Figure D-3**
**ODMDS Alternatives**

Nautical Miles
2 0 2
3 0 3
Kilometers

N W E S

### 1.3.3 Candidate New Upland Placement Sites

A "Dredged Material Upland Placement Study, Apra Harbor Guam", was prepared for NAVFAC Pacific in May 2008 to assess the availability of upland placement sites as a preferred alternative to the ODMDS option since ocean disposal is only to be used if upland re-use or disposal is not available. Upland placement sites, often referred to as upland placement facilities, are bounded by confinement dikes or structures to enclose the disposal area, thereby isolating the dredged material from its surrounding environment. A upland placement facility consists of a fully diked facility located above the water line and out of wetland areas. They may be used for either coarse or fine-grained material. The material is placed into the facility either hydraulically or mechanically. Placing the material directly into the facility from the dredging site through pipelines is the most economical method. The dredged material consists of a certain percentage of slurry when it is pumped into the facility. Depending on the placement method, slurry material initially deposited in the upland placement facility may occupy from 1.1 times (mechanical placement) to 5 to 10 times (hydraulic placement) its original volume due to water content. Following placement, the finer sediments are allowed to consolidate, settle, and dewater. Slurry water evaporates or percolates into the ground. Facilities that use weirs to discharge effluent from the facility must be designed with sufficient retention times to ensure adequate suspended sediment settling would occur prior to discharge into the receiving water body in order to meet applicable water quality standards.

The Navy has dry (or drying) dredged material stockpiled in multiple upland sites on Orote Peninsula. These sites are nearly at capacity. If beneficial uses are identified, then areas within the existing disposal sites could potentially be reused for the placement of new dredged material. Alternatively, the Navy could create new upland disposal sites and has conducted a site selection study that identified suitable sites.

Although dredged materials are exempt from being characterized as hazardous waste under the Resource Conservation and Recovery Act (RCRA), Subtitle C, they could potentially have a harmful effect on human health or the environment if they were found to have contaminants at harmful levels. Dredged materials that exceed specified laboratory testing criteria must be managed in upland areas with engineering controls to prevent leaching of contaminants into adjacent surface or groundwater bodies. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) may be required prior to discharge. The design, construction, and monitoring of the site is subject to USACE approval. Based on historical sediment characterization, the dredge sediments to be removed from the project areas addressed in Volumes 2 and 4 are not expected to require special handling.

For upland placement, the dredged material is unloaded into a shoreside containment area or directly into sealed-end dump trucks at a designated wharf (e.g., Uniform Wharf has been used in the past). No free water is anticipated to drain back into Apra Harbor. The retention area would be constructed in accordance with Navy specifications for Temporary Environmental Control that requires a filter fabric liner. The trucks haul the dredged material to a pre-designated upland placement site for potential subsequent beneficial use.

The upland placement sites are enclosed by earthen berms approximately 13 ft (4 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. No effluent is anticipated. Non hazardous dredged material water is allowed to evaporate or percolate through the ground. Utilities in the site would be realigned outside of the enclosure. No closure plan or environmental monitoring is proposed. The exterior slopes would be seeded to discourage erosion and minimize visual impact. The drying material is unlikely to generate dust, but once dry there would be dust associated with relocating the dry materials. Unlike hydraulic dredging, no ponding water from the placement of the mechanically removed material is anticipated that might attract migrating birds. In the event a site becomes an attractive nuisance for migrating birds, they could be discouraged by decoys and noise makers. Once the dredged material is removed, the CDF site could be re-leveled for alternative use or re-used for future dredged material placement.

There are existing upland placement facilities on-base and potential new sites have been identified, as shown on Figure D-2 and described in Table D-1.

**Table D-1. Potential Upland Placement Site Characteristics**

| | *Field 3* | *Field 4* | *Field 5* | *PWC Compound* | *Polaris Point* |
|---|---|---|---|---|---|
| Site Area (acres) | 16.0 | 26.6 | 53.2 | 27.8 | 44.3 |
| Dike Center Line Perimeter (ft) | 2,965 | 5,600 | 7,000 | 5,000 | 5,900 |
| Dike Width (ft) | 8 | 8 | 12 | 12 | 12 |
| Dike Elevation (ft) | 18.5 | 16.00 | 26.00 | 19.00 | 31.00 |
| Dredged Material Lift Height (ft) | 16.50 | 14.00 | 24.00 | 17.00 | 29.00 |
| Dike Volume (CY) | 129,005 | 185,837 | 606,667 | 242,778 | 711,278 |
| Internal Volume (CY) | 296,915 | 414,968 | 1,453,237 | 519,684 | 1,361,372 |
| Total Capacity (CY) | 425,920 | 600,805 | 2,059,904 | 762,461 | 2,072,649 |
| | | | | | |
| Sierra Wharf Dredge Volume (CY)[1] | 508,877 | | | | |
| Aircraft Carrier Dredge Volume (CY)[2] | 479,000 (Former SRF) – 608,000 (Polaris Point) | | | | |
| Capacity for 100% of which project | Sierra | Sierra or aircraft carrier | Sierra & aircraft carrier | Sierra or aircraft carrier | Sierra and aircraft carrier |
| NEPA documentation exists for upland placement site? | Yes-Alpha/Bravo Improvements | No | Yes-Alpha/Bravo Improvements | No | Yes-Inner Apra Harbor maintenance dredge project |

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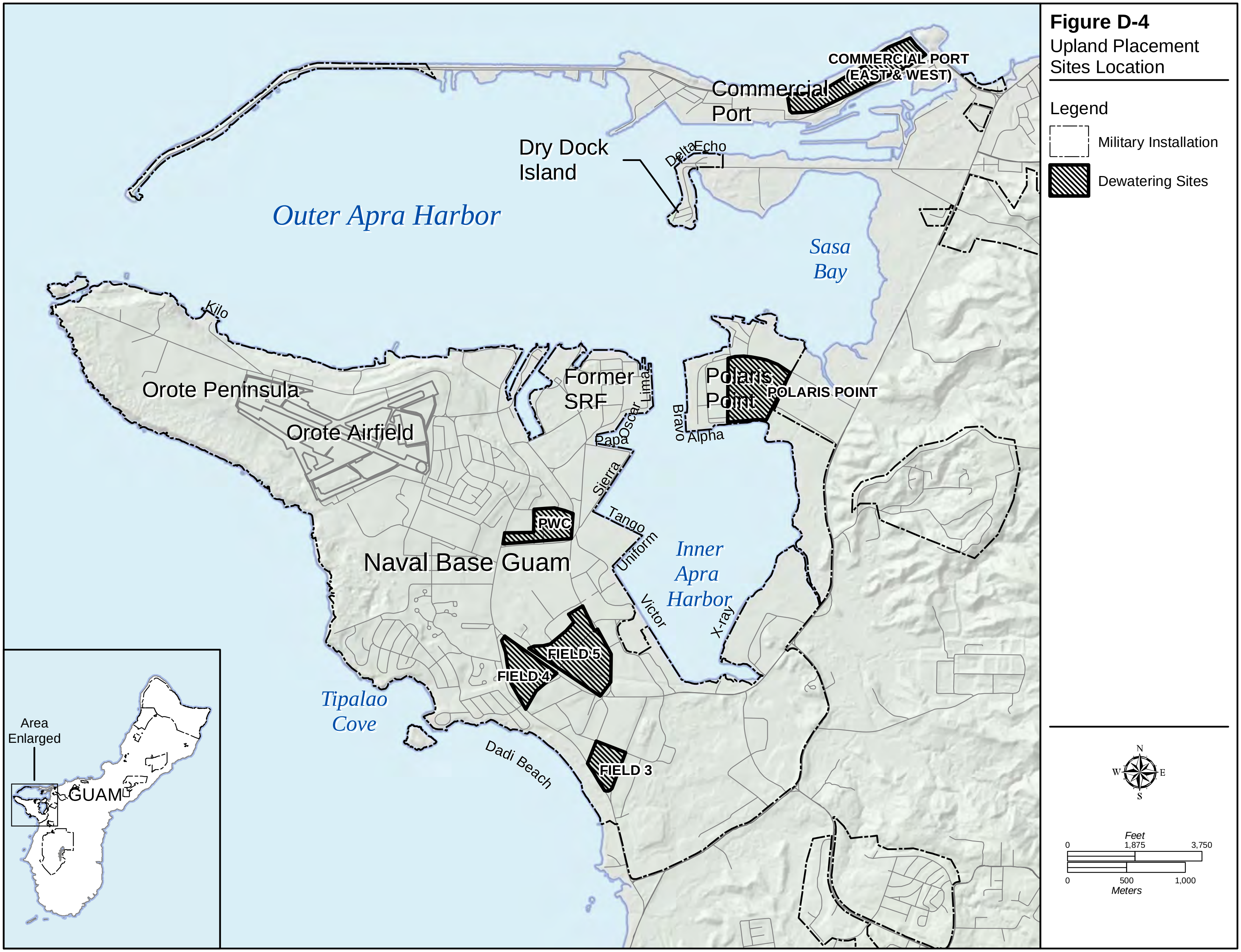
**Figure D-4**
Upland Placement Sites Location



The Commercial Port Sites are not being considered in this EIS/OEIS, because they are on non-DoD land. Port Authority Guam or other GovGuam entity would be responsible for preparing the NEPA documentation and acquiring permits for the establishment of a upland placement site.

The potential environmental impacts of using Field 3 and Field 5 are addressed in the P-431, Alpha-Bravo Wharves Improvements EA. The Polaris Point site was considered for the Inner Apra Harbor maintenance dredging project and addressed in the corresponding EA *(Final Environmental Assessment Inner Apra Harbor Maintenance Dredging, Guam, Department of Navy, October 2003*). PWC Compound and Field 4 have not been addressed previously in a NEPA document. As shown in Table D-1, only one of the various upland placement site options would be required to accommodate the entire dredged volume anticipated for Sierra Wharf dredging (508,877 CY [389,064 $m^3$], including 2-ft overdredge). The Polaris Point and Field 5 sites would each have sufficient capacity for both the Sierra Wharf and aircraft carrier wharf dredge material volume. Assuming 100% upland site placement, there is adequate capacity identified among these sites for the two dredging projects. Used in combination with ODMDS and beneficial use, only a portion of one of the candidate sites would be required to accommodate the dredged material.

Beneficial use is the preferred disposal option for clean dredged material when practical. The material must meet engineering specifications for the specific beneficial reuse. A number of opportunities for beneficial use have been identified, including backfill for a commercial port expansion, construction material for roads, or daily landfill cover. Prior to beneficial use, the dredged material must be tested to ensure it meets the engineering specifications for the proposed reuse. If a beneficial reuse is not identified for this dry material it would occupy valuable space that could otherwise be available for more dredged material. Beneficial reuse may require additional NEPA review.

