4 Cumulative Impacts

Supplemental Environmental Impact Statement/ Overseas Environmental Impact Statement Mariana Islands Training and Testing

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4 Cumulative Impacts

4.1 Principles of Cumulative Impacts Analysis

The approach taken herein to analyze cumulative effects meets the objectives of the National Environmental Policy Act (NEPA) of 1969, Council on Environmental Quality (CEQ) regulations, and CEQ guidance, and has not changed from the approach as described in the 2015 Mariana Islands Training and Testing (MITT) Final Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) (Council on Environmental Quality, 1997; U.S. Department of the Navy, 2015b).

4.1.1 Determination of Significance

Per the CEQ's *Considering Cumulative Effects Under the NEPA* (Council on Environmental Quality, 1997), the "levels of acceptable change used to determine the significance of effects will vary depending on the type of resource being analyzed, the condition of the resource, and the importance of the resource as an issue." Furthermore, "this change is evaluated in terms of both the total threshold beyond which the resource degrades to unacceptable levels and the incremental contribution of the proposed action to reaching that threshold." In practice, "the analyst must determine the realistic potential for the resource to sustain itself in the future and whether the proposed action will affect this potential." In other words, for a proposed action to have a cumulatively significant impact on an environmental resource, two conditions must be met. First, the combined effects of all identified past, present, and reasonably foreseeable projects, activities, and processes on a resource, including the effects of the proposed action, must be significant. Second, the proposed action must make a measurable or meaningful contribution to that significant cumulative impact.

4.1.2 Identifying Region of Influence for Cumulative Impacts Analysis

The region of influence for analyses of cumulative impacts can vary for different resources and environmental media. CEQ guidance (Council on Environmental Quality, 1997) indicates that the region of influence for cumulative impacts almost always should be expanded beyond those for the project-specific analyses. This guidance continues, indicating that one way to evaluate the region of influence is to consider the distance an effect can travel, and it identifies potential cumulative assessment boundaries accordingly. For air quality, the potentially affected air quality regions are the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere. For water resources and land-based effects, watershed boundaries may be the appropriate regional boundary. For wide-ranging or migratory wildlife, specifically marine mammals, fish, sea turtles, and marine birds, any impacts of the Proposed Action might combine with the impacts of other activities or processes within the range of the population.

The region of influence for evaluating the cumulative impacts of the Proposed Action are defined for each resource in Section 4.4 (Resource-Specific Cumulative Impacts). The basic geographic boundary for the majority of resources analyzed for cumulative impacts in this Supplemental EIS (SEIS)/OEIS is the entire MITT Study Area (Figure 2.1-1). The region of influence for cumulative impacts analysis for some resources are expanded to include activities outside the Study Area that might impact migratory or wide-ranging animals. Other activities potentially originating from outside the Study Area that are considered in this analysis include impacts associated with maritime traffic (e.g., vessel strikes and underwater noise) and commercial fishing (e.g., bycatch and entanglement).

Comments received from the public during scoping related to cumulative impacts are addressed in Section 4.6 (Public Comments). Comments received from the public during the Draft Supplemental EIS

(SEIS)/OEIS commenting period related to cumulative impacts are addressed in Appendix K (Public Comment Responses).

4.2 Projects and Other Activities Analyzed for Cumulative Impacts

The cumulative analysis includes consideration of past, present, and reasonably foreseeable future actions that overlap in time and space with the Proposed Action. Actions and projects that have been added to this cumulative analysis since the 2015 MITT Final EIS/OEIS include the Saipan water system improvements project, the wastewater system for Saipan, the Saipan Resort Hotel, the Plumeria Resort and Casino, aquaculture, and undersea communications cables. For past actions, the cumulative impacts analysis only considers those actions or activities that have had ongoing impacts that may be additive to impacts of the Proposed Action. Likewise, present and reasonably foreseeable future actions selected for inclusion in the analysis are those that may have effects additive to the effects of the Proposed Action as experienced by specific environmental receptors.

The cumulative impacts analysis makes use of the best available data, quantifying impacts where possible and relying on the qualitative description and best professional judgment where detailed measurement is unavailable. Because specific information and data on past projects and actions are typically scarce, the analysis of past effects is often qualitative (Council on Environmental Quality, 1997). Likewise, analysis of ongoing actions is often inconsistent or unavailable. All likely future development or use of the region is considered to the greatest extent possible, even when a foreseeable future action is not planned in sufficient detail to permit complete analysis (Council on Environmental Quality, 1997).

