3.1 Sediments and Water Quality

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3.1 Sediments and Water Quality

3.1.1 Affected Environment

The purpose of this section is to supplement the analysis of impacts on sediments and water quality as presented in the 2015 Mariana Islands Training and Testing (MITT) Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) with new information relevant to proposed changes in training and testing activities conducted at sea and on Farallon de Medinilla (FDM). Information presented in the 2015 MITT Final EIS/OEIS that remains valid is noted as such and referenced in the appropriate sections. Any new or updated information describing the affected environment and analysis of impacts on sediments and water quality associated with the Proposed Action is provided in this section. Comments received from the public during scoping related to sediments and water quality are addressed in Section 3.1.3 (Public Scoping Comments) (Denton et al., 1997; U.S. Department of the Navy, 2015).

3.1.1.1 Existing Conditions

Ocean water resources, climate, and the existing water quality in the MITT Study Area were discussed in the 2015 MITT Final EIS/OEIS. The 2015 MITT Final EIS/OEIS analyzed potential impacts on sediment quality in nearshore and deep water sediments, as well as water quality on the surface and within the water column, and determined that potential impacts on sediment and water quality would not be significant. As stated in the 2015 MITT Final EIS/OEIS, some studies suggest that deep water is, in general, of higher quality than surface waters. Additionally, water quality in marine environments is determined by complex interactions between physical, chemical, and biological processes (U.S. Department of the Navy, 2015).

There is no new information since the publication of the 2015 MITT Final EIS/OEIS for marine sediments that would alter the analysis of potential impacts on water and sediment quality. New information, however, has been released that would improve the understanding of existing conditions for water quality, mainly with regards to marine debris and climate change. In addition, published results that inform the evaluation for water quality impacts in the immediate vicinity of FDM are now available and summarized below. The new information, however, does not indicate an appreciable change to the existing environmental conditions as described in the 2015 MITT Final EIS/OEIS.

3.1.1.1.1 Marine Debris and Water Quality

Richardson et al. (2016) describe the results of seine net (vertical nets that are held in place with weights and buoys) surveys in open ocean waters of the western and central Pacific Ocean within exclusive economic zones (EEZs) of 25 Pacific countries and territories, as well as in international waters. A majority of the reported purse seine (a seine net that fully encompasses an area of fish) pollution incidents are related to plastics waste. Other common pollution incidents are related to oil spillages and to abandoned, lost, or dumped fishing gear. Data analysis highlighted the need for increased monitoring, reporting, enforcement of pollution violations for all types of fishing vessels operating in the Pacific region, a regional outreach and compliance assistance program on marine pollution prevention, and improvements in Pacific port waste reception facilities. Most of the pollution incidents associated with marine debris occurred in Papua New Guinea’s EEZ (approximately 45 percent), while less than 1 percent of the debris accumulations collected on the surface by Richardson et al. (2016) were within the portion of the United States (U.S.) EEZ surrounding Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and other U.S. Pacific islands.

3.1.1.1.2 Climate Change and Water Quality

New information on the potential for climate change to impact water quality was obtained for the western Pacific region. The 2015 MITT Final EIS/OEIS identified decreasing ocean pH (i.e., increasing acidity), increasing water temperatures, and increasing storm activity as aspects of climate change that potentially impact water quality.

Rainfall and tropical cyclones are significant aspects of the climate on islands within the Study Area; however, potential impacts on rainfall and tropical cyclone patterns are difficult to estimate (Keener et al., 2015). One study for Guam predicts fewer, but more intense, storms, that would likely follow new storm tracks, and a moderate increase in daily and annual average rainfall (U.S. Marine Corps, 2014). On Saipan, an assessment of vulnerability to climate change assumed a future small increase in average rainfall, an increase in extreme rainfall, as well as more extreme wet and dry seasons. Although difficult to predict, changes in rainfall and storm intensity are generally anticipated to be harmful to ecosystems that provide ecological services beneficial to water quality within the Study Area.

Keener et al. (2015) documented a coral bleaching event off of Guam in 2013 through 2014. That event, combined with the strong associations between sea surface temperature increases and coral bleaching events throughout the Pacific (Griesser & Spillman, 2016), suggests that it is highly likely sea surface temperature increases in the Mariana Islands are at least partially to blame for coral bleaching events. Coral cover on Guam is generally similar to other southern Mariana Islands, but lower than the northern islands (Raymundo et al., 2016). Because coral distribution and coral cover on reefs is naturally patchy and heterogeneous, a single island-wide number is not a particularly useful summary of the coral community. Long-term monitoring surveys conducted by the National Oceanic and Atmospheric and Administration’s Coral Reef Ecosystem Division Pacific Assessment and Monitoring Program found approximately 10−15 percent coral cover overall, but the recent multi-year coral bleaching events have had dramatic, if patchy, consequences for the reef communities on Guam. For example, Raymundo et al. (2017) estimated a 53 percent decline in staghorn *Acropora* spp. on Guam. Of the 21 sites in the study, 6 are on Joint Region Marianas-administered submerged lands, including 4 in Apra Harbor. The estimated mean mortality of staghorn *Acropora* spp. was 80 percent at Big Blue Shoals, 80 percent at Western Shoals, 30 percent at Dogleg, and 90 percent at Gab (Raymundo et al., 2016). In the past several years, corals in Guam have been bleaching regularly each summer and recovery has been limited, leading to significant levels of coral mortality (Harvey, 2016; Raymundo et al., 2017).