<u>PWC Site</u>: As described in the Dredged Material Upland Placement Study, Apra Harbor Guam, (NAVFAC Pacific 2008) the PWC site is bounded by Harbor Drive to the south, Marine Drive to the west, Sumay Drive to the east and NOB Hill Bowl Theater to the north. The proposed medical dental clinic would be west of the site. A upland placement area with a footprint size of 27.8 acres (11.3 ha) would provide capacity for dewatering of material from the Sierra Wharf dredging project. The maximum capacity that could be stored at this site is approximately 762,461 $yd^3$ (582,943 $m^3$). This assumes a dike height of 19 ft. (5.8 m) and would require 242,778 $yd^3$ (185,617 $m^3$) of dike material.

Assuming mechanical dredging as a worst case scenario, dredged material would be excavated using a clamshell dredge and placed in an adjacent dump scow. Tugs would transport the scow approximately 0.5 mile (0.8 km) to Uniform Wharf. Material would be offloaded at the wharf using a 30-ton crane equipped with a 15-$yd^3$ (11.46 $m^3$) clamshell bucket. Then material would be loaded directly into sealed-end dump trucks for transportation to the upland placement facility or temporarily stored in a bermed retention area on Uniform Wharf. The maximum dimensions for the retention area would be 400 ft (120 m) by 35 ft (10 m). The design would be in accordance with Navy specifications for Temporary Environmental Control (Specification 01575).

The transportation route to the upland placement site extends approximately 0.25 miles (0.4 km), along Sumay Drive to an access road on Harbor Drive. Approximately 20–30 truck trips per hour are anticipated during active dredging periods. At the upland placement site, material would be offloaded and spread evenly to keep dike height and drying time to a minimum. A bulldozer and dragline would be used to spread the material. Dried dredged material would be used to increase dike height as facility fills.

The 27.8 acres (11.3 ha) upland placement site would be constructed with an earthen dike with side slopes of 1 vertical on 3 horizontal. The perimeter along the centerline of the dike would be approximately 5,000 ft (1,524 m). Site preparation costs including the removal of abandoned buildings needs to be considered. Upland placement sites would be constructed prior to the onset of dredging. Both sites would require vegetation clearing, scouring and compaction. No soil or fill would be brought to or removed from the site.

No closure plan or environmental monitoring is anticipated. The exterior slopes would be seeded to discourage erosion and minimize visual impact. The drying material is unlikely to generate dust until it is disturbed in preparation for beneficial use. A fabric fence would be constructed around the perimeter if dust becomes an issue. No ponding water is anticipated, so no impact to migratory birds is anticipated; however, they can be discouraged using netting, decoys or noise makers. Once dried dredged material is removed, the site can be graded for alternative land use or reused as a dewatering facility.

Field 3: Field 3 is located on undeveloped land south of the Commissary (NAVFAC Pacific 2008). It is bounded by Exchange Road (Route 2B), Shoreline drive and on the west an unmarked north-south arterial connecting Shoreline Drive with marine Drive. The site is approximately 16 acre (6.5 ha). Maximum capacity at the site would be 425,920CY (325,639 m3). The transportation route from Inner Apra Harbor is approximately 1.75 miles (2.8km). A water line would be relocated.

Field 4: The Field 4 Upland placement site is situated on undeveloped lands near the Tipalao housing complex. The site is bounded by Shoreline Drive to the west and Marine Drive to the east. The Field 4 site, with a footprint size of 26.6 acres (10.8 ha), would be constructed to provide capacity for dewatering of material from the Sierra construction dredging project. The maximum capacity that could be stored at this site would be approximately 600,805 CY (459,348 m3). This assumes a dike height of 16 ft. (4.9 m) and a lift height of 14 ft (4.3 m). The proposed Military Working Dog Kennel relocation site is within the Field 4 southern boundary. The upland placement site capacity and footprint would be reduced to avoid impact to the kennel.

Dredged material handling would be as described for the PWC site. The transportation route to the upland placement site extends approximately 1.2 miles (0.9 km), along Sumay Drive to an access road. At the upland placement site, material would be offloaded and spread evenly to keep dike height and drying time to a minimum. Earthen dikes would form the exterior walls of the upland placement site. Dried dredged material would be used to increase dike height as the facility fills. The dredged material height within the site would always be below the perimeter berm height. No effluent is anticipated and no infiltration fields are proposed.

The 26.6 acres (10.8 ha) upland placement site would be constructed with an earthen dike with side slopes of one vertical on three horizontal. The perimeter along the centerline of the dike is approximately 5,600 ft (1,707 m). Consideration for removal of power lines is needed.

Field 5: Field 5 upland placement site is located between Marine Drive and Sumay Drive (NAVFAC Pacific 2008). The footprint would be approximately 53 acres (21.5 ha) and maximum capacity is estimated at 2,059,904 CY (1,574,910 $m^3$). The transportation route is approximately 1.2 miles (1.9 km) from Uniform Wharf along Sumay Drive to an access road. A portion of the site has been used for placement of dredged materials.

Polaris Point: The Polaris Point Site (NAVFAC Pacific 2008) is undeveloped land occupying the central and southeastern portions of Polaris Point. It is bound by Inner Apra Harbor to the south, a fence line to the east, and Polaris Point Road to the north and west. The footprint is approximately 2,072,649 CY (1,584,654 $m^3$). The materials would be offloaded at Alpha Wharf to dump trucks and transported approximately 0.25 miles along Polaris Point Road. It can contain an estimated 2,072,649 CY (1,584,654 $m^3$) of dredged material.

## 1.4 MUNITIONS

### 1.4.1 Introduction

The majority of the munitions proposed at the ranges proposed in this Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) are small arms. The term “small arms” defines a family of firearms that may be both carried and discharged by one person, as opposed to artillery weapons. Small arms include rifles, handguns (pistols and revolvers), shotguns, submachine guns, and machine guns. Generally, small arms are those of .50 caliber (cal) or less. Small arms ammunition nomenclature is expressed by caliber (the diameter of the bullet measured in inches) or the diameter of the bullet in millimeters (mm). For example, a .50 caliber round measures approximately 0.5 inches in diameter and a 9 mm round measures 9 mm in diameter.

In this EIS/OEIS, small arms ammunition that would be authorized for use at proposed ranges on Guam includes 5.56 mm, 9 mm, 7.62 mm, and .50 caliber. Ranges on Tinian would be authorized for 5.56 mm, 9 mm, 7.62 mm, and .45 calibre.

### 1.4.2 Munitions Constituents

The primary munitions constituent (MC) associated with small arms is lead. Other MCs include antimony, arsenic, copper, zinc, iron, manganese, lead styphnate, and lead azide. Lead styphnate and lead azide are more typically associated with the firing point while antimony, copper, zinc, and lead are more typically associated with the impact area (NAVFAC 2008).

Table D-2 provides data on the chemical composition of small arms projectiles proposed for use at ranges proposed in this EIS/OEIS. The U.S. Army has identified the following small arms range and small arms range contaminant features of note (U.S. Army Environmental Center [USAEC] 2006):

- Of the metals typically associated with small arms ranges, lead and copper have the lowest potential for mobility due to their relatively low solubility constants in soil.
- Antimony generally has moderate mobility in soil and remains readily adsorbed to soil particles in neutral to low pH ranges.
- Zinc is highly mobile in soil and has the potential to migrate off-range.
- Lead and copper are found in the highest concentrations on the range, while zinc concentrations are generally one to two orders of magnitude lower, followed by antimony.
- Using risk-based concentrations as a guide, copper and zinc have a relatively low toxicity; lead and antimony toxicities are relatively high.
- A soil’s cation exchange capacity is assumed to have a predominant influence on lead adsorption to soil particles among other soil properties and soils comprised of smaller particles such as silt and clay will result in higher lead adsorption to soil particles.

**Table D-2. Elemental Weight Composition of Small Arms Projectiles**

| *Munition* | *Jacket Description* | *Total Elemental Weight (grains)* | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | *Cu* | *Zn* | *Fe* | *Pb* | *Mn* | *Sb* | *As* |
| 5.56 mm, ball, M855 | Jacket Pointed – Cu Alloy | 17.82 | 1.96 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| 5.56 mm, ball, M193 | Jacket Pointed – Cu Alloy | 15.75 | 1.73 | 0.01 | 38.12 | 0.00 | 0.39 | 0.00 |
| 5.56 mm, tracer, M196 | Cu Alloy Clad Steel | 4.50 | 0.50 | 19.09 | 26.24 | 0.05 | 0.27 | 0.00 |
| 7.62 mm, NATO ball, M80 | Cu Alloy Clad Steel | 6.21 | 0.68 | 27.44 | 112.86 | 0.07 | 1.14 | 0.00 |
| | Alt - Cu Alloy | 31.05 | 3.42 | 0.02 | 91.20 | 0.00 | 5.82 | 0.00 |
| 7.62 mm, ball, M59 | Brass | 51.30 | 5.64 | 54.26 | 38.14 | 0.47 | 0.39 | 0.00 |
| 7.62 mm, tracer, M62 | Cu Alloy Clad Steel | 11.70 | 1.29 | 47.73 | 71.29 | 0.12 | 0.72 | 0.00 |
| | Alt - Cu Alloy | 554.90 | 6.04 | 0.03 | 71.31 | 0.00 | 0.72 | 0.00 |
| 9 mm | Gliding Metal | 22.95 | 2.52 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| .50 cal[1] DoDIC A555 | | | | | | | | |

*Legend*: As = arsenic; Cu = copper; Fe = iron; Mn = manganese; Pb = lead; Sb = antimony; Zn = zinc.
*Sources*: Munitions Items Disposition Action System data in NAVFAC (2008).

1. Data not available for these .50 caliber munitions

### 1.4.3 Small-Arms Cartridge Construction

A complete small-arms round is known as a cartridge and generally consists of a cartridge case, primer, a quantity of propellant within the cartridge case, and a bullet or projectile. Blank and rifle grenade cartridges are sealed with paper closure disks in lieu of bullets. A typical cartridge and the terminology of its components are shown on Figure D-5.