The cumulative impacts analysis is not bound by a specific future timeframe. The Proposed Action includes general types of activities addressed by this SEIS/OEIS that are expected to continue indefinitely, and the associated impacts could occur indefinitely. Likewise, some reasonably foreseeable future actions and other environmental considerations addressed in the cumulative impacts analysis are expected to continue indefinitely (e.g., seismic surveys, maritime traffic, commercial fishing). While Navy training and testing activities requirements change over time in response to world events, it should be recognized that available information, uncertainties, and other practical constraints limit the ability to analyze cumulative impacts for the indefinite future. Navy environmental planning and compliance for training and testing activities is an ongoing process, and the Navy anticipates preparing new or supplemental environmental planning documents covering changes in training and testing activities in the Study Area as necessary. These future environmental planning documents would include a cumulative impacts analysis based on information available at that time.

Table 4.2-1 lists the other actions and other environmental considerations identified for the cumulative impacts analysis, including activities presented in the 2015 MITT Final EIS/OEIS with updated information. Descriptions of each action and environmental consideration carried forward for analysis are provided in the sections that follow. For the perspective of general project locations, please refer to Figures 2.1-1 through 2.1-4, which depict the Study Area, boundaries of individual training and testing activities locations, and large marine ecosystems and open ocean areas within and adjacent to the Study Area.

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Military Mission, Testing, and Training Activities						
Commonwealth of the Northern Mariana Islands (CNMI) Joint Military Training (CJMT)	CNMI	The Draft 2015 Commonwealth of the Northern Mariana Islands (CNMI) Joint Military Training (CJMT) EIS/OEIS (U.S. Department of the Navy, 2015a) provided a draft evaluation of the potential impacts associated with alternatives for meeting U.S. Indo-Pacific Command Service Components' unfilled unit-level and combined-level training requirements in the Western Pacific. The draft action alternatives proposed the establishment of a series of live-fire and maneuver ranges and training areas; expansion of existing ranges and training areas; and construction of new ranges and training areas within the CNMI, including amphibious operations. The Notice of Intent to complete the EIS/OEIS was published in the *Federal Register* on March 14, 2013. Following an in-depth review of public comments on the proposed construction of military training areas in CNMI, and consultation with CNMI Executive Branch, the Department of Defense (DoD) announced in October 2015 it would issue a Revised Draft EIS for its proposed actions for the CJMT. The proposed revised Draft EIS will evaluate contribution to the cumulative effects of ongoing actions in the CNMI. Specifically, the resources evaluated and the information collected as part of the CJMT project to date will contribute to cumulative impacts, including geology and soils, water resources, air quality, noise, airspace, land and submerged land use, recreation, terrestrial biology, marine biology, cultural resources, visual resources, transportation, utilities, socioeconomics and environmental justice, hazardous materials and waste, and public health and safety.	Resource management measures include avoidance and minimization measures, best management practices, and standard operating procedures.			C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
CNMI Joint Region Marianas Integrated Natural Resources Management Plan (INRMP)	CNMI	In June 2019, the Navy completed the Joint Region Marianas Integrated Natural Resources Management Plan (INRMP). An INRMP is a long-term planning document designed to guide the management of natural resources on military-administered areas, support military missions, and ensure compliance with environmental laws and regulations. The purpose of the 2019 Joint Region Marianas INRMP is to maintain long-term ecosystem health and operational requirements of the DoD's mission while minimizing impacts on natural resources. It is also the intent of the INRMP to provide a conservation benefit to federally protected species (ESA-listed corals, fishes, sea turtles, and marine mammals). In order to meet these purposes, the Joint Region Marianas INRMP establishes a list of management projects for ESA-listed corals, fishes, sea turtles, and marine mammals that either improve the understanding of these species in the wild or are designed to protect species and their habitat without infringing on the DoD's military mission. An INRMP also supports an installation's mission while conserving and rehabilitating installation resources for multiple use, sustainable yield, and biological integrity. National Marine Fisheries Service (NMFS), as a partner in the development of the Joint Region INRMP, endorsed the Joint Region Marianas INRMP in June 2019. Specific management goals subject to annual funding availability under the June 2019 INRMP include • Coral Habitat Enhancement (surveys, management) [*Naval Base Guam, Andersen Air Force Base, Tinian Military Lease Area*] • Marine Flora Management (survey subtidal areas for algae and seagrasses) [*Naval Base Guam, Tinian Military Lease Area*] • Marine Resources Data Management (Coordination with Pacific Islands Fisheries Science Center for surveys) [*Naval Base Guam,*	Implementation of the Joint Region Marianas INRMP program and the focused strategies and actions of the management projects for marine resources provides a conservation benefit to the marine ecosystem in the nearshore waters of military-owned or leased lands by maintaining and enhancing marine community structure, function, species diversity, and resiliency. Using this regional ecosystem-based approach for managing protected species and their associated ecosystems ensures that the Navy remains in compliance with federal and territorial laws while supporting the	X	X	X