Even though the new studies show variability in coral cover at FDM and decreases in some coral species off Guam, this information does not appreciably change the analysis presented in the 2015 MITT Final EIS/OEIS because the species composition on the reefs has not changed.

Changes in pH outside the normal range can make it difficult for marine organisms that make hard structures through calcification (e.g., shells or skeletons) to maintain their structures. Many of those creatures are at the base of the marine food chain, such as phytoplankton, so changes may cascade through the ecosystem. Rising water temperatures can be detrimental to coastal ecosystems and, by extension, coastal water quality because these ecosystems provide ecological services (e.g., sediment trapping, nutrient cycling).

3.1.1.1.3 Farallon de Medinilla

Range condition assessments are conducted at all operational ranges within the Mariana Islands Range Complex in accordance with Department of Defense (DoD) Instruction 4715.14, Operational Range Assessments, and the Chief of Naval Operations Range Sustainability Environmental Program Analysis

Policy. The Navy is committed to surveying the FDM coral reef environment every five years, as well as performing the routine clearance of unexploded ordnance and other range debris from the FDM impact areas. The coral reef surveys provide an indication if the waters surrounding FDM (designated Class A) are degrading in quality, as evidenced by coral health. Routine clearance of unexploded ordnance from the FDM impact areas removes potential sources of munition constituents, helping to protect CNMI's water quality. The Navy engaged with the National Marine Fisheries Service in coral consultations under the Endangered Species Act (ESA) and through the Essential Fish Habitat Assessment, relevant to all species of corals and essential fish habitats that are present in the Study Area. These consultations and regulatory conclusions were summarized in the 2015 MITT Final EIS/OEIS.

No detailed data was available for munitions expenditure during the last three decades of the 20th century on FDM, but early environmental planning documents in 1974 and 1999 provide some insight to the source loading. Delivered munitions that resulted in either a low-order detonation or a “dud” are the predominant energetic munition constituent source material on FDM. Munition constituents commonly associated with munitions such as high melting explosive (HMX) (also referred to as octogen), royal demolition explosive (RDX) (also referred to as cyclonite), dinitrotoluene (DNT), and heavy metals are likely present in small dispersed residual quantities associated with high-order detonations and in localized higher concentrations associated with duds or low-order detonations. Areas with high explosive concentrations are often found around “carcasses” of munitions that were only partly detonated. Heavily cratered areas on military ranges often have below detection or low high-explosive concentrations, suggesting that high-order detonations leave only trace amounts of explosive residues (U.S. Army Corps of Engineers, 2007).

The frequency of low-order detonations or dud rates of munitions fired into the impact zones at FDM is not known; however (MacDonald & Mendez, 2005) provided failure rates and low-order detonation rates for various munitions types, shown in Table 3.1-1.

Table 3.1-1: Rates of Failure and Low-Order Detonations

Ordnance	Failure Rate (Percent)	Low-Order Detonation Rate (Percent)
Guns/artillery	4.68	0.16
Hand grenades	1.78	–
Explosive ordnance	3.37	0.09
Rockets	3.84	–
Submunitions[1]	8.23	–

[1] Submunitions are munitions contained within and distributed by another device such as a rocket.

Sources: MacDonald and Mendez (2005); U.S. Army Corps of Engineers (2007)

Since the publication of the 2015 MITT Final EIS/OEIS, the draft analysis of multi-year dive surveys conducted in nearshore waters of FDM between 1997 and 2012 has been published (Smith & Marx, 2016). During these dive surveys, Smith and Marx (2016) provide qualitative observations of water quality and sediment quality surrounding the live-fire range. A summary of the observations is included below, and a more detailed description of the surveys and observations may be found in Section 3.1.3.1.5.3 (Farallon de Medinilla Specific Impacts) of the 2015 MITT Final EIS/OEIS. (Smith & Marx, 2016).