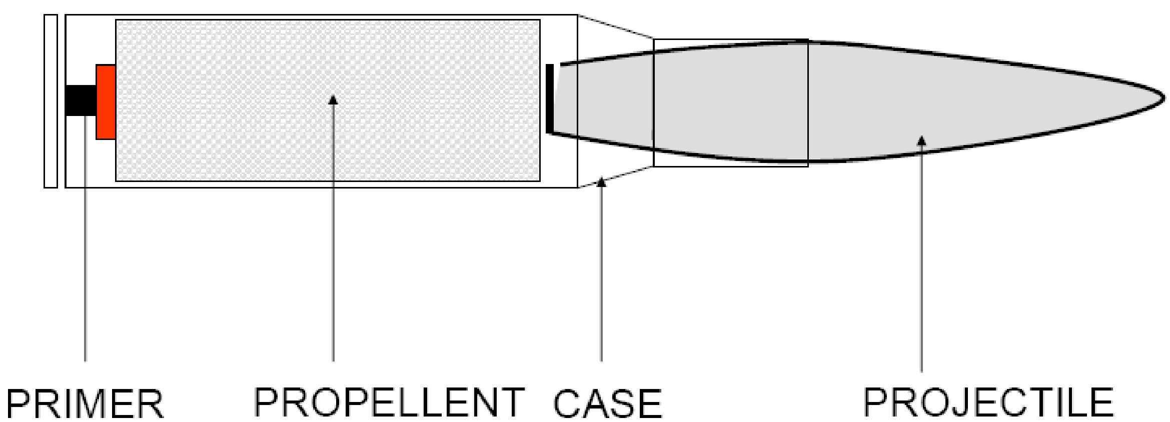



**Figure D-5. Small Arms Cartridge Construction**

The cartridge case is the means by which the other components are assembled and provides a waterproof container for the propellant. The cartridge case is expended from the weapon at the firing line and collected and removed from the range. The primer is functioned (exploded) by a blow from the firing pin of the weapon. The primer ignites the propellant (smokeless powder), which in turn imparts the necessary velocity to project the bullet down range.

*Projectile*: The bullet is generally cylindrical with a round or oval nose. The base may be square or boat tailed. With few exceptions, bullets through .50 cal are assemblies of a jacket and a lead or steel core. Ball rounds usually contain a slug of antimony hardened lead. The outer core of the .50 cal round is made of soft steel. Tracer rounds contain a lead slug and a chemical composition in the rear. The bullet jacket may be either gliding metal, gliding metal clad steel, or copper plated steel.

*Case*: Although steel, aluminum, zinc, and plastic materials have been used experimentally, brass, a composition of 70% copper and 30% zinc, is the most commonly used material for cartridge cases.

*Propellant*: Cartridges are loaded with varying weights of propellant. This is to impart sufficient velocity (within safe pressures) to the projectile to obtain the required ballistic performance. These propellants are either of the single-base (nitrocellulose) or double-base (nitrocellulose and nitroglycerine) type. The propellant grain configuration may be cylindrical with a single, lengthwise perforation, spheroid (ball) or flake. Most propellants are coated with a deterrent (to assist in controlling the rate of combustion) and with a final coating of graphite (to facilitate flow of propellant and eliminate static electricity in loading cartridges).

*Primer*: Small-arms cartridges contain either a percussion or electric primer. The percussion primer consists of a brass or gliding metal cup that contains a pellet of sensitive explosive material secured by a paper disk and a brass anvil. The electric primer consists of an electrode button in contact with the priming composition, a primer cup assembly, and insulator.

Once a projectile ejects from the bore of the weapon, it travels towards the target. Because of scouring of the projectile in the weapon barrel, a small amount of copper (if the bullet is copper jacketed) and/or lead (unjacketed projectile) may be deposited near the firing point. In addition, small quantities of propellant powder and lead styphnate used in the primer may also be released. The projectile then impacts the berm backstop (when present) or falls in the impact area.

The extent of fragmentation of the projectile influences the rate of corrosion, the release of lead and other metal ions, and migration potential. Intact rounds and rounds fragmented into relatively large pieces are not easily transported by natural transport mechanisms. Generally, 9 mm pistol rounds will stay intact upon impact with the soil and are usually found with little to no deformation or fragmentation. Conversely, rifle rounds (5.56 mm, 7.62 mm) travel at much higher velocities and will impact the ground with much more force. At relatively short distances, 82-656 ft (25-200 m), these rounds will often fragment into very small particle sizes upon impact with the soil. Beyond these distances, there is less fragmentation, resulting in large metal fragments and intact rounds. The degree of fragmentation appears to be more a function of distance from the firing point as opposed to the type of soil into which the round is being fired (USAEC 2006).

### 1.4.4 Other Munitions, Explosives, and Pyrotechnics

Table D-3 summarizes data for other munitions, explosives, and pyrotechnics proposed for use during training activities on Guam assessed in this EIS/OEIS.

**Table D-3. MC for Other Munitions, Explosives, and Pyrotechnics or Proposed Ranges and Training Areas on Guam**

| *Munition* | *MC* | *Location Proposed for use in this EIS/EOIS* |
|---|---|---|
| MK19 40 mm TP | ( No explosive component) | Machine Gun Range, Guam |
| M67 Hand Grenade, Fragmentation | 185 g of Composition B explosive that is 60% military-grade RDX (hexahydro-1,3,5-trinitro-1,3,5- triazine), 39% military-grade TNT, and 1% wax. Military-grade RDX contains about 10% HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine), | Hand Grenade Range, Andersen South<br>Hand Grenade House, Andersen South or NCTS Finegayan |
| Grenade, flash bang (“Stun grenade”) | 4.5 grams of a pyrotechnic metal-oxidant mix of magnesium or aluminum and an oxidizer such as ammonium perchlorate or potassium perchlorate | Hand Grenade House, Andersen South or NCTS Finegayan |
| C4 | 91% RDX, 9% oil | Demolition Range |
| Flare, Surface, Trip | DoDIC L495 | MOUT and Maneuver Training Areas, Andersen South |
| Signal, Illumination Ground (“Slap flare”) | DoDIC L312 | MOUT and Maneuver Training Areas, Andersen South |
| Ground Burst (Artillery Simulator) | DoDIC L594 | MOUT and Maneuver Training Areas, Andersen South |
| Green hand smoke | DoDIC L940 | MOUT and Maneuver Training Areas, Andersen South |
| Yellow hand smoke | DoDIC L945 | MOUT and Maneuver Training Areas, Andersen South |
| TNT | 100% TNT | Breacher and Shooting House, Andersen South<br>Demolition Range, NCTS Finegayan |

*Source*: Hewitt et al. 2007.

## 1.5 REFERENCES

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# Appendix D

# Project Description Technical Appendix

# Guam and CNMI Military Relocation EIS/OEIS

# Volume 9: Appendices

### Table of Contents

# CHAPTER 1.
# D: PROJECT DESCRIPTION TECHNICAL APPENDIX

## 1.1 DREDGING - METHODS

There are two general types of dredging operations (Weston Solutions Inc. 2005): mechanical dredging operations and hydraulic dredging operations. The operations vary by the method used to loosen the material from its *in situ* state and transport the material from the seafloor to the water surface. The type of dredging equipment that is used would affect the characteristics of the dredged material. Differences in dredged material characteristics resulting from dredging methods as well as logistical considerations relevant to the use of mechanical and hydraulic dredges are described in the following subsections.

Mechanical dredging excavates in situ sediments with a grab or bucket. One of the most common types of mechanical dredges is the clamshell dredge, which is named for the type of bucket used in the operation. Typically, a large barge is loaded with the bucket dredge and transported to the dredging site with tugs. The barge is then secured in place. The dredging process consists of lowering the bucket to the seafloor, closing the bucket and raising it back to the water surface, and depositing the dredged material into a scow or, if appropriate, directly into an adjoining placement site. The efficiency and capacity of this type of dredging is determined by the capacity of the bucket, which varies between 1.5 and 25 CY (1 and 20 $m^3$), scow capacity, which typically varies from 130 to 3,300 CY (99 to 2,523 $m^3$), and the number of available scows.

An “environmental bucket” is a type of clamshell bucket, but is closed to minimize the release of sediment from the bucket into the water column. Once the material is retrieved from the ocean floor it is managed as described for the clamshell. The only difference between the two dredge methods is the design of the bucket.

Mechanical dredges operate best in consolidated, hard packed material since dredging buckets have difficulty retaining the loose, fine material that is often washed away as the bucket is raised. Depending on scow characteristics, excess water drains off at the dredging site reducing the water content of the dredged material to approximately 10 percent. Mechanical dredges are often used in tightly confined areas, such as harbors, around docks and piers, and in relatively protected channels. This type of dredge is not suitable for rough seas or areas of high vessel traffic. By using numerous scows with one dredge, mechanical dredging can proceed continuously. As one scow is being filled, another can be towed to the placement site.

In hydraulic dredging, material is loosened from its in situ state and lifted in suspension through a pipe system connected to a centrifugal pump. Hydraulic dredging is most efficient when working with fine materials and sands since they are easily held in suspension. Coarser materials, including gravel, may be hydraulically dredged; however, these materials require a greater demand of pump power and can cause excessive wear on pumps and pipes. The two main types of hydraulic dredges are pipeline and hopper dredges.

A cutter suction dredge is a hydraulic dredge that uses a device consisting of rotating blades or teeth, called a cutterhead, to break up or loosen bottom material. A large centrifugal pump removes the material from the bottom of the channel and pumps the sediment-water slurry through a discharge pipeline. Material dredged by a cutter suction dredge is directly placed into the placement area by the discharge pipeline. Since the slurry mixture (10-20% solids to water) has a higher density than the ambient water, it descends to the bottom of the placement area in a manner dependent on the sediment characteristics. Cutter suction dredges operate continuously, and are cost effective if the placement site is in relative close proximity to the dredge area. However, because the pipeline is usually floated on the water surface, pipeline dredges are not suited for work in high traffic areas where they would pose an obstruction to navigation. They are also not recommended for areas with heavy debris that can clog pumps and impair efficiency. To avoid these problems, pipelines can be weighted to the seafloor, however this is commonly problematic.

A hopper dredge is a type of hydraulic dredging employing a vessel having the shape of a conventional ship hull and that is equipped with either single or twin trailing suction pipes. A hopper dredge operates much like a floating vacuum cleaner in that material is lifted through the trailing suction pipes by one or more pumps and then the mixture of water and solids is stored in a hopper contained within the hull of the dredger. A hopper dredge operates best by skimming layers of material in long, narrow runs and is primarily used in open water, such as rivers, canals, and open sea. This type of dredge is unable to get into corners (i.e., Inner Apra Harbor), difficult to maneuver in confined spaces, unsuitable for use in shallow water, and is not effective on hard materials such as stiff clays (Inner Apra Harbor). A hopper dredge can move quickly to a placement area under its own power, but the operation loses efficiency as the transport distance increases.

Once the hopper is full, material may be discharged onto an open-water placement site by opening the hopper doors located in the bottom of the ship’s hull or fluidized by jets and hydraulically pumped from the hopper. For bottom dumping, the entire contents of the hopper can be emptied in a matter of minutes. Upon discharge from the hopper dredge, the dredged material falls through the water column as a well-defined jet of high-density fluid. As with the pipeline dredge, the descent and deposition of the slurry mixture is dependent on the material’s physical characteristics. Hydraulic pump out can take up to 30–60 minutes and discharge slurry is similar in density to cutterhead slurry.

In addition, hopper dredging is typically used as an alternative to hydraulic cutterhead dredging when bottom dumping or when a large distance between the dredge site and upland placement area precludes the use of a cutterhead dredge.