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
		Andersen Air Force Base] • Marine Habitat Mapping (benthic habitat mapping) [*Naval Base Guam, Andersen Air Force Base, Farallon de Medinilla*] • Acoustic Telemetry Network (acoustic tag deployment ESA fish and sea turtles in and adjacent Apra Harbor) [*Naval Base Guam*] • Scalloped Hammerhead Shark Study (eDNA mapping for presence, visual survey, tagging in and adjacent to Apra Harbor) [*Naval Base Guam, Andersen Air Force Base*] • Sea Turtle Population Protection and Enhancement (visual survey and tagging of sea turtles) [*Naval Base Guam, Andersen Air Force Base, Tinian Military Lease Area, Farallon de Medinilla*] • Fish, Coral, and Marine Surveys (visual surveys) [*Farallon de Medinilla*] • Assess ESA-Listed *Scleractinian* Corals (visual surveys and condition assessment for ESA-corals) [*Farallon de Medinilla*] The resources managed under the INRMP that could contribute to cumulative impacts include geology and soils, water resources, air quality, terrestrial biology, and marine biology.	operational functionality of the military installations and ranges in the Action Area.			

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Divert Activities and Exercises	Saipan and Tinian	The USAF proposed improvements to an existing airfield near the Philippine Sea in support of expanding mission requirements in the western Pacific, along with divert capabilities for current, emerging, and future training activities. A Draft EIS analyzing environmental impacts associated with the divert activities and exercises was published in June 2012 and found adverse effects could occur from the construction phase of the project on cultural resources, as well as adverse impacts to socioeconomic resources and environmental justice, and human health and safety. The USAF published a Revised Draft Divert EIS in 2015 and released a Final EIS and Record of Decision in 2016 (U.S. Department of the Air Force, 2016). The USAF selected the preferred alternative, Alternative 2 - Modified Tinian Alternative and specifically the North Option as the location to implement the proposed action described in the Divert EIS. In spring 2018 the U.S. Air Force published the intention to prepare a Supplemental EIS to assess the potential environmental consequences associated with proposed Tinian Divert Infrastructure Improvements. On May 17, 2019, the USAF published the NOA for the Draft SEIS for the proposed Tinian Divert Infrastructure Improvements. The NOA began the public review period for the Draft SEIS, which ended on July 1, 2019. Substantive comments received during the public review period will be considered during preparation of the Final SEIS. The USAF now proposes to construct a fuel pipeline, and associated infrastructure at the seaport, to transport fuel from the seaport to the airport. Therefore, the USAF also proposes to improve certain existing roads between the seaport and airport that would be used to support Divert-related projects. Additional information about the proposed action is provided on the project website. Therefore, this project may contribute to the cumulative impacts on natural, noise, cultural and socioeconomic resources in the Study Area.	Mitigation measures will be implemented to minimize, avoid, rectify, reduce, or compensate for potential impacts on specific resource areas. There are mitigation measures for noise during construction, air quality, airspace and airfield environment, geology and soils, water resources, terrestrial biological resources, cultural resources, land use, hazardous materials and wastes, infrastructure and utilities, socioeconomic resources and environmental justice, and human health and safety.	C	O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Foreign Navies Training and Testing Activities	Study Area	As the navies of the world increase their "blue water" capabilities, the presence of foreign military within the Study Area will also likely increase. Foreign military vessels currently transit through the Global Commons and international waters within the Study Area while en route to and from Guam, Hawaii, and other locations in and bordering the Pacific. As the extent of naval activities conducted by sovereign vessels and embarked aircraft while in the MITT is not quantified nor quantifiable, it is very likely that routine systems checks as well as opportunistic training and testing occurs. The resources impacted by ongoing and proposed MITT activities would also be exposed to similar stressors (e.g., acoustics from sonar and explosives, vessel strike) introduced by foreign vessels and aircraft conducting activities not related to the MITT Proposed Action.		O	O	O
Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation EIS/Guam CNMI Military Relocation (2012 Roadmap Adjustments) SEIS	Guam	In July 2015, the Final SEIS Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments) was completed (U.S. Department of the Navy, 2015b). The Final SEIS analyzed the potential environmental impacts of five action alternatives for the family housing component of the proposed action and five action alternatives for the live-fire training range complex component, plus a no action alternative. The proposed action was to construct and operate a cantonment area, family housing, and a Live-Fire Training Range Complex on Guam to support the Marine Corps relocation. The Navy selected the preferred alternative as described in the Final 2015 SEIS. The preferred alternative included cantonment and family housing Alternative E with the U.S. Marine Corps cantonment to be located at Navy Computer and Telecommunications Station – Guam (Finegayan), and family housing to be located at Andersen Air Force Base. The Live-Fire Training Range Complex option selected was Alternative 5, to be located at Andersen Air Force Base – Northwest Field. The Live-Fire Training Range Complex also includes a stand-alone hand	Mitigation measures will be implemented to minimize, avoid, rectify, reduce, or compensate for potential impacts on specific resource areas. There are mitigation measures for water resources, terrestrial biological resources, marine biological resources, cultural resources, utilities, socioeconomic resources, and environmental justice	C	C	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
		grenade range at Andersen South. The Record of Decision for the SEIS includes cantonment and family housing at the Navy Computer and Telecommunications Station in the Finegayan area of Guam, and family housing to be located at Andersen AFB. The Live Fire Training Range Complex would be located at Andersen AFB, Northwest Field and includes a stand-alone hand grenade range at Andersen South (U.S. Department of the Air Force, 2016). Potential impacts were analyzed for geological and soil resources, water resources, air quality, noise, airspace, land and submerged land use, recreational resources, terrestrial biological resources, marine biological resources, cultural resources, visual resources, ground transportation, marine transportation, utilities, socioeconomic resources and general services, hazardous materials and waste, public health and safety, and environmental justice. Continuing cumulative impacts could occur for water resources, air quality, noise, airspace, recreational resources, terrestrial biological resources, ground transportation, utilities, and socioeconomic resources and general services.	and the protection of children.			
Surveillance Towed Array Sensor System Low Frequency Active Sonar	Pacific Ocean, Atlantic Ocean, Indian Ocean, and the Mediterranean Sea	The Navy utilizes Surveillance Towed Array Sensor System Low Frequency Active Sonar systems onboard several T-AGOS class vessels in the western and central North Pacific Ocean, not including polar waters, and the southwestern Indian Ocean. The Navy is currently conducting covered SURTASS LFA sonar activities under a Letter of Authorization (LOA) published in the Federal Register on August 12, 2019, effective through August 11, 2026. The Navy has updated its relevant environmental planning and compliance documents and published the Final SEIS/OEIS for Surveillance Towed Array Sensor System Low Frequency (SURTASS LFA) Sonar in June 2019 (U.S. Department of the Navy, 2019). National Marine Fisheries Service (NMFS) published a Proposed Rule on the project in March 2019 in the	The objective of mitigation for the employment of Surveillance Towed Array Sensor System Low Frequency Active Sonar is to reduce or avoid potential exposures of marine mammals, sea turtles, and human divers to	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