- **Natural causes of erosion**. Based on these direct observations of damage off the coast of FDM, the majority of disturbances to the seafloor sediments, substrates, and mass wasting of FDM can be attributed to typhoons and storm surges. Further, damage attributed to military training activities recovered within two to three years at the same rate of damage associated with natural phenomenon (Smith & Marx, 2016). As discussed in Section 3.10 (Terrestrial Species and Habitats), prior to the mid-1990s, the ordnance drops on FDM were not confined to designated impact zones, and there were no ordnance constraints in terms of net explosive weight. The vegetation loss on the island and subsequent erosion has likely decreased under current training constraints for FDM relative to the intensive range use over the decades prior to the mid-1990s.
- **Assessment of long-term impacts: military impacts**. Based on the dive surveys, there is no evidence that long-term adverse impacts on the nearshore environment have taken place as a result of military training activities. These findings are based on the number of detectable impacts (e.g., from visual observation during dive surveys), the size of those impacts, and the apparent recovery time (e.g., how long an ordnance fragment or physical damage is no longer visually apparent). Impacts on the physical environment clearly attributable to military training activities were noted in 2007, 2008, 2010, and 2012 (Smith & Marx, 2016). Indirect impacts, such as ordnance skipping or eroding off of FDM and rock and ordnance fragments blasted off of the island, were detected in every survey year. Dive surveys completed in 2005 noted that disturbed sites in 2004 showed no color differences with surrounding undamaged areas, and revealed new, small (less than 3 centimeters), scattered colonies of coral and crustose coralline algae. By 2006 and observed again through 2012, no visual evidence of abnormalities, or of damaged or diseased coral, could be detected (Smith et al., 2013). Further, no new submerged cliff blocks were observed between 2005 and 2012. Small-to-medium-sized fresh rock fragments (generally less than 1 foot [30 centimeters]) have been observed yearly, and are attributed to detonation impacts. In 2007, the first clear indication of a detonation of a bomb on the seafloor was observed. The impact area was measured to be approximately 100 square feet (9 square meters). During the subsequent survey in 2008, the impact area supported new growth of stony corals and crustose algae; by 2009, no trace of the disturbance could be detected by the surveyors (Smith & Marx, 2009). The vast majority of unexploded ordnance observed in the water lacked fins and tail assemblies, which indicates that the ordnance either skipped or ricocheted off of the island, or eroded or washed off of FDM at a later date (Smith & Marx, 2016).
- **Indicators of diminished water quality**. The dive surveys have looked for indicators of diminished water quality in waters surrounding FDM. For instance, high densities of macrobioeroders (e.g., boring sponges), bleaching of corals, surface lesions, or dead patches on stony corals or stony coral mucus production have been associated with sedimentation, pollutants, or other stressors that diminish water quality. Although a moderate bleaching event was noted in 2007, and a barnacle infestation was noted in 2012 (Smith et al., 2013), the bleaching event was regional and extended from southern Japan through the Mariana Islands and south through waters surrounding Palau, which suggests that it was not due to training events at FDM. In addition, subsequent surveys observed soft and fire corals had recovered completely, and 75 percent of the stony corals had recovered by 2008 (Smith & Marx, 2009, 2016). The dive surveys were not conducted in more recent years with bleaching events; however, the health of the marine ecosystem surrounding FDM was comparable to similar

habitats within the Mariana Archipelago, demonstrating that training activities occurring at FDM do not have an appreciable impact on the water quality (Smith & Marx, 2016).

3.1.2 Environmental Consequences

Section 3.1 (Sediments and Water Quality) of the 2015 MITT Final EIS/OEIS analyzed potential impacts of training and testing activities resulting from the following stressors: (1) explosives (in-air explosives and in-water explosives) and explosives byproducts, (2) metals, (3) chemicals other than explosives, and (4) a miscellaneous category of other materials. The 2015 MITT Final EIS/OEIS assessed the likelihood for these stressors to result in the following potential impacts on sediments and water quality:

- The potential release of materials into the water that subsequently disperse, react with seawater, or dissolve over time
- The potential for depositing materials on the ocean bottom and any subsequent interactions with sediments or the accumulation of such materials over time
- The potential for depositing materials on the ocean bottom and any subsequent interaction with the water column
- The potential for depositing materials on the ocean bottom and any subsequent disturbance of those sediments or their resuspension in the water column

This section evaluates how, and to what degree, potential impacts on sediments and water quality from stressors described in Section 3.0 (Introduction) may have changed since the analysis presented in the 2015 MITT Final EIS/OEIS was completed. Tables 2.5-1 and 2.5-2 in Chapter 2 (Description of Proposed Action and Alternatives) list the proposed training and testing activities, the number of times each event would be conducted annually, and the locations within the Study Area where the activity would typically occur under each alternative. The tables also present the same information for activities described in the 2015 MITT Final EIS/OEIS so that the proposed levels of training and testing under this supplement can be easily compared.

The Navy conducted a review of federal and state regulations and standards relevant to sediments and water quality, as well as a review of new literature pertaining to sediments and water quality that could inform the analysis presented in the 2015 MITT Final EIS/OEIS. Although additional information was found and described in Section 3.1.1 (Affected Environment), the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2015 MITT Final EIS/OEIS. Thus, the analysis in the 2015 MITT Final EIS/OEIS remains valid. The analysis presented in this section also considers standard operating procedures, which are discussed in Section 2.3.3 (Standard Operating Procedures) of this Draft Supplemental EIS (SEIS)/OEIS, and mitigation measures that are described in Chapter 5 (Mitigation). These measures are not specifically designed to offset potential impacts on water resources; however, implementation of some of these measures designed for other resource areas discussed in this SEIS/OEIS would avoid or reduce potential impacts on sediments and water quality. For example, Table 5.4-1 (Seafloor Resource Mitigation Areas) lists several protective measures that avoid or reduce disturbance to corals and benthic habitats, as well as targeting and ordnance restrictions that would reduce runoff into FDM's nearshore habitats.