The dredging method historically used in Guam is mechanical dredging with a barge-mounted crane attached to clamshell buckets to retrieve the sediment and deposit it on a scow (barge). It is likely that this method would be used for the proposed dredging; however, the decision would not be made until the final design. The project would likely be a design/build contract that would not be awarded until the Record of Decision on this EIS/OEIS is complete. Mechanical dredging is assessed as the environmentally conservative method of dredging in the EIS/OEIS. Should the contractor choose to use an alternative method, informal consultation with agencies and approval by U.S. Army Corps of Engineers (USACE) would be required.

A Rivers and Harbors Act, Section 10 (33 USC 403), Clean Water Act, Section 404 (33 USC 1344), and Marine Protection Research and Sanctuaries Act (MPRSA) Section 103 USC 1413 permit application would be submitted to the USACE for approval and would be reviewed by other regulatory agencies.

USACE Section10/404/103 permit is the abbreviated reference for the three permits that are reviewed under one application.

### 1.2 DREDGING BEST MANAGEMENT PRACTICES

All dredges resuspend sediment; however, resuspension is primarily near field and can be controlled (at least partially). Depending on the specific performance standards for the project, BMPs that may be implemented to control the movement of resuspended sediment and minimize the impacts of dredging in Apra Harbor include operational and engineered controls. Operational controls include actions that can be undertaken by the dredge operator to reduce the impacts of the dredging operations. Engineered controls require a physical construction technology or modification of the physical dredge plant to cause the desired change in conditions. Examples of engineered controls for turbidity might include installation of dredgehead shrouds, silt curtains, sheet-pile enclosures, and pneumatic (bubble) curtains, etc. Usually, an attempt will be made to implement an operational fix prior to using the engineered method because of the higher costs of engineered controls (USACE 2005).

Application of operational and engineered controls is potentially expensive and can significantly reduce overall production rates and efficiency. Further, the improper use of controls can have direct negative impacts on a project and the environment (e.g., through increased sediment resuspension or increasing the time needed to complete the project). The degree of controls needed is a site-specific or area-specific decision. Therefore, controls should be applied only when conditions clearly indicate their need and should not be set as a requirement solely because they can be applied (USACE 2005). Operational controls for resuspension of sediment may include changes in dredging methods and/or in operation of the equipment. Examples of operational controls that have been tested on a limited basis include:

- Reducing the dredging rate to slow down the dredging operation (this is especially important with respect to bucket speed approaching the sediment surface and bucket removal from the surface after closing).
- Reducing bucket over-penetration, which can cause sediment to be expelled from the vents in the bucket or cause sediment to become piled on top of the bucket, then eroded during bucket retrieval.
- Eliminating overflow from barges during dredging or transport.
- Changing the method of operating the dredge, based on changing site conditions such as tides, waves, currents, and wind.
- Modifying the depth of the cutterhead for hydraulic dredging, rate of swing of the ladder and of the rotating cutterhead, and reducing the speed of advance of the dredge.
- Modifying the descent or hoist speed of a wire-supported bucket, employing aprons to catch spillage, and using a rinse tank to clean the bucket each cycle.
- Sequencing the dredging by moving upstream to downstream.
- Varying the number of dredging passes (vertical cuts) to increase sediment capture.
- Using properly sized tugs and support equipment.

Unfortunately, few data are available to support the effectiveness of most of the above operational modifications in reducing resuspension (USACE 2005). Experienced dredge operators are often challenged to find an optimal rate and method of operation for a given set of conditions. For hydraulic dredging, resuspension is generally minimized at the same point that production is optimized. If the rate of operation is slowed or accelerated, the resuspension and release may be increased (USACE 2008). In addition to controls placed on operation of the basic dredging equipment, other operational control measures may be considered for mechanical dredging. These include use of submerged trays or plates to catch or contain spillage from buckets as they are raised and slewed to the barge, and use of wash tanks to remove adhering sediments from a bucket prior to start of the next cycle (Lane et al. 2005 in USACE 2008). Such measures would slow the overall dredging process, and the advantages with respect to reduction of resuspension should be considered in light of the disadvantages with respect to production. The use of an enclosed bucket (e.g. environmental bucket) may also be beneficial in minimizing sediment loss from the ascending bucket if the substrate is soft enough for its effective use.

Engineered resuspension controls for environmental dredging can be defined as designed controls or containments deployed around or in conjunction with the dredge plant (USACE 2008). Transport of resuspended contaminated sediment released during dredging can be reduced by using physical barriers around the dredging operation. Under favorable site conditions, these barriers help limit the areal extent of particle-bound contaminant migration resulting from dredging resuspension and enhance the long-term benefits gained by the removal process. Conversely, because the barriers contain resuspended sediment, they may increase, at least temporarily, residual contaminant concentrations inside the barrier compared to what it would have been without the barriers (USACE 2008). Physical barriers may be appropriate when site conditions warrant minimal transport of suspended sediment and can be used individually, in a series (i.e., multiple silt curtain barriers) or in conjunction with each other (i.e. silt curtain and bubble curtain).

Types of physical barriers may include:

- Cofferdams.
- Removable dams (e.g., Geotubes).
- Sheet-pile enclosures.
- Silt curtains.
- Silt screens.
- Pneumatic (Bubble) curtains.

Cofferdams and removable dams are generally associated with “dry excavation” remedies as compared to the other types of containments for resuspended sediments around a dredging operation (USACE 2008).

#### 1.2.1 Silt Curtains

The most recognized engineered control for managing resuspended sediment at dredging projects is the “silt curtain.” Although the terms “silt curtain,” “turbidity curtain,” and “silt screen” may frequently be used interchangeably, there are fundamental differences. Curtains are made of impervious materials, such as coated nylon, and primarily redirect all water flow around the enclosed area. In contrast, screens are made from synthetic geotextile fabrics, which allow water to flow through, but retain a large fraction of the suspended solids inside the screened area (USACE 2008). Silt curtains and screens are designed to contain or deflect suspended sediments or turbidity in the water column. 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. Suspended solids can also conceivably be diverted from areas where environmental damages could occur from the settlement of these suspended particles. 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. Silt curtains and silt screens are flexible barriers that hang down from the water surface. Both systems use a series of floats on the surface and a ballast chain or anchors along the bottom. Silt curtains are vertical, flexible structures that extend downward from the water surface to a specified water depth. (Figure 1-1).

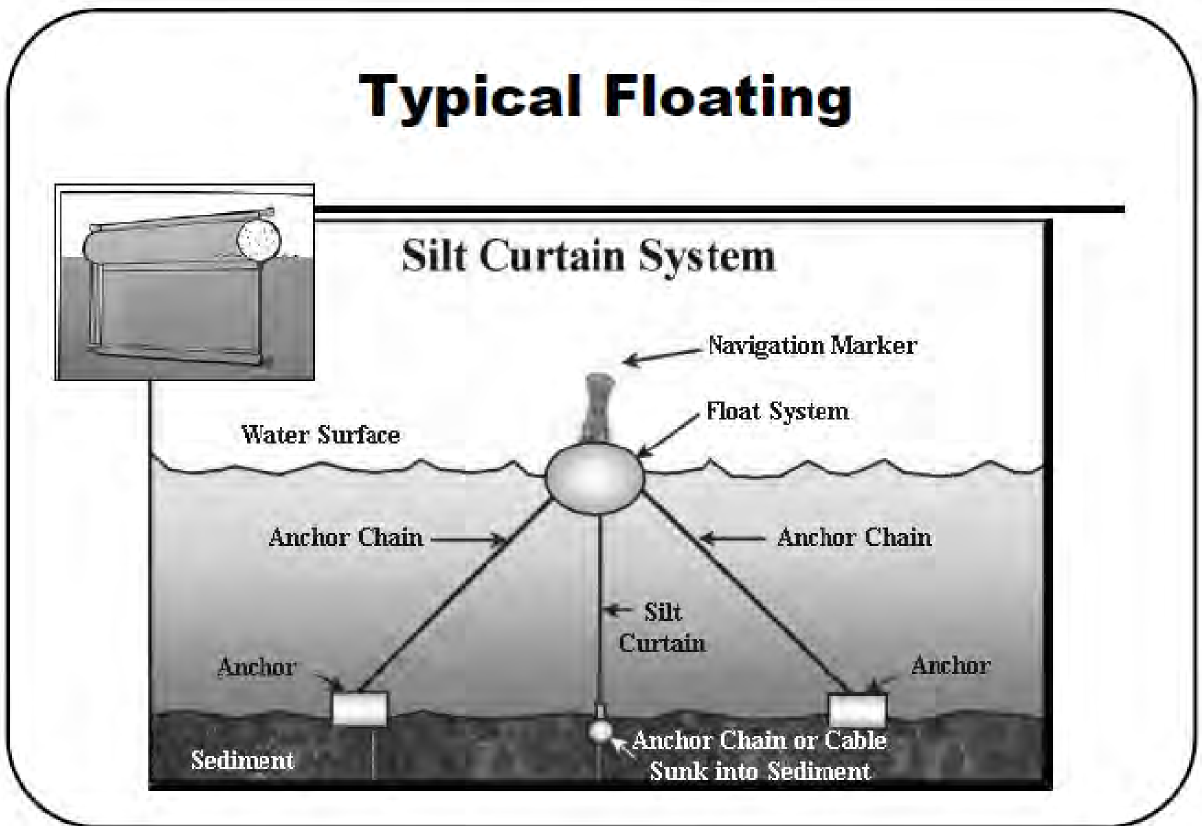


**Figure D-1. Typical Hanging Silt Curtain System**

A tension cable is often built into the curtain immediately above or just below the flotation segments (top tension) to absorb stresses imposed by currents and hydrodynamic turbulence. The curtains are usually manufactured in standard sections (e.g., up to 50 ft) that can be joined together at a particular site to provide a curtain of specified length. Curtains are generally deployed to extend to 1-2 ft above the bottom to allow mudflow to pass beneath them. Anchored lines hold the curtain in a deployed configuration that can be U- or V-shaped, or circular or elliptical, depending upon the application (USACE 2005).

An engineered control such as a silt curtain does not treat turbidity resulting from sediment resuspension; depending on the deployment configuration of the curtain, it merely contains or directs the movement of resuspended sediment. Partial depth deployments, normally extending from the surface to a set depth, will act to contain the resuspended sediment and reduce spreading in the upper water column; however, the resuspended material is free to move beneath the partial curtain. A full depth deployment will act to further contain and prevent spreading, and further limit resuspended sediment movement. However, there are potential releases from full-depth deployments due to ineffective seals along the bottom, tidal fluctuations, or movement of vessels through gaps in the curtains, etc. Even with an effective containment, the result may be an increase in concentrations of both suspended solids and dissolved contaminants within the curtain containment area that have the potential for being released when the curtain is relocated or removed during demobilization (Francingues and Thompson 2006 in USACE 2008). Whereas properly deployed and maintained silt curtains can effectively control the distribution of turbid water, they are not designed to contain or control fluid mud. In fact, when the accumulation of fluid mud reaches the depth of the ballast chain along the lower edge of the skirt, the curtain must be moved away from the discharge; otherwise sediment accumulation on the lower edge of the skirt can pull the curtain underwater and eventually bury it. Consequently, the rate of fluid mud accumulation relative to changes in water depth due to tides must be considered during a silt curtain operation.