		Federal Register, and NMFS issued an ESA Programmatic Biological Opinion/Incidental Take Statement for SURTASS LFA Sonar (effective with 2019 MMPA 7-Year Final Rule from 2019 to 2026) in July 2019 (United States Navy and Permits and Conservation Division et al., 2019). The underwater sound produced by this activity may contribute to the cumulative impacts on marine mammals and sea turtles in the Study Area (U.S. Department of the Navy, 2012), as the SURTASS LFA Study Area overlaps the entire MITT Study Area. The underwater sound produced by this project may contribute to the cumulative impacts on marine mammals and sea turtles in the Study Area.	Surveillance Towed Array Sensor System Low Frequency Active Sonar transmissions.			
Terminal High-Altitude Area Defense (THAAD) Permanent Stationing in Guam	Andersen Air Force Base, Guam	The Environmental Assessment (EA) for this project documents the environmental impacts associated with the expeditionary (temporary) placement and operation of a THAAD ballistic missile defense battery at Andersen Air Force Base in Guam, and from the proposed permanent stationing of the THAAD battery at its current location on Northwest Field (NWF). As a secondary, connected action to the expeditionary deployment and proposed permanent stationing of the THAAD battery in Guam, this EA also analyzes the potential impacts from the expansion of the NWF cargo drop zone training area that was encumbered by THAAD operations (U.S. Army, 2015).		C/O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Other Commercial Industries						
Aquaculture	Oceans worldwide (including the Guam Aquaculture and Development Training Center in Mangilao [Fadian Hatchery])	Aquaculture is the farming of aquatic organisms such as fish, shellfish, and plants. Globally, 29 percent of stocks are fished at biologically unsustainable levels, and aquaculture helps meet demand and offsets stress to wild populations (National Marine Fisheries Service, 2015b). Aquaculture production reached an all-time high of 97 million metric tons in 2013 and is the fastest-growing form of food production, at 6 percent per year globally. Forty-seven percent of aquaculture operations occur in the Pacific Ocean. On Guam, the largest and oldest aquaculture center in the Western Pacific, the Fadian Hatchery, has been operating since the 1970s. A recent bill would expand aquaculture in Guam and improve the facilities at the Fadian Hatchery. The threats of aquaculture operations on wild fish populations include reduced water quality, competition for food, predation by escaped or released farmed fishes, the spread of disease and parasites, and reduced genetic diversity (Kappel, 2005). These threats become apparent when farmed fish escape and enter the natural ecosystem (Hansen & Windsor, 2006; Ormerod, 2003). The Marine Aquaculture Policy provides direction to enable the development of sustainable marine aquaculture (National Marine Fisheries Service, 2015b).		C/O	C/O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Coastal Land Development and Tourism	Coastline	Coastal development intensifies use of coastal resources, resulting in potential impacts on water quality, marine habitat, and air quality. Coastal land development in the Study Area is both intensive and extensive. Development continues to impact coastal resources through point and non-point source pollution, concentrated recreational use, intensive ship traffic using major port facilities, and coastal tourism (e.g., hotels, resorts, restaurants, food industry, vacation homes, second homes) and supporting infrastructure (e.g., retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, recreational fishing facilities). Coastal development is regulated by states and territories through the Coastal Zone Management Act and associated state and local programs. Chapter 6 (Additional Regulatory Considerations) provides additional information on coastal zone management in the Study Area. Coastal development intensifies use of coastal resources through dune and nearshore habitat loss and disturbance, point and non-point source water pollution, entrainment in outflows and other structures, and air quality degradation. Self-contained underwater breathing apparatus (SCUBA) and snorkeling have the potential to degrade reef systems through disturbance and collecting. Collisions between whale-watching ships and whales are common. Temporary permits could be obtained from the CNMI Homeland Security and Emergency Management Office for various ecotourism activities. It is anticipated these activities would occur in the future (U.S. Department of the Navy, 2015a).	Site-specific mitigation often determined during Coastal Consistency Review by the Guam Coastal Management Program and the Commonwealth of the Northern Mariana Islands Coastal Zone Management Program	C/O	C/O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Commercial Fishing	Pacific Ocean	Commercial fishing constitutes an important and widespread use of the ocean resources throughout the Study Area, and can adversely affect marine species and habitats. Potential impacts include overfishing of targeted species and bycatch, both of which negatively affect fish stocks and other marine resources. Bycatch is the capture of fish, marine mammals, sea turtles, marine birds, and other non-targeted species that occurs incidental to normal fishing operations. Use of mobile fishing gear, such as bottom trawls, disturbs the seafloor and reduces structural complexity. Indirect impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), and generation of marine debris. Lost gill nets, purse seines, and long lines may foul and disrupt bottom habitats and have the potential to entangle or be ingested by marine mammals. Jackson et al. (2001) analyzed paleoecological records of marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before the present, historical documents, and ecological records from scientific literature sources over the past century. The analysis concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climate change. Fisheries bycatch has been identified as a primary driver of population declines in several groups of marine species, including sharks, mammals, marine birds, and sea turtles (Wallace et al., 2010). Therefore, commercial fishing may contribute to cumulative impacts on marine mammals, sea turtles, fish, and marine habitats in the Study Area.	Various bycatch mitigation technologies, quotas, and seasonal restrictions required per the fishery-specific permit process	O	O	O
Grand Mariana Casino and Hotel Resort	Garapan	This project plans for potentially up to 2,000 hotel rooms in stages, beginning with a 250-room hotel and casino (U.S. Department of the Air Force, 2016).				C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Maritime Traffic	Pacific Ocean	Portions of the Study Area are heavily traveled by commercial, recreational, and government marine vessels, with several commercial ports occurring in or near the Study Area. Section 3.12 (Socioeconomic Resources) provides additional information for marine vessel traffic in the Study Area. Primary concerns for the cumulative impacts analysis include vessels striking marine mammals and sea turtles, the introduction of non-native species through ballast water, and underwater sound from ships and other vessels. Therefore, maritime traffic may contribute to the cumulative impacts on marine mammals and sea turtles in the Study Area. Additionally, air and water quality in busy ports can be diminished due to engine emissions and fuel leaks. Secondary impacts include maintenance of port infrastructure, which often includes dredging requirements to maintain channel depths, and habitat loss and degradation in coastal habitats.	Continued adherence to state and federal marine traffic and operations regulations	O	O	O
Plumeria Resort and Casino	Tinian	Construction is slated to run into 2027. The hotel would include over 6,000 accommodation units and be built in three phases to include villas, a casino, golf course, water park, shops, restaurants, and new roads over 151 hectares of property at Puntan Diablo Cove on Tinian (U.S. Department of the Air Force, 2016). The resources evaluated that could contribute to cumulative impacts include water resources, air quality, cultural resources, geology and soils, terrestrial resources, and socioeconomic resources.			C	C/O
Project ATISA	Undersea between Guam, Saipan, Rota, and Tinian	The DoCoMo Pacific and NEC Corporation built a 175-mile optical fiber cable system that connects Guam and the CNMI and offers new wireless, cable TV, home phone, and broadband services.		C	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Recreational and Cultural Fishing	Pacific Ocean	Recreational and cultural fishing includes impacts from vessel traffic (e.g., strike, noise, water pollution, marine debris) and can compound impacts on fish stocks already experiencing exploitation. Recreational and cultural fishing and boat traffic usually occurs nearshore rather than in the deeper open ocean, and recreational/cultural traffic typically frequents popular locations, which can concentrate damage in these areas from anchors or other bottom-disturbing equipment.	Operational regulations, seasonal restrictions, licensing, and quotas used to manage and mitigate negative effects of recreational and cultural fishing, such as geographic limitations (i.e., no fishing in refuges/marine preservation areas)	O	O	O