The most relevant new information used in this section is published by the Hawaii Undersea Military Munitions Assessment (HUMMA), a program administered by the DoD and the University of Hawaii at Manoa (Briggs et al., 2016; Edwards et al., 2016; Kelley et al., 2016; Koide et al., 2016; Silva & Chock, 2016; Tomlinson & De Carlo, 2016). The investigations completed as part of the program provide quantitative information on the fate and transport of sea-disposed conventional munitions at a munitions dump site south of Oahu, including (1) the spatial extent and distribution of munitions; (2) the integrity of munitions casings; (3) whether munitions constituents could be detected in sediment, seawater, or animals near munitions; (4) whether constituent levels at munitions sites differed significantly from levels at reference control sites; (5) whether statistically significant differences in ecological population metrics could be detected between the two types of sites; and (6) whether munitions constituents or their derivatives potentially pose an unacceptable risk to human health.

3.1.2.1 Explosives and Explosives Byproducts

Sources of explosives and explosives byproducts include the various munitions used during training and testing activities. Potential impacts of explosives and explosive byproducts were analyzed in Section 3.1.3.1 (Explosives and Explosives Byproducts) in the 2015 MITT Final EIS/OEIS, and that analysis remains valid.

Over 98 percent of residual explosive materials would result from ordnance failures (i.e., the munition fails to detonate and explosives remain in the casing). Ordnance failure rates for various munition types are shown in Table 3.1-4 in Section 3.1.3.1.3 (Ordnance Failure and Low-Order Detonations) of the 2015 MITT Final EIS/OEIS. The percentages for ordnance failure range from just below two percent to just over eight percent. As part of the HUMMA program, Briggs et al. (2016) sampled for explosive materials in sediments and marine invertebrates and fish, showing no detections of explosive residue chemical markers in the biological samples. In 2009, no explosive residues were located within sediments; however, in 2012, 2 of the 121 samples showed low concentrations (0.09 and 0.12 milligrams per kilogram) of an explosive residue compound, 4-nitrotoluene. These samples were collected within 50 centimeters of a munitions casing, with no detections further away from the casing (Briggs et al., 2016). Within the Study Area, ocean currents would quickly disperse leached explosive materials in the water column, and residual explosive materials would not result in water toxicity.

3.1.2.1.1 Impacts from Explosives and Explosives Byproduct Stressors Under Alternative 1

Under Alternative 1, the number of explosive munitions used during at-sea training and testing activities would decrease, compared to the number analyzed in the 2015 MITT Final EIS/OEIS (see Table 3.0-16); however, there would be an increase in the number of activities on FDM that use explosive ordnance (Table 3.0-19). The Navy conducted an analysis as part of this SEIS/OEIS to quantify the amount of ordnance used on FDM, in terms of net explosive weight, that would change compared to what was analyzed in the 2015 MITT Final EIS/OEIS. This analysis shows that the proposed increases in ordnance use on FDM would be less than 1 percent compared to levels analyzed previously.

This small increase on FDM under Alternative 1 would have no appreciable change on the impact conclusions presented in the 2015 MITT Final EIS/OEIS because (1) most of the explosives would be consumed during detonation; (2) the frequency of low-order detonations would be low, and therefore the frequency of releases of explosives would be low; and (3) the constituents of explosives would be subject to physical, chemical, and biological processes that would render the materials harmless or otherwise disperse them to undetectable levels. Neither state nor federal standards or guidelines would be violated. The impacts of unconsumed explosives on water and sediment quality would be long term, local, and negative. Chemical, physical, or biological changes in sediment or water quality would likely be measurable, but neither state nor federal standards or guidelines would be violated.

3.1.2.1.2 Impacts from Explosives and Explosives Byproduct Stressors Under Alternative 2

As with Alternative 1, activities proposed under Alternative 2 would decrease the number of explosive munitions used during at-sea training and testing activities, compared to the number analyzed in the 2015 MITT Final EIS/OEIS (see Table 3.0-16) and increase the number on FDM. At-sea ordnance use under Alternative 2 would be greater than Alternative 1; however, the amount of ordnance use on FDM would be the same under Alternative 2 as with Alternative 1 (Table 3.0-19). Increases for at-sea activities under Alternative 2 as compared to Alternative 1 would have no appreciable change on the impact conclusions for explosives and explosives byproducts stressors as was presented in the 2015 MITT Final EIS/OEIS. Therefore, under Alternative 2, impacts on sediments and water quality from the use of explosives and generating explosives byproducts would be negligible.

3.1.2.1.3 Impacts from Explosives and Explosives Byproduct Stressors Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Explosives and explosives byproduct stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing at-sea training and testing activities would result in fewer explosives and explosive byproducts introduced into the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing at-sea training and testing activities under the No Action Alternative would lessen the potential for impacts on sediments and water quality resulting from explosives and explosive byproducts.

3.1.2.2 Metals

Sources of metals introduced into the marine environment as part of training and testing activities include munitions and expended materials containing metals (i.e., lead, brass, manganese, copper, nickel, tungsten, chromium, molybdenum, vanadium, boron, selenium, columbium, or titanium). Since the publication of the 2015 MITT Final EIS/OEIS, the Navy has conducted a review of new literature pertaining to the potential impacts of metals on sediments and water quality. Although additional information was found, as described in the following paragraph, the new information does not indicate an appreciable change to the existing environmental conditions as described in the 2015 MITT Final EIS/OEIS.