The effectiveness of a silt curtain installation is primarily determined by the hydrodynamic conditions at the site. Conditions that will reduce the effectiveness of the silt curtain include:

- Strong currents (For all practical purposes, silt curtains are not very effective at current velocities > 1 ½ knots [2.5 ft/sec]).
- Excessive depths (At depths greater than 10-15 ft, loads or pressures on curtains and mooring systems become excessive and could result in failure of standard construction materials).
- High winds.
- Changing water levels.
- Excessive wave height (including ship wakes).
- Drifting ice and debris.
- Movement of equipment into and out of the curtained area.

As a generalization, silt curtains are most effective in relatively shallow, quiescent water, without significant tidal fluctuations. As water depth increases and turbulence caused by currents and waves increases, it becomes increasingly difficult to isolate the dredging operation from the ambient water effectively. The effectiveness of silt curtains is also influenced by the quantity and type of suspended solids, the mooring method, and the characteristics of the barrier (JBF Scientific Corp. 1978 in USACE 2008). Ideally, the silt curtain should remain in place until the dredging is completed; allow for traffic in and out; and allow relocation as the dredge moves to a new site. Care must also be taken so that the curtains do not impede navigation traffic. As a result, the use of silt curtains to minimize the impacts of dredging in Apra Harbor may be more effective if used to protect specific areas (e.g., valuable habitat, water intakes, or recreational areas) from suspended sediment contamination (USEPA 1994 in USACE 2008). Protecting sensitive areas with curtains as opposed to enclosing the dredging area may provide the required protection with less impact to the dredging operation.

### 1.2.2 Pneumatic (Bubble) Curtains

The pneumatic barrier is a containment method designed to reduce sedimentation by reducing the ability of suspended sediments to settle in the protected area. A specially engineered pattern of pipes is installed on the aquatic bed and air is forced through the pipes to create "bubble curtains." The current is produced by air flowing through a perforated manifold laid on the bed of the water body. The air is supplied from a compressor that is located onshore.

The pneumatic barrier is composed of two parts, a compressor and a perforated pipe. The compressor must be sized to create sufficient air flow to overcome hydrostatic pressure, frictional losses, and expel water from the pipe (Applicability of an Air Barrier, 1992). The pipe may be constructed from steel, aluminum, rubber, PVC, or polyethylene. Each of these materials have properties making them suitable to be used as the manifold. However, polyethylene or rubber can withstand the water pressure, are flexible, and resist corrosion in the sea. For these reasons they are more highly recommended. Water currents and frequent barge traffic over the pipe make it necessary to anchor the pneumatic barrier to the bottom. Anchoring methods may be simple or complex depending on the anticipated currents and overhead traffic. In many instances, cinder blocks or other weights are suitable for anchoring the manifold. These weights should be easy to remove if dredging operations make it necessary to remove the manifold from the water. The pneumatic barrier uses a physical flow mechanism to produce the desired surface current and has been effectively demonstrated to prevent sedimentation in Kill Van Kull and Bayonne, NJ . The effectiveness of the barrier occurs when the air bubbles are released from the manifold under pressure. The bubbles rise and expand as the hydraulic pressure decreases. The rising air column causes an upward water flow. As the vertical flowing water reaches the surface it is diverted into the horizontal direction causing a surface current extending in both directions away from the vertical stream of bubbles. This generated surface current effectively redirects the movement of suspended sediment away from sensitive resources (Figure 1-2).

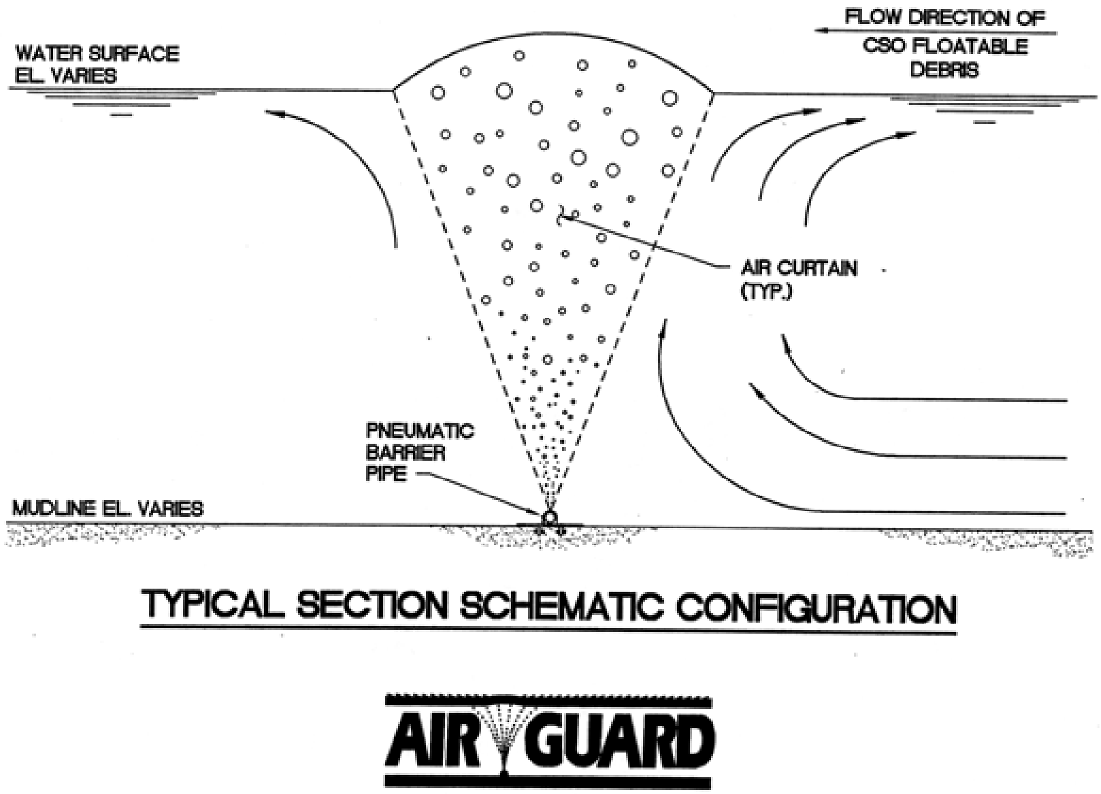


**Figure D-2. Typical Bubble Screen Schematic Configuration**

The proper air flow required to form an effective barrier is related to the following three factors: 1) The maximum surface current required to overcome wind forces and natural tidal currents. 2) The amount of air to overcome loss through the pipes orifices. 3) The amount of air to overcome frictional loss.

The benefits of the pneumatic barrier include; ease of operation and environmental benefits. The ease of operation is due to the relatively labor free deployment and the environmental benefits are the result of increased dissolved oxygen that can help restore life to the lower depths of heavily polluted waterbodies. However, the pneumatic barrier is limited by tidal currents. Pneumatic curtains become less effective in tidal currents exceeding 1.5 fps (feet per second). Additionally, added costs are incurred with compressor maintenance and operation as are air emissions.

Site-specific Best Management Practices (BMPs) would be developed in coordination with federal agencies and incorporated in the EIS/OEIS as they become available and included in the USACE permit application. The USACE issued a Public Notice "Reissuance of Nationwide Permits and Final Regional Conditions for Honolulu District" (Public Notice Number: POH-206-351, August 31, 2007). The public notice is applicable to Hawaii, Guam and Samoa projects. Regional conditions are not site–specific and provide additional protection for the aquatic environment and will be conditions of the USACE permit. The relevant ones are as follows:

### 1.2.3 Regional Condition 12, Endangered Species

A survey of the project area shall be performed just prior to commencement or resumption of construction activity to ensure that no protected species are in the project area. If protected species are detected, construction activities shall be postponed until the animal(s) voluntarily leave the area.

If any listed species enters the area during conduct of construction activities, all activities shall cease until the animal(s) voluntarily depart the area.

All on-site project personnel shall be apprised of the status of any listed species potentially present in the project area and the protections afforded to those species under Federal laws.

Any incidental take of marine mammals shall be reported immediately to NOAA Fisheries' 24-hour hotline at 1-888-256-9840. Information reported must include the name and phone number of a point of contact, location of the incident, and nature of the take and/or injury.

Note: Conditions 12.1-12.4 pertain to projects within waters that may support listed marine mammals and/or sea turtles. Additional requirements may be designated by the Corps as appropriate for specific projects.

Pursuant to the Endangered Species Act, any take of federally protected species (other than marine mammals) must be reported to the U.S. Fish and Wildlife Office of Law Enforcement in Honolulu at 1-808-861-8525.

### 1.2.4 Regional Condition 13, BMPs

Turbidity and siltation will be minimized through the use of effective silt containment devices. The silt control devices will be installed properly and maintained for the duration of the in-water work.

Work will be postponed during adverse tidal or weather conditions.

Dredging and filling will be scheduled to avoid coral spawning and recruitment periods.

Project design will minimize unavoidable loss of special aquatic sites and compensatory mitigation will be provided for unavoidable losses.

Project related equipment that is in contact with the water will be cleaned prior to use.

No contamination (trash) of nearby properties is permitted.

Fueling will take place away from the shoreline and a spill contingency plan will be prepared. Absorbent pads and containment booms would be kept onsite for emergencies.

Underlayer fills and soil exposed during construction will be protected from erosion by use of appropriate materials (e.g., pre-cast concrete armor, plastic sheeting).

The scows would be tied to the dredging barge and not require anchors or chains on the ocean floor.

Chiseling may be required to roughen the substrate prior to dredging to facilitate the ability of the clamshell to grab hold of the material. No blasting would be required.

In Apra Harbor, silt curtains have historically been a condition of dredging permits. Typically, the silt curtain contains the sediment within the project area and the curtain moves with the dredging operation. Another proposal has been the use of silt curtains to protect the specific notable resource areas (e.g., Jade Shoals and Western Shoals) in the vicinity. The silt curtains would remain in place throughout the project.

The ROD may not include a decision on dredging methodology, because the final design may not be available in time for the Final EIS. Environmental worst case is generally believed to be mechanical dredging. It has the greater combined potential for environmental impacts from direct and indirect impacts to coral reefs due to sediment redistribution. Pipeline dredges have direct adverse impact potential due to removal of coral by the cutterhead assembly and due to occasional misplacement of the pipeline carrying dredged sediments to the approved disposal area but much less turbidity and indirect impacts occur from this method of dredging. Representing a worst case scenario, mechanical dredging is used in the impact analysis.