Saipan Water System Improvements	Saipan (Multiple Sites)	The project will provide focus and direction for meeting a U.S. EPA stipulated order to meet Clean Water Act and the Safe Drinking Water Act requirements in Saipan on existing water quality outputs. Construction of the project began in 2012 and is expected to occur through 2020 (U.S. Department of the Air Force, 2016). The resources evaluated that could contribute to cumulative impacts include public health and safety, socioeconomic resources, and water quality.		C	C	C/O
Wastewater System for Saipan	Saipan (Multiple Sites)	The project is updating the existing water/sewer system due to a U.S. Federal Court order. The rehabilitated water/sewer system will be compliant with U.S. Environmental Protection Agency (EPA) requirements. Construction of the project began in 2012 and is expected to occur through 2020 (U.S. Department of the Air Force, 2016). The resources evaluated that could contribute to cumulative impacts include public health and safety, socioeconomic resources, and water quality.		C	C	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Seismic Surveys	Waters near the Study Area in the Territory of Guam and the Commonwealth of the Northern Mariana Islands	Seismic surveys are typically accomplished by towing a sound source, such as an airgun array that emits acoustic energy in timed intervals behind a research vessel. The transmitted acoustic energy is reflected and received by an array of hydrophones. This acoustic information is processed to provide information about geological structure below the seafloor. The oil and gas industry uses seismic surveys to search for new hydrocarbon deposits. Also, academic geologists use them to study plate tectonics and other topics. The underwater sound produced by these surveys could affect marine life, including marine mammals. For example, the potential exists to expose some animals to sound levels exceeding 180 decibels referenced to 1 micropascal root mean square, which would in turn potentially result in temporary or permanent loss of hearing (Bureau of Ocean Energy Management, 2011). All seismic surveys conducted by U.S. vessels are subject to the Marine Mammal Protection Act (MMPA) authorization process administered by NMFS, as well as the NEPA process associated with issuing MMPA authorizations.	Specific mitigations and conditions are designated for implementation during seismic surveys by the NMFS in MMPA authorizations to reduce impacts to marine mammals	O	O	O
Tinian Airport Improvements	Airport on Tinian	The project includes (1) relocation of the Aircraft Rescue and Fire Fighting Facility building, (2) terminal improvements, (3) acquisition of a 1,500-gallon Aircraft Rescue and Fire Fighting Facility vehicle, and (4) a new water line (U.S. Department of the Air Force, 2016).		C	C	O
Undersea Communications Cables	Pacific Ocean/ Connections between Guam and Hawaii and Asia	Submarine cables provide the primary means of voice, data, and Internet connectivity between the mainland U.S. and the rest of the world (Federal Communications Commission, 2017). The Federal Communications Commission grants licenses authorizing cable applicants to install, own, and operate submarine cables and associated landing stations in the United States. Cables are installed by specialized boats across flat ocean surfaces and	Continued adherence to international marine construction and operational regulations	C/O	C/O	C/O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
		dug into the seabed in shallow areas. Over 550,000 mi. of cables currently exist in the world's oceans. SEA-US trans-Pacific cables will be routed to avoid congested earthquake prone regions and to optimize stable connectivity between the United States and Asia with landing stations in Hawaii and Guam. DoCoMo's ATISA network also is in operation and connects Guam, Saipan, Rota, and Tinian. Other telecom and consortiums continue to discuss the potential submarine cable projects in the region. Cable networks will continue to be updated in the future creating job opportunities and benefits to professions where cables connect users to the internet for less cost (Losinio, 2017). Potential impacts of installation and maintenance activities would include noise and vessel strike from boat traffic and increased seafloor disturbance and sedimentation in localized areas where the cable is installed. Likewise, electromagnetic fields are generated by some cables that may be sensed by and affect the migration behavior of some fish, sharks, rays, and eels (Bureau of Ocean Energy Management, 2016).				
Research and Conservation						
Academic Research	Global	Wide-scale academic research is conducted in the Study Area by federal entities, such as the Navy and National Oceanic and Atmospheric Administration/NMFS, as well as state and private entities and other partnerships. Although academic research aims to capture data without disturbing the ambient conditions of the ocean environment, vessels contribute to traffic, noise, and strike hazard; seismic activity contributes noise; and various other collection methods, such as trawling, could be disruptive to the ecosystems under observation. Impacts from academic research operations can be similar to the impacts expected from oil and gas airgun survey activities, when	NMFS and local government programs manage scientific research permits for certain activities	O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
		an airgun array that emits acoustic energy in timed intervals behind a research vessel is used.				
Pollution Prevention Grant	CNMI	The CNMI Bureau of Environmental and Coastal Quality provided this grant to support CNMI programs that reduce the environmental impact of local businesses significantly. The impacts of the programs the grant supported were to reduce pollution in air, water, and land during construction and operations by setting requirements and conditions for the Bureau of Environmental and Coastal Quality's permitting process.		O	O	O
Ocean Pollution and Ecosystem Alteration						
Noise	Global	Ambient noise is the collection of ever-present sounds of both natural and human origins. Ambient noise in the ocean is generated by sources that are natural such as physical (e.g., earthquakes, rainfall, waves breaking, and lightning hitting the ocean), biological (e.g., snapping shrimp and the vocalizations of marine mammals), and anthropogenic (human-generated) sources. Anthropogenic sources have substantially increased ocean noise since the 1960s, and include commercial shipping, oil and gas exploration and production activities (including air gun, sonar, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, and acoustic deterrent and harassment devices), military (testing, training, and mission activities), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore wind farms), and research (including sound from air guns, sonar, and telemetry). The contribution of military and non-military vessel traffic to the underwater noise experienced in the Study Area is discussed in Section 3.0.4.1.2 (Vessel Noise).		O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Marine Debris Section 3.1.1.1.1 (Marine Debris and Water Quality)	Global	Marine debris is any anthropogenic object intentionally or unintentionally discarded, disposed of, or abandoned that enters the marine environment (National Marine Fisheries Service, 2006). Common types of marine debris include various forms of plastic and abandoned fishing gear. Marine debris degrades marine habitat quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service, 2006). Plastic debris is a major concern because it degrades slowly and many plastics float. The floating debris is transported by currents throughout the oceans and has been discovered accumulating in oceanic gyres (Law et al., 2010). Additionally, plastic waste in the ocean chemically attracts hydrocarbon pollutants such as polychlorinated biphenyl and dichlorodiphenyltrichloroethane, which accumulate up to one million times more in plastic than in ocean water (Mato et al., 2001). Fish, marine animals, and birds can mistakenly consume these wastes that contain elevated levels of toxins, instead of their prey. In the North Pacific Subtropical Gyre, it is estimated that the fishes in this area are ingesting 12,000–24,000 U.S. tons of plastic debris a year (Davison & Asch, 2011). CNMI has attempted to reduce the occurrence of marine debris under Section 309 of the Coastal Zone Management Act as amended in 1990 and 1996, through the CNMI Department of Coastal Resources Management which implements fines and penalties for violators.		O	O	O