As described in Section 3.1.3.1 (Explosives and Explosives Byproducts) of the 2015 MITT Final EIS/OEIS, sediment samples collected from World War II-era munitions disposal sites and heavily used Navy ranges show that metals are not impacting sediment quality despite longtime use and high concentrations of military munitions composed primarily of metal components (Briggs et al., 2016; Kelley et al., 2016; Koide et al., 2016; Smith & Marx, 2016; U.S. Department of the Navy, 2013). The concentration of munitions and other expended materials containing metals in any one location in the Study Area would be a small fraction of that from a munitions disposal site, a target island used for 45 years, or a water range in a river used for almost 100 years. Chemical, physical, or biological changes to sediments or water quality in the Study Area would not be detectable and would be similar to nearby areas without munitions or other expended materials containing metals. This conclusion is based on the following: (1) most of the metals are benign, and those of potential concern make up a small percentage of expended munitions and other metal objects; (2) metals released through corrosion would be diluted by currents or bound up and sequestered in adjacent sediments; (3) elevated concentrations of metals in sediments would be limited to the immediate area around the expended material; and (4) the areas over which munitions and other metal components would be distributed are large.

3.1.2.2.1 Impacts from Metal Stressors Under Alternative 1

Under Alternative 1, the number of sources of metals that would be expended during training and testing would increase as compared to the 2015 MITT Final EIS/OEIS (see Table 3.0-14 through Table 3.0-17 and Table 3.0-19). Although the overall amount of metals introduced to the Study Area would increase, the analysis is not dependent on the amount of metals. Instead, the 2015 MITT Final EIS/OEIS analyzed whether or not the metals deposited from training and testing activities would impact sediments and water quality.

Since the publication of the 2015 MITT Final EIS/OEIS, the Navy has conducted a review of existing federal and local regulations and standards relevant to sediments and water quality, as well as a review of new literature pertaining to sediments and water quality. There is no new information that changes the basis of the conclusions presented for the potential impacts of metals on sediments and water quality. Therefore, the increases shown in Tables 2.5-1 and 2.5-2 for training and testing activities proposed under Alternative 1 would have no appreciable change on the impact conclusions presented in the 2015 MITT Final EIS/OEIS.

3.1.2.2.2 Impacts from Metal Stressors Under Alternative 2

Under Alternative 2, the number of sources of metals being expended would increase as compared to the 2015 MITT Final EIS/OEIS and Alternative 1 (see Tables 3.0-14 through Table 3.0-17 and Table 3.0-19). These increases would have no appreciable change on the impact conclusions for metals as summarized above under Alternative 1 and as presented in the 2015 MITT Final EIS/OEIS. Therefore, under Alternative 2, impacts on sediments and water quality from activities that expend metals would be negligible.

3.1.2.2.3 Impacts from Metal Stressors Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Metal stressors as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing training and testing activities would result in fewer metals introduced into the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for impacts on sediments and water quality resulting from metals released during training and testing activities.

3.1.2.3 Chemicals Other Than Explosives

Chemicals other than explosives are associated with the following military expended materials: (1) solid-fuel propellants in missiles and rockets; (2) Otto Fuel II torpedo propellant and combustion byproducts; (3) polychlorinated biphenyls in target vessels used during sinking exercises; (4) other chemicals associated with explosive munitions; and (5) chemicals that simulate chemical warfare agents, referred to as “simulants.”

Simulants: Simulants were not analyzed in the 2015 MITT Final EIS/OEIS. The Department of Defense uses compounds, referred to as simulants, as substitutes for chemical and biological warfare agents to test equipment intended to detect their presence. Simulants must have one or more characteristics of a real chemical or biological agent—size, density, or aerosol behavior—to effectively mimic the agent. Simulants must also pose a minimal risk to human health and the environment to be used safely in outdoor tests.

Simulants are selected using the following criteria: (1) safety to humans and the environment, and (2) the ability to trigger a response by sensors used in the detection equipment. Simulants would be relatively benign (e.g., low toxicity or effects potential) from a human health, safety, and environmental perspective. Exposure levels during testing activities would be well below concentrations associated with any adverse human health or environmental effects. The degradation products of simulants used during testing would also be harmless. Given these characteristics of simulants used during testing activities, it is reasonable to conclude that simulants would have no impact on sediments and water quality in the Study Area. Simulants are not analyzed further in this section.

3.1.2.3.1 Impacts from Chemical Stressors Other than Explosives Under Alternative 1

Under Alternative 1, the number of sources of chemicals other than explosives would increase as compared to the 2015 MITT Final EIS/OEIS (see Table 3.0-14 through Table 3.0-17 and Table 3.0-19).

The fate and transport of solid fuel propellants are described in Section 3.1.3.3.2 (Missile and Rocket Propellant – Solid Fuel) of the 2015 MITT Final EIS/OEIS. The analysis in the 2015 MITT Final EIS/OEIS concluded that, based on the small amount of residual propellant that would remain from training and testing activities using missiles or rockets, perchlorates would not occur in concentrations that would impact sediments and water quality in the Study Area. The changes in the number of missiles and rockets shown in Tables 2.5-1 and 2.5-2 for activities proposed under Alternative 1 would have no appreciable change on the impact conclusions presented in the 2015 MITT Final EIS/OEIS.