### 1.3 DREDGE MATERIAL DISPOSAL OPTIONS

Three dredged material management options would likely be available on Guam in 2010. The existing options are beneficial reuse and upland placement site. The U.S. Environmental Protection Agency (USEPA) is pursuing the designation of an ocean dredged material disposal site (ODMDS) approximately 11 to 14 nm (20.4 to 26 km) from the west coast of Apra Harbor. The designation is anticipated in 2010 and the ODMDS EIS is being prepared concurrent with this EIS/OEIS. An ODMDS would provide Guam a third option for dredged material management.

Ocean disposal is regulated under Title 1 of the MPRSA (33 USC 1401 et seq). Formal designation of an ODMDS in the Federal Register does not constitute approval of dredged material for ocean disposal. Designation of an ODMDS provides one additional dredged material management option for consideration in the review of each proposed dredging project. Ocean disposal is only allowed when USEPA and USACE determine, on a case-by-case basis, that the dredged material: 1) is environmentally suitable according to testing criteria (40 CFR Parts 225 and 227), as determined from physical, chemical, and bioassay/ bioaccumulation testing that is briefly described in Section 2.7 (USEPA and USACE 1991), 2) does not have a viable beneficial reuse, and 3) there are no practical land placement options available.

Preliminary sediment characterization data for the Sierra Wharf and aircraft carrier alternative wharf sites suggest most, if not all, of the material would meet the testing criteria and be suitable for dewatering on land, or ODMDS disposal (NAVFAC Pacific 2006). No Navy dredging project on Guam has required designation of an upland site for the treatment or remediation of sediment. None is anticipated for this project. The DEIS relies on the existing sediment characterization results to assess impacts. Results from additional analysis per 40 CFR Part 227 would be used to develop a dredge material management plan that would be included in the USACE Section 404/10/103 permit application. It is possible that multiple disposal methods would be appropriate for the project.

The EIS/OEIS impact analysis considers four scenarios for the placement of dredged material: 100% disposal in a proposed ocean dredged material disposal site (ODMDS), 100% disposal upland, 100% beneficial reuse, and 15-20% beneficial reuse/75-80% ocean disposal.

### 1.3.1 Beneficial Reuse

Beneficial reuse is the preferred disposal option for clean dredged material when practical. The material must meet engineering specifications for the specific beneficial reuse. A number of opportunities for beneficial use have been identified, including backfill for a commercial port expansion, construction material for roads, or daily landfill cover. Prior to beneficial use, the dredged material must be tested to ensure it meets the engineering specifications for the proposed reuse. If a beneficial reuse is not identified for this dry material it would occupy valuable space that could otherwise be available for more dredged material. Beneficial reuse may require additional NEPA review.

NAVFAC Pacific prepared a Phase 1 Dredged Material Management Plan in 2005 that presented findings on an evaluation of potential beneficial use projects for dredged material in anticipation of Apra Harbor dredging projects (NAVFAC Pacific 2005). The findings were revisited and an updated report was prepared in 2008 (NAVFAC Pacific 2008). Factors used to evaluate beneficial use included identifying local opportunities, the distance from the dredge site, capacity of beneficial use relative to material available, and site accessibility. Beneficial use must meet other measures of practicability such as timeliness, geotechnical and chemical requirement of the reuse and cost. The viable dredge material beneficial reuse options on Guam include:

- Construction material – specifically munitions storage construction and fill.
- Landfill cover
- Fill for the planned PAG commercial port expansion

The Military Relocation construction contractor would have existing stockpiled dried dredged material available for use and would have newly dredged material available for consideration. Other reuse options would be evaluated as the final designs for the projects are developed. No specific beneficial reuse projects are addressed in this EIS/OEIS, but it remains an important option. Supplemental NEPA documentation and permitting may be required, especially for in-water projects like shoreline restoration. The Navy encourages GovGuam to develop a dredged material management plan for Guam that identifies specific projects, timing and the physical requirements for each reuse.

The Navy and GovGuam entered into a Memorandum of Understanding (MOU) (April 2001) whereby dredged material generated by the Navy would be made available to GovGuam. The MOU was specifically prepared for the reuse of Inner Apra Harbor maintenance dredge material at the Commercial Port. Although the maintenance dredging is completed, the MOU continues to be valid. GovGuam would be responsible for 1) laboratory analyses that verify the physical suitability of the material, and 2) NEPA documents and permits required for the reuse, just as the Navy would be required to meet the documentation for the reuse of dredged material on DoD land. To date, it has not been practical to transfer material to PAG because they have not been prepared to receive and store the material because the Commercial Port improvement projects have not been programmed for funding. Ideally, the material would be transported by barge directly to PAG during the dredging operation. The reasons for not reusing the material include:

- The physical characteristics of the dredged material may not meet the standards for the specific beneficial use alternative.

- The timing of the beneficial use project may not coincide with the availability of appropriate dredged material.

### 1.3.2 ODMDS

Currently, there is no ODMDS for Guam but there may be one designated in 2010 and available for use during construction of the proposed action. The ODMDS would be located greater than 9 nm from the west coast of Apra Harbor (Figure D-1) (USEPA 2009). Surface currents at this site tend to be highly variable during most of the year, with periods of strong and consistent southward flowing pulses during the wet weather season. Consistent with the pattern observed at the regional scale, intermediate layer currents (1,300 ft. [400 m] to 6,550 ft. [2,000 m]) at the this site tend towards the northeast with decreasing variability with increasing depth. Current speeds are about 0.10-0.16 ft/s (3–5 cm/s) in the intermediate layer. On a regional scale, the bottom currents were highly variable; however, in the area of the potential ODMDS, the bottom currents below 8,200 ft. (2,500 m) are more consistent, trending in a north-northwesterly direction at a speed of approximately 0.07 ft/s (Weston 2007).

The dredged material would be loaded directly onto scows during dredging and proceed directly to the ODMDS for disposal. The established shipping lanes would be used and the vessels would be subject to standard rules of Navigation and a Notice to Mariners would be issued. For maximum efficiency, two 4,000 CY (3,058 $m^3$) barges are assumed to used to allow one barge to be loaded while another is transiting to or from the ODMDS.

There will always be the need for upland placement of some dredged material, but the ODMDS would result in less land area being used for dredged material dewatering and stockpiling.

USACE may issue ocean disposal permits for dredged material if USEPA concurs with the decision (MPRSA Section 103). If USEPA does not agree with a USACE permit decision, a waiver process under Section 103 allows further action to be taken. The permitting regulations promulgated by the USACE, under the MPRSA, appear at 33 CFR Parts 320 to 330 and 335 to 338. Roles and responsibilities associated with the ODMDS are as follows:

- USEPA (and USACE for federal projects in consultation with EPA) would conduct surveillance, monitoring, and site management at the ODMDS
- USACE issues the permits for specific dredging activities with USEPA concurrence
- USCG is responsible for vessel traffic-related tracking and monitoring
- Permittee is responsible for implementing and financing all permit conditions

All dredging permits require compliance with a Dredge Operation Plan that addresses all phases of a specific dredging project, including reporting and monitoring requirements, environmental protection measures, safety precautions, and requirements for dredged material screening (e.g., unexploded ordnance, size), if necessary. During dredging activities, agencies would have remote access to a real-time GPS automated vessel location system. The system allows agencies to monitor the location and weight of the vessel transporting the dredged material. If the vessel loses weight (i.e., dredged material) prior to reaching the ODMDS, it is readily apparent in the graphical representation viewed on a computer screen.

Alarms can be set through the remote system to notify supervising agencies when thresholds are not met for weight or travel route. Agencies can respond quickly to halt the disposal and investigate the situation. The remote tracking software is available under various names (e.g., eTracs™) by different vendors has been successfully used to monitor dredging operations at various USEPA designated ODMDS.

A Site Management and Monitoring Plan (SMMP) was prepared for the Guam ODMDS (USEPA 2009). The SMMP outlines requirements for monitoring specific disposal operations and long-term site conditions. Should the monitoring reveal unanticipated adverse environmental impacts, management actions would include modification of the site use/disposal procedures, additional site monitoring or site closure. The SMMP is updated every 10 years and public notice is required for each SMMP update.

The vessel carrying the dredged material from Apra Harbor would travel along existing shipping lanes and be subject to USCG rules and regulations. USCG primary roles consist of promoting maritime safety, supporting national defense, providing maritime security, protecting natural resources, and facilitating maritime transport and commerce. It enforces federal laws on the high seas and waters within U.S. territorial jurisdiction. The USCG is part of the Department of Homeland Security, but from 1967 to 2003 it was under the jurisdiction of the Department of Transportation.

Navigation rules are codified in International Navigational Rules Act of 1977 (Public Law 95-75, 91 Stat. 308, or 33 U.S.C. 1601-1608), and, the Inland Navigation Rules Act of 1980 (Public Law 96-591, 94 Stat. 3415, 33 U.S.C. 2001-2038).

**Figure D-3. ODMDS Location Map**

### 1.3.3 Candidate New Upland Placement Sites

A "Dredged Material Upland Placement Study, Apra Harbor Guam", was prepared for NAVFAC Pacific in May 2008 to assess the availability of upland placement sites as a preferred alternative to the ODMDS option since ocean disposal is only to be used if upland re-use or disposal is not available. Upland placement sites, often referred to as upland placement facilities, are bounded by confinement dikes or structures to enclose the disposal area, thereby isolating the dredged material from its surrounding environment. A upland placement facility consists of a fully diked facility located above the water line and out of wetland areas. They may be used for either coarse or fine-grained material. The material is placed into the facility either hydraulically or mechanically. Placing the material directly into the facility from the dredging site through pipelines is the most economical method. The dredged material consists of a certain percentage of slurry when it is pumped into the facility. Depending on the placement method, slurry material initially deposited in the upland placement facility may occupy from 1.1 times (mechanical placement) to 5 to 10 times (hydraulic placement) its original volume due to water content. Following placement, the finer sediments are allowed to consolidate, settle, and dewater. Slurry water evaporates or percolates into the ground. Facilities that use weirs to discharge effluent from the facility must be designed with sufficient retention times to ensure adequate suspended sediment settling would occur prior to discharge into the receiving water body in order to meet applicable water quality standards.

The Navy has dry (or drying) dredged material stockpiled in multiple upland sites on Orote Peninsula. These sites are nearly at capacity. If beneficial uses are identified, then areas within the existing disposal sites could potentially be reused for the placement of new dredged material. Alternatively, the Navy could create new upland disposal sites and has conducted a site selection study that identified suitable sites.