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
Pollution (Section 3.1, Sediments and Water Quality)	Global	Common ocean pollutants are derived from land-based activities and include toxic compounds such as metals, pesticides, and other organic chemicals; excess nutrients from fertilizers and sewage; detergents; oil; plastics; and other solids. Pollutants enter oceans from non-point sources (stormwater runoff from watersheds), point sources (wastewater treatment plant discharges), other land-based sources (windblown debris), spills, dumping, vessels, and atmospheric deposition. Bilgewater is a mix of water, oily fluids, lubricants, grease, cleaning fluids, and other wastes that are pumped out periodically from vessel holding tanks, either to a reception facility onshore or treated with a bilge oil-separator and discharged at sea. Discharging sewage is largely prohibited under the Clean Water Act. The main risk of oil or other petroleum product spills is from ships, whether carrying petroleum to and from ports or in fuel tanks, and from pipelines and onshore facilities that transport and store oil and gas. CNMI has attempted to reduce the occurrence of pollution under Section 309 of the Coastal Zone Management Act as amended in 1990 and 1996, through the CNMI Department of Coastal Resources Management which implements fines and penalties for violators.		O	O	O
Climate Change (Section 3.2, Air Quality)	Global	Predictions of long-term negative environmental impacts, some of which have begun to occur at present, due to climate change include sea level rise; changes in ocean surface temperature, acidity/alkalinity, and salinity; changing weather patterns with increases in the severity of storms and droughts; changes to local and regional ecosystems (including the potential loss of species); shrinking glaciers and sea ice; thawing permafrost; a longer growing season; and shifts in plant and animal ranges, fecundity, and productivity. A special report by the Intergovernmental Panel on Climate Change discussed the long-term warming trend observed since pre-industrial times (Intergovernmental Panel on Climate Change, 2018), and how higher than the global annual average temperatures are being experienced in many		X	X	X