The fate and transport of Otto Fuel II torpedo propellant and combustion byproducts are described in Section 3.1.3.3.3 (Torpedo Propellant – Otto Fuel II and Combustion Byproducts) of the 2015 MITT Final EIS/OEIS. Otto Fuel II and its combustion byproducts would be released into the water column only in small amounts during combustion. Furthermore, all non-explosive torpedoes are typically recovered for reuse following training and testing activities, which removes any unconsumed fuel from the environment immediately after completion of the activity. Combustion byproducts of Otto Fuel II would be released into the water column, where they would dissolve, dissociate, or be dispersed and diluted. One combustion byproduct, hydrogen cyanide, does not normally occur in seawater; however, it is soluble in seawater and would be diluted to less than 1 micrograms per liter (1.0 part per billion)—below EPA-recommended concentrations (U.S. Environmental Protection Agency, 2010)—at a distance of approximately 18 feet from the center of the torpedo's path when first discharged. Additional dilution would occur thereafter, with the rate of dilution depending, in part, upon circulation in the water column in the vicinity of the discharge. The changes in the number of torpedoes shown in Tables 2.5-1 and 2.5-2 for activities proposed under Alternative 1 would have no appreciable change on the impact conclusions presented in the 2015 MITT Final EIS/OEIS.

The fate and transport of Polychlorinated Biphenyls (PCBs) are described in Section 3.1.3.3.4 (Polychlorinated Biphenyls in Target Vessels) of the 2015 MITT Final EIS/OEIS. Sinking exercises would decrease under Alternative 1 in this SEIS/OEIS and are therefore not analyzed further. Public comments, however, were received that concerned the potential resuspension of PCBs in the water column after activities that use underwater explosives in Outer Apra Harbor. Figure 2.1-5 in Chapter 2 (Description of the Proposed Activities and Alternatives) shows the location of the Outer Apra Harbor Underwater Detonation (UNDET) site. The Navy's literature review found PCB measurements obtained by a University of Guam study in 1997 for PCB contamination within Apra Harbor (Denton et al., 1997). The location of the UNDET site in Outer Apra Harbor corresponds to a sediment sampling site that was considered by Denton et al. (1997) as within the "light" contamination range (1–10 nanograms/gram dry weight). PCB profiles, determined in sediments from Hotel Wharf and the Commercial Port area, closely resembled those of Aroclor 1254, a commercial PCB mixture that was once widely used as a dielectric fluid in electrical transformers (Denton et al., 1997). Another set of samples were collected in 2014 within Outer Apra Harbor. As part of this sampling regime, preliminary remediation goals were established for different types of PCBs. The location within Outer Apra Harbor that is used for underwater explosions did not exceed these preliminary remediation goal thresholds for PCBs (U.S. Department of the Navy, 2017). Because the same location is used for UNDET sites, the Navy avoids resuspension of PCBs from undisturbed benthic habitats where PCBs may have migrated. There is no information in the University of Guam study that changes the basis of the above findings. Therefore, based on the findings above, the changes in the numbers of UNDETs used within Outer Apra Harbor as shown in Tables 2.5-1 and 2.5-2 would have not appreciably changed the impacts that chemicals other than explosives would have on sediments and water quality.

The fate and transport of other chemicals associated with explosive munitions are described in Section 3.1.3.3.5 (Other Chemicals Associated with Ordnance) of the 2015 MITT Final EIS/OEIS. Residual chemical constituents associated with explosive munitions can remain in the environment after low-order (i.e., incomplete) detonations and in unconsumed explosives. These constituents, listed in Table 3.1-10 of the 2015 MITT Final EIS/OEIS, are in addition to the explosives contained in the munition. Lead azide, titanium compounds, perchlorates, barium chromate, and fulminate of mercury are not naturally constituents of seawater. Another residual constituent, lead oxide, is a rare, naturally occurring mineral (Agency for Toxic Substances and Disease Registry, 2007). As noted in Section 3.1.2.1 (Explosives and Explosives Byproducts), fewer explosive munitions would be used during training activities under Alternative 1 compared to the number of explosives proposed in the 2015 MITT Final EIS/OEIS. Some testing activities would use more explosive munitions, while others would use fewer. Based on the detailed analysis in Section 3.1.3.1 (Explosives and Explosion Byproducts) in the 2015 MITT Final EIS/OEIS and the summary of recent studies in Section 3.1.2.1 (Explosives and Explosives Byproducts) in this SEIS/OEIS, concentrations of chemical constituents associated with explosive munitions is expected to be localized to areas adjacent to the munition and similar to concentrations from nearby sites. The changes in the number of explosions shown in Tables 2.5-1 and 2.5-2 for activities proposed under Alternative 1 would have no appreciable change on the impact conclusions presented in the 2015 MITT Final EIS/OEIS.

3.1.2.3.2 Impacts from Chemical Stressors Other than Explosives Under Alternative 2

Under Alternative 2, the number of sources used that would generate chemicals other than explosives would increase as compared to Alternative 1 (see 3.0-14 through Table 3.0-17 and Table 3.0-19). As discussed in Alternative 1, increases as associated with Alternative 2 would have no appreciable change on the impact conclusions for chemicals other than explosives as summarized above under Alternative 1 and as presented in the 2015 MITT Final EIS/OEIS. Therefore, under Alternative 2, impacts on sediments and water quality from activities that expend chemicals other than explosives would be negligible.