Although dredged materials are exempt from being characterized as hazardous waste under the Resource Conservation and Recovery Act (RCRA), Subtitle C, they could potentially have a harmful effect on human health or the environment if they were found to have contaminants at harmful levels. Dredged materials that exceed specified laboratory testing criteria must be managed in upland areas with engineering controls to prevent leaching of contaminants into adjacent surface or groundwater bodies. Treatment of dewatering liquids (e.g. metals and persistent organic pollutants) may be required prior to discharge. The design, construction, and monitoring of the site is subject to USACE approval. Based on historical sediment characterization, the dredge sediments to be removed from the project areas addressed in Volumes 2 and 4 are not expected to require special handling.

For upland placement, the dredged material is unloaded into a shoreside containment area or directly into sealed-end dump trucks at a designated wharf (e.g., Uniform Wharf has been used in the past). No free water is anticipated to drain back into Apra Harbor. The retention area would be constructed in accordance with Navy specifications for Temporary Environmental Control that requires a filter fabric liner. The trucks haul the dredged material to a pre-designated upland placement site for potential subsequent beneficial use.

The upland placement sites are enclosed by earthen berms approximately 13 ft (4 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. No effluent is anticipated. Non hazardous dredged material water is allowed to evaporate or percolate through the ground. Utilities in the site would be realigned outside of the enclosure. No closure plan or environmental monitoring is proposed. The exterior slopes would be seeded to discourage erosion and minimize visual impact. The drying material is unlikely to generate dust, but once dry there would be dust associated with relocating the dry materials. Unlike hydraulic dredging, no ponding water from the placement of the mechanically removed material is anticipated that might attract migrating birds. In the event a site becomes an attractive nuisance for migrating birds, they could be discouraged by decoys and noise makers. Once the dredged material is removed, the CDF site could be re-leveled for alternative use or re-used for future dredged material placement.

There are existing upland placement facilities on-base and potential new sites have been identified, as shown on Figure D-2 and described in Table D-1.

**Table D-1. Potential Upland Placement Site Characteristics**

| | *Field 3* | *Field 4* | *Field 5* | *PWC Compound* | *Polaris Point* |
|---|---|---|---|---|---|
| Site Area (acres) | 16.0 | 26.6 | 53.2 | 27.8 | 44.3 |
| Dike Center Line Perimeter (ft) | 2,965 | 5,600 | 7,000 | 5,000 | 5,900 |
| Dike Width (ft) | 8 | 8 | 12 | 12 | 12 |
| Dike Elevation (ft) | 18.5 | 16.00 | 26.00 | 19.00 | 31.00 |
| Dredged Material Lift Height (ft) | 16.50 | 14.00 | 24.00 | 17.00 | 29.00 |
| Dike Volume (CY) | 129,005 | 185,837 | 606,667 | 242,778 | 711,278 |
| Internal Volume (CY) | 296,915 | 414,968 | 1,453,237 | 519,684 | 1,361,372 |
| Total Capacity (CY) | 425,920 | 600,805 | 2,059,904 | 762,461 | 2,072,649 |
| | | | | | |
| Sierra Wharf Dredge Volume (CY)[1] | 508,877 | | | | |
| Aircraft Carrier Dredge Volume (CY)[2] | 479,000 (Former SRF) – 608,000 (Polaris Point) | | | | |
| Capacity for 100% of which project | Sierra | Sierra or aircraft carrier | Sierra & aircraft carrier | Sierra or aircraft carrier | Sierra and aircraft carrier |
| NEPA documentation exists for upland placement site? | Yes-Alpha/Bravo Improvements | No | Yes-Alpha/Bravo Improvements | No | Yes-Inner Apra Harbor maintenance dredge project |

Figure D-4. Upland De-Watering Site Locations

The Commercial Port Sites are not being considered in this EIS/OEIS, because they are on non-DoD land. Port Authority Guam or other GovGuam entity would be responsible for preparing the NEPA documentation and acquiring permits for the establishment of a upland placement site.

The potential environmental impacts of using Field 3 and Field 5 are addressed in the P-431, Alpha-Bravo Wharves Improvements EA. The Polaris Point site was considered for the Inner Apra Harbor maintenance dredging project and addressed in the corresponding EA *(Final Environmental Assessment Inner Apra Harbor Maintenance Dredging, Guam, Department of Navy, October 2003*). PWC Compound and Field 4 have not been addressed previously in a NEPA document. As shown in Table D-1, only one of the various upland placement site options would be required to accommodate the entire dredged volume anticipated for Sierra Wharf dredging (508,877 CY [389,064 $m^3$], including 2-ft overdredge). The Polaris Point and Field 5 sites would each have sufficient capacity for both the Sierra Wharf and aircraft carrier wharf dredge material volume. Assuming 100% upland site placement, there is adequate capacity identified among these sites for the two dredging projects. Used in combination with ODMDS and beneficial use, only a portion of one of the candidate sites would be required to accommodate the dredged material.

Beneficial use is the preferred disposal option for clean dredged material when practical. The material must meet engineering specifications for the specific beneficial reuse. A number of opportunities for beneficial use have been identified, including backfill for a commercial port expansion, construction material for roads, or daily landfill cover. Prior to beneficial use, the dredged material must be tested to ensure it meets the engineering specifications for the proposed reuse. If a beneficial reuse is not identified for this dry material it would occupy valuable space that could otherwise be available for more dredged material. Beneficial reuse may require additional NEPA review.

<u>PWC Site</u>: As described in the Dredged Material Upland Placement Study, Apra Harbor Guam, (NAVFAC Pacific 2008) the PWC site is bounded by Harbor Drive to the south, Marine Drive to the west, Sumay Drive to the east and NOB Hill Bowl Theater to the north. The proposed medical dental clinic would be west of the site. A upland placement area with a footprint size of 27.8 acres (11.3 ha) would provide capacity for dewatering of material from the Sierra Wharf dredging project. The maximum capacity that could be stored at this site is approximately 762,461 $yd^3$ (582,943 $m^3$). This assumes a dike height of 19 ft. (5.8 m) and would require 242,778 $yd^3$ (185,617 $m^3$) of dike material.

Assuming mechanical dredging as a worst case scenario, dredged material would be excavated using a clamshell dredge and placed in an adjacent dump scow. Tugs would transport the scow approximately 0.5 mile (0.8 km) to Uniform Wharf. Material would be offloaded at the wharf using a 30-ton crane equipped with a 15-$yd^3$ (11.46 $m^3$) clamshell bucket. Then material would be loaded directly into sealed-end dump trucks for transportation to the upland placement facility or temporarily stored in a bermed retention area on Uniform Wharf. The maximum dimensions for the retention area would be 400 ft (120 m) by 35 ft (10 m). The design would be in accordance with Navy specifications for Temporary Environmental Control (Specification 01575).

The transportation route to the upland placement site extends approximately 0.25 miles (0.4 km), along Sumay Drive to an access road on Harbor Drive. Approximately 20–30 truck trips per hour are anticipated during active dredging periods. At the upland placement site, material would be offloaded and spread evenly to keep dike height and drying time to a minimum. A bulldozer and dragline would be used to spread the material. Dried dredged material would be used to increase dike height as facility fills.

The 27.8 acres (11.3 ha) upland placement site would be constructed with an earthen dike with side slopes of 1 vertical on 3 horizontal. The perimeter along the centerline of the dike would be approximately 5,000 ft (1,524 m). Site preparation costs including the removal of abandoned buildings needs to be considered. Upland placement sites would be constructed prior to the onset of dredging. Both sites would require vegetation clearing, scouring and compaction. No soil or fill would be brought to or removed from the site.

No closure plan or environmental monitoring is anticipated. The exterior slopes would be seeded to discourage erosion and minimize visual impact. The drying material is unlikely to generate dust until it is disturbed in preparation for beneficial use. A fabric fence would be constructed around the perimeter if dust becomes an issue. No ponding water is anticipated, so no impact to migratory birds is anticipated; however, they can be discouraged using netting, decoys or noise makers. Once dried dredged material is removed, the site can be graded for alternative land use or reused as a dewatering facility.

Field 3: Field 3 is located on undeveloped land south of the Commissary (NAVFAC Pacific 2008). It is bounded by Exchange Road (Route 2B), Shoreline drive and on the west an unmarked north-south arterial connecting Shoreline Drive with marine Drive. The site is approximately 16 acre (6.5 ha). Maximum capacity at the site would be 425,920CY (325,639 m3). The transportation route from Inner Apra Harbor is approximately 1.75 miles (2.8km). A water line would be relocated.

Field 4: The Field 4 Upland placement site is situated on undeveloped lands near the Tipalao housing complex. The site is bounded by Shoreline Drive to the west and Marine Drive to the east. The Field 4 site, with a footprint size of 26.6 acres (10.8 ha), would be constructed to provide capacity for dewatering of material from the Sierra construction dredging project. The maximum capacity that could be stored at this site would be approximately 600,805 CY (459,348 m3). This assumes a dike height of 16 ft. (4.9 m) and a lift height of 14 ft (4.3 m). The proposed Military Working Dog Kennel relocation site is within the Field 4 southern boundary. The upland placement site capacity and footprint would be reduced to avoid impact to the kennel.

Dredged material handling would be as described for the PWC site. The transportation route to the upland placement site extends approximately 1.2 miles (0.9 km), along Sumay Drive to an access road. At the upland placement site, material would be offloaded and spread evenly to keep dike height and drying time to a minimum. Earthen dikes would form the exterior walls of the upland placement site. Dried dredged material would be used to increase dike height as the facility fills. The dredged material height within the site would always be below the perimeter berm height. No effluent is anticipated and no infiltration fields are proposed.

The 26.6 acres (10.8 ha) upland placement site would be constructed with an earthen dike with side slopes of one vertical on three horizontal. The perimeter along the centerline of the dike is approximately 5,600 ft (1,707 m). Consideration for removal of power lines is needed.

Field 5: Field 5 upland placement site is located between Marine Drive and Sumay Drive (NAVFAC Pacific 2008). The footprint would be approximately 53 acres (21.5 ha) and maximum capacity is estimated at 2,059,904 CY (1,574,910 $m^3$). The transportation route is approximately 1.2 miles (1.9 km) from Uniform Wharf along Sumay Drive to an access road. A portion of the site has been used for placement of dredged materials.

Polaris Point: The Polaris Point Site (NAVFAC Pacific 2008) is undeveloped land occupying the central and southeastern portions of Polaris Point. It is bound by Inner Apra Harbor to the south, a fence line to the east, and Polaris Point Road to the north and west. The footprint is approximately 2,072,649 CY (1,584,654 $m^3$). The materials would be offloaded at Alpha Wharf to dump trucks and transported approximately 0.25 miles along Polaris Point Road. It can contain an estimated 2,072,649 CY (1,584,654 $m^3$) of dredged material.

## 1.4 MUNITIONS

### 1.4.1 Introduction

The majority of the munitions proposed at the ranges proposed in this Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) are small arms. The term "small arms" defines a family of firearms that may be both carried and discharged by one person, as opposed to artillery weapons. Small arms include rifles, handguns (pistols and revolvers), shotguns, submachine guns, and machine guns. Generally, small arms are those of .50 caliber (cal) or less. Small arms ammunition nomenclature is expressed by caliber (the diameter of the bullet measured in inches) or the diameter of the bullet in millimeters (mm). For example, a .50 caliber round measures approximately 0.5 inches in diameter and a 9 mm round measures 9 mm in diameter.