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future
		land regions and seasons. An example of the increase in the severity of storms occurred in October 2018. Typhoon Yutu had sustained winds of 180 miles per hour, and was the Earth's 10th Category 5 storm of 2018. It was the biggest storm to hit U.S. soil since 1935, as two people were killed, hundreds were injured, and over 3,000 houses were destroyed. In the aftermath much of Saipan and Tinian went without power for weeks afterwards and had severe water shortages (Wong & Cruz, 2018).Anthropogenic greenhouse gas emissions have changed the physical and chemical properties of the oceans, including a 1-degree Celsius temperature rise, increased carbon dioxide absorption, decreased pH, alteration of carbonate chemistry, the decline in dissolved oxygen, and disruption of ocean circulation (Poloczanska et al., 2016). Observations of species responses that have been linked to anthropogenic climate change are widespread, and trends include shifts in species distribution to higher latitudes and deeper locations, earlier onset of spring and later arrival of fall, declines in calcification, and increases in the abundance of warm-water species. Climate change is expected to continue to impact the Study Area negatively and will contribute added stressors to all resources in the Study Area. CNMI has attempted to assess and mitigate the effects of climate change under Section 309 of the Coastal Zone Management Act as amended in 1990 and 1996, through the CNMI Department of Coastal Resources Management, through working groups and research.				