3.1.2.3.3 Impacts from Chemical Stressors Other than Explosives Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Chemical stressors other than explosives as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer releases of chemical stressors other than explosives into the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for impacts on sediments and water quality resulting from chemical stressors other than explosives.

3.1.2.4 Other Materials

Other materials include marine markers and flares, chaff, towed and stationary targets, and miscellaneous components of other devices. These materials and components are made mainly of nonreactive or slowly reactive materials (e.g., glass, carbon fibers, and plastics), or they break down or decompose into benign byproducts (e.g., rubber, steel, iron, and concrete). Most of these objects would settle to the sea floor where they would (1) be exposed to seawater, (2) become lodged in or covered by seafloor sediments, (3) become encrusted (e.g., by rust) through oxidation, (4) dissolve slowly, or (5) be covered by marine organisms such as coral. Plastics may float or descend to the bottom, depending upon their buoyancy.

The various types of expended materials that would be used during training and testing activities are described in detail in Section 3.1.3.4 (Other Materials) in the 2015 MITT Final EIS/OEIS. The section describes the constituent components of marine markers, flares, and chaff as well as other items, and the fate and transport of those constituents in the marine environment. Pyrotechnic materials in marine markers and flares are largely consumed during use, and byproducts are released into the air. Chemical constituents of marine markers and flares are listed in Table 3.1-11 and the constituents of chaff are listed in Table 3.1-12 of the 2015 MITT Final EIS/OEIS.

3.1.2.4.1 Impacts from Other Materials Under Alternative 1

Under Alternative 1, the number of proposed training and testing activities that would introduce other materials, such as marine markers and flares, chaff, towed and stationary targets, and miscellaneous components would increase over levels analyzed previously in the 2015 MITT Final EIS/OEIS (see Table 3.0-17, Tables 3.0-20 through 3.0-24). Increases in training and testing activities under Alternative 1 would have no appreciable change on the impact conclusions presented in the 2015 MITT Final EIS/OEIS.

3.1.2.4.2 Impacts from Other Materials Under Alternative 2

Under Alternative 2, the number of proposed training and testing activities that would introduce other materials, such as marine markers and flares, chaff, towed and stationary targets, and miscellaneous components would increase over levels analyzed previously in the 2015 MITT Final EIS/OEIS (see Table 3.0-17, Tables 3.0-20 through 3.0-24). There would also be increases under Alternative 2 in the number of training and testing activities that would likely introduce other materials into the environment, as compared to Alternative 1. As with Alternative 1, increases in training and testing activities proposed under Alternative 2 would have no appreciable change on the impact conclusions presented in the 2015 MITT Final EIS/OEIS.

3.1.2.4.3 Impacts from Other Materials Under the No Action Alternative

Under the No Action Alternative, proposed training and testing activities would not occur. Other military activities not associated with this Proposed Action would continue to occur. Other materials as listed above would not be introduced into the marine environment. Therefore, existing environmental conditions would either remain unchanged or would improve slightly after cessation of ongoing training and testing activities.

Discontinuing the training and testing activities would result in fewer releases of other materials within the marine environment where training and testing activities have historically been conducted. Therefore, discontinuing training and testing activities under the No Action Alternative would lessen the potential for impacts on sediments and water quality resulting from plastics, marine markers, flares, and chaff released during training and testing activities.

3.1.3 Public Scoping Comments

The public raised a number of issues during the scoping period in regard to sediments and water quality. The issues are summarized in the list below.

- **Public scoping comments concerning FDM.** Some commenters noted a lack of studies documenting the amount of ordnance debris and unexploded ordnance in waters surrounding FDM, while other comments requested that the Navy analyze potential loss of land mass associated with military training activities on FDM. The Navy has included a detailed summary of recent published studies that describe multi-year dive studies conducted by Smith and Marx (2016). The results of these surveys are included in Section 3.1.1.1.3 (Farallon de Medinilla) of this SEIS/OEIS. Throughout all dive surveys, the coral fauna at FDM were observed to be healthy and robust. The nearshore physical environment and basic habitat types at FDM have remained unchanged over the 13 years of survey activity. These conclusions are based on (1) a limited amount of physical damage, (2) very low levels of partial mortality and disease (less than 1 percent of all species observed), (3) absence of excessive mucus production, (4) good coral recruitment, (5) complete recovery by 2012 of the 2007 bleaching event, and (6) a limited number of macrobioeroders and an absence of invasive crown of thorns starfish (*Acanthaster planci*). These factors suggest that sedimentation that may result from military use of FDM is not sufficient as to adversely impact water quality, a conclusion substantiated by repeated dive surveys discussed above (Smith & Marx, 2016).
- **Public scoping comments regarding the potential loss of landmass through erosion of FDM from military use.** Some commenters have expressed concerns regarding erosion of FDM, and the potential loss of landmass. The U.S. military has used FDM as a bombing range since at least 1971. FDM's vegetation appears to have undergone significant changes since the island was leased by the DoD and the subsequent use for military training. The 2015 MITT Final EIS/OEIS compared historic aerial photographs to recent aerial imagery, which shows that the island has lost substantial forests over the decades, with the northern portion of the island with the most intact forest structure remaining on FDM (see Section 3.10, Terrestrial Species and Habitats, of the 2015 MITT Final EIS/OEIS). It is likely that the loss of vegetation over the past decades has accelerated erosion of soils and limestone weathering on the island. The current training activities that use ordnance are constrained in terms of ordnance type and target location (e.g., designated impact zones). These restrictions were put in place as part of past Section 7 ESA consultations with the U.S. Fish and Wildlife Service and would continue under the SEIS. While