In this EIS/OEIS, small arms ammunition that would be authorized for use at proposed ranges on Guam includes 5.56 mm, 9 mm, 7.62 mm, and .50 caliber. Ranges on Tinian would be authorized for 5.56 mm, 9 mm, 7.62 mm, and .45 calibre.

### 1.4.2 Munitions Constituents

The primary munitions constituent (MC) associated with small arms is lead. Other MCs include antimony, arsenic, copper, zinc, iron, manganese, lead styphnate, and lead azide. Lead styphnate and lead azide are more typically associated with the firing point while antimony, copper, zinc, and lead are more typically associated with the impact area (NAVFAC 2008).

Table D-2 provides data on the chemical composition of small arms projectiles proposed for use at ranges proposed in this EIS/OEIS. The U.S. Army has identified the following small arms range and small arms range contaminant features of note (U.S. Army Environmental Center [USAEC] 2006):

- Of the metals typically associated with small arms ranges, lead and copper have the lowest potential for mobility due to their relatively low solubility constants in soil.
- Antimony generally has moderate mobility in soil and remains readily adsorbed to soil particles in neutral to low pH ranges.
- Zinc is highly mobile in soil and has the potential to migrate off-range.
- Lead and copper are found in the highest concentrations on the range, while zinc concentrations are generally one to two orders of magnitude lower, followed by antimony.
- Using risk-based concentrations as a guide, copper and zinc have a relatively low toxicity; lead and antimony toxicities are relatively high.
- A soil's cation exchange capacity is assumed to have a predominant influence on lead adsorption to soil particles among other soil properties and soils comprised of smaller particles such as silt and clay will result in higher lead adsorption to soil particles.

**Table D-2. Elemental Weight Composition of Small Arms Projectiles**

| Munition | Jacket Description | Total Elemental Weight (grains) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Cu | Zn | Fe | Pb | Mn | Sb | As |
| 5.56 mm, ball, M855 | Jacket Pointed – Cu Alloy | 17.82 | 1.96 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| 5.56 mm, ball, M193 | Jacket Pointed – Cu Alloy | 15.75 | 1.73 | 0.01 | 38.12 | 0.00 | 0.39 | 0.00 |
| 5.56 mm, tracer, M196 | Cu Alloy Clad Steel | 4.50 | 0.50 | 19.09 | 26.24 | 0.05 | 0.27 | 0.00 |
| 7.62 mm, NATO ball, M80 | Cu Alloy Clad Steel | 6.21 | 0.68 | 27.44 | 112.86 | 0.07 | 1.14 | 0.00 |
| | Alt - Cu Alloy | 31.05 | 3.42 | 0.02 | 91.20 | 0.00 | 5.82 | 0.00 |
| 7.62 mm, ball, M59 | Brass | 51.30 | 5.64 | 54.26 | 38.14 | 0.47 | 0.39 | 0.00 |
| 7.62 mm, tracer, M62 | Cu Alloy Clad Steel | 11.70 | 1.29 | 47.73 | 71.29 | 0.12 | 0.72 | 0.00 |
| | Alt - Cu Alloy | 554.90 | 6.04 | 0.03 | 71.31 | 0.00 | 0.72 | 0.00 |
| 9 mm | Gliding Metal | 22.95 | 2.52 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 |
| .50 cal[1] DoDIC A555 | | | | | | | | |

*Legend*: As = arsenic; Cu = copper; Fe = iron; Mn = manganese; Pb = lead; Sb = antimony; Zn = zinc.
*Sources*: Munitions Items Disposition Action System data in NAVFAC (2008).

1. Data not available for these .50 caliber munitions

### 1.4.3 Small-Arms Cartridge Construction

A complete small-arms round is known as a cartridge and generally consists of a cartridge case, primer, a quantity of propellant within the cartridge case, and a bullet or projectile. Blank and rifle grenade cartridges are sealed with paper closure disks in lieu of bullets. A typical cartridge and the terminology of its components are shown on Figure D-5.

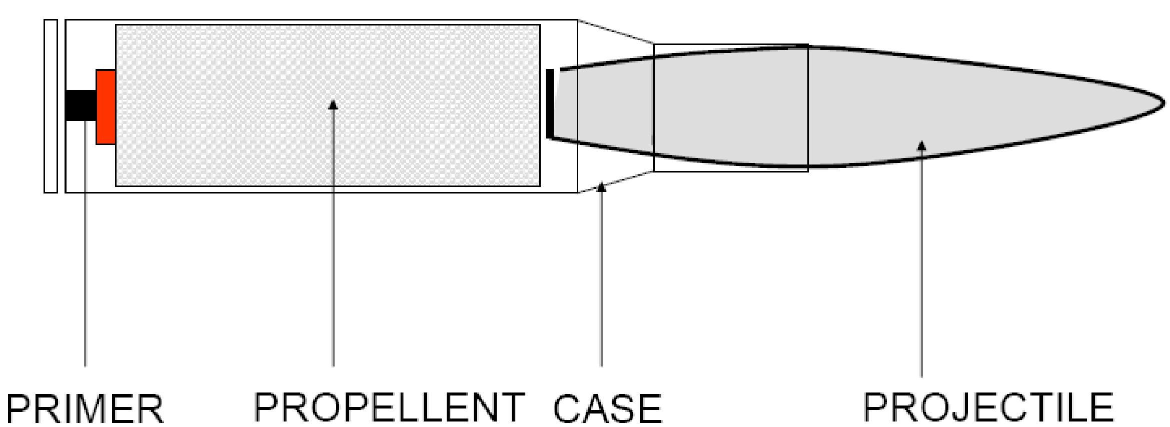


**Figure D-5. Small Arms Cartridge Construction**

The cartridge case is the means by which the other components are assembled and provides a waterproof container for the propellant. The cartridge case is expended from the weapon at the firing line and collected and removed from the range. The primer is functioned (exploded) by a blow from the firing pin of the weapon. The primer ignites the propellant (smokeless powder), which in turn imparts the necessary velocity to project the bullet down range.

*Projectile*: The bullet is generally cylindrical with a round or oval nose. The base may be square or boat tailed. With few exceptions, bullets through .50 cal are assemblies of a jacket and a lead or steel core. Ball rounds usually contain a slug of antimony hardened lead. The outer core of the .50 cal round is made of soft steel. Tracer rounds contain a lead slug and a chemical composition in the rear. The bullet jacket may be either gliding metal, gliding metal clad steel, or copper plated steel.

*Case*: Although steel, aluminum, zinc, and plastic materials have been used experimentally, brass, a composition of 70% copper and 30% zinc, is the most commonly used material for cartridge cases.

*Propellant*: Cartridges are loaded with varying weights of propellant. This is to impart sufficient velocity (within safe pressures) to the projectile to obtain the required ballistic performance. These propellants are either of the single-base (nitrocellulose) or double-base (nitrocellulose and nitroglycerine) type. The propellant grain configuration may be cylindrical with a single, lengthwise perforation, spheroid (ball) or flake. Most propellants are coated with a deterrent (to assist in controlling the rate of combustion) and with a final coating of graphite (to facilitate flow of propellant and eliminate static electricity in loading cartridges).

*Primer*: Small-arms cartridges contain either a percussion or electric primer. The percussion primer consists of a brass or gliding metal cup that contains a pellet of sensitive explosive material secured by a paper disk and a brass anvil. The electric primer consists of an electrode button in contact with the priming composition, a primer cup assembly, and insulator.

Once a projectile ejects from the bore of the weapon, it travels towards the target. Because of scouring of the projectile in the weapon barrel, a small amount of copper (if the bullet is copper jacketed) and/or lead (unjacketed projectile) may be deposited near the firing point. In addition, small quantities of propellant powder and lead styphnate used in the primer may also be released. The projectile then impacts the berm backstop (when present) or falls in the impact area.

The extent of fragmentation of the projectile influences the rate of corrosion, the release of lead and other metal ions, and migration potential. Intact rounds and rounds fragmented into relatively large pieces are not easily transported by natural transport mechanisms. Generally, 9 mm pistol rounds will stay intact upon impact with the soil and are usually found with little to no deformation or fragmentation. Conversely, rifle rounds (5.56 mm, 7.62 mm) travel at much higher velocities and will impact the ground with much more force. At relatively short distances, 82-656 ft (25-200 m), these rounds will often fragment into very small particle sizes upon impact with the soil. Beyond these distances, there is less fragmentation, resulting in large metal fragments and intact rounds. The degree of fragmentation appears to be more a function of distance from the firing point as opposed to the type of soil into which the round is being fired (USAEC 2006).

### 1.4.4 Other Munitions, Explosives, and Pyrotechnics

Table D-3 summarizes data for other munitions, explosives, and pyrotechnics proposed for use during training activities on Guam assessed in this EIS/OEIS.

**Table D-3. MC for Other Munitions, Explosives, and Pyrotechnics or Proposed Ranges and Training Areas on Guam**

| *Munition* | *MC* | *Location Proposed for use in this EIS/EOIS* |
|---|---|---|
| MK19 40 mm TP | ( No explosive component) | Machine Gun Range, Guam |
| M67 Hand Grenade, Fragmentation | 185 g of Composition B explosive that is 60% military-grade RDX (hexahydro-1,3,5-trinitro-1,3,5- triazine), 39% military-grade TNT, and 1% wax. Military-grade RDX contains about 10% HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine), | Hand Grenade Range, Andersen South<br>Hand Grenade House, Andersen South or NCTS Finegayan |
| Grenade, flash bang (“Stun grenade”) | 4.5 grams of a pyrotechnic metal-oxidant mix of magnesium or aluminum and an oxidizer such as ammonium perchlorate or potassium perchlorate | Hand Grenade House, Andersen South or NCTS Finegayan |
| C4 | 91% RDX, 9% oil | Demolition Range |
| Flare, Surface, Trip | DoDIC L495 | MOUT and Maneuver Training Areas, Andersen South |
| Signal, Illumination Ground (“Slap flare”) | DoDIC L312 | MOUT and Maneuver Training Areas, Andersen South |
| Ground Burst (Artillery Simulator) | DoDIC L594 | MOUT and Maneuver Training Areas, Andersen South |
| Green hand smoke | DoDIC L940 | MOUT and Maneuver Training Areas, Andersen South |
| Yellow hand smoke | DoDIC L945 | MOUT and Maneuver Training Areas, Andersen South |
| TNT | 100% TNT | Breacher and Shooting House, Andersen South<br>Demolition Range, NCTS Finegayan |

*Source*: Hewitt et al. 2007.

## 1.5 REFERENCES


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