Table 4.2-1: Past, Present, and Reasonably Foreseeable Actions (continued)

Factor/Project	Location	Project Description	Summary of Impact Minimization and Mitigation Measures[1]	Project Timeframe C = Construction O = Operation X = Other		
				Past	Present	Future

[1] Some projects/activities did not list specific impacts minimization measures (such as avoidance techniques, standard operating procedures, or industry-best management practices) or mitigation requirements; either official documentation of project descriptions could not be obtained or did not specify these actions. In most cases, site-specific actions are to be developed as specific projects are developed.

Notes: CNMI = Commonwealth of the Northern Mariana Islands, EA = Environmental Assessment, EIS = Environmental Impact Statement, NOA = Notice of Availability, OEIS = Overseas Environmental Impact Statement, SCUBA = Self-Contained Underwater Breathing Apparatus, SEIS = Supplemental EIS, U.S. = United States, USAF = U.S. Air Force

4.3 Cumulative Impacts on Environmental Resources

Since the information available on past, present, and reasonably foreseeable actions varies in quality and level of detail, impacts of these actions were quantified where available data made it possible; otherwise, professional judgment was used to make a qualitative assessment of impacts. Due to the large scale of the area considered (the Study Area and overlapping areas of other actions) and multiple other activities interacting in the ocean environment (Table 4.2-1), the analysis of the incremental contribution to cumulative stress that the Proposed Action may have on a given resource is largely qualitative and speculative. Chapter 3 (Affected Environment and Environmental Consequences) includes a robust discussion of the "general threats," an analysis of aggregate project effects, and a broader level analysis specific to areas where impacts are concentrated (i.e., ranges/operating areas). The Chapter 3 (Affected Environment and Environmental Consequences) analysis is referenced and briefly summarized in each section below to provide context and perspective to the rationale for the conclusions that the Proposed Action would have an insignificant contribution to the cumulative stress experienced by these resources.

Cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the Proposed Action in combination with