these measures were specifically designed to protect ESA-listed species and habitats on FDM, the restrictions would likely reduce the rates of erosion experienced in previous decades on the island. In addition, since the 2015 MITT Final EIS/OEIS, the Navy has relocated vertical cliff targets (established on the western side of the island) to interior locations within impact zones. The target relocations were done to minimize impacts on seabird rookeries along the western side of the island. Smith and Marx (2016) also provided anecdotal observations of coral reefs surrounding the island over the course of multi-year dive surveys. These observations suggest healthy reef environments surrounding the island, without signs of sedimentation that would result from erosion of soils from the impact areas. In summary, the intensive bombing regimes of FDM in past decades likely resulted in the loss of forested areas on the island; such reductions in forests likely resulted in erosion of the upper plateau of the island. Current restrictions, however, confine the bombing activities to discrete impact zones located in the interior of the island, with additional restrictions on the types of ordnance allowed for use on the island, thereby reducing the potential for erosion and loss of land mass of FDM.

- **Public scoping comments concerning resuspension of PCBs in Outer Apra Harbor.** Some commenters were concerned about resuspension of PCBs in the water column resulting from underwater explosions within Outer Apra Harbor. Section 3.1.2.3 (Chemicals Other Than Explosives) of this SEIS/OEIS includes additional information on the potential for resuspension of PCBs in the water column, which includes sediment data collected from a site in close proximity to the Outer Apra Underwater Detonation Site. The potential for resuspension of PCBs in the water column is reduced because (1) the sediment samples collected by Denton et al. (1997) showed that this location is within the "light" concentration range (1–10 nanograms/gram dry weight), (2) additional sediment sampling from 2014 shows that the area where underwater detonations would occur contains sediments that do not exceed remediation goals for different types of PCBs, and (3) the Navy uses the same seafloor location for underwater explosions. Therefore, the Navy does not conduct this training activity in other areas of Apra Harbor identified as "moderate" or "high" concentrations. In addition, no new undisturbed benthic locations that are contaminated by PCBs would be used for underwater explosions.
- **Public scoping comments concerning general impacts on water quality in offshore marine environments.** Some commenters were concerned about the fate and transport of metal fragments as they are deposited in open ocean training locations. Section 3.1.3.2 (Metals) in the 2015 MITT Final EIS/OEIS describes the potential impacts of metals introduced into marine environments from training locations. Although Guam does not maintain screening standards for metals in sediments or water, the U.S. Environmental Protection Agency maintains "threshold" values for metals in marine environments (see Table 3.1-8 of the 2015 MITT Final EIS/OEIS). In 2014, the CNMI Bureau of Environmental and Coastal Quality established water quality standards, designating the coastal waters surrounding FDM as "Class A" waters, which are maintained for recreational and aesthetic use, with some allowable uses as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife (Commonwealth of the Northern Mariana Islands Bureau of Coastal and Environmental Quality, 2014). Based on the multi-year dive surveys discussed above, there are no indications of adverse impacts on fish, shellfish, or wildlife within the coastal waters surrounding FDM, with the dive surveys showing healthy ecosystem functions and wildlife abundance within these waters. While no quantitative sampling for metals in training areas have been completed, there are a number of studies

conducted in marine training and testing locations that have attempted to measure metal content where military activities occur. In one study, the water was sampled for lead, manganese, nickel, vanadium, and zinc at a shallow bombing range in Pamlico Sound (state waters of North Carolina) immediately following a training event with non-explosive practice bombs. All water quality parameters tested, except nickel, were within the state limits. The nickel concentration was significantly higher than the state criterion, although the concentration did not differ significantly from the control site located outside the bombing range. The results suggest that bombing activities were not responsible for the elevated nickel concentrations (U.S. Department of the Navy, 2010). A recent study conducted by the U.S. Marine Corps sampled sediments and water quality for 26 different constituents related to munitions at several U.S. Marine Corps water-based training ranges. Metals included lead and magnesium. These areas were also used for bombing practice. No munitions constituents were detected above screening values used at the U.S. Marine Corps water ranges (U.S. Department of the Navy, 2010). A study by Pait et al. (2010) of previous Navy training areas at Vieques, Puerto Rico, found generally low concentrations of metals in marine sediments. Areas in which live ammunition and loaded weapons were used ("live-fire areas") were also included in the analysis. Additional studies are summarized in the 2015 MITT Final EIS/OEIS. In no instance did metals exceed federal or state thresholds. It is unlikely that metals in sediments or the water column from military training activities would exceed federal thresholds in the Study Area, a conclusion that is consistent with other range locations and qualitative observations of ecosystem health surrounding FDM, as observed by Smith and Marx (2016).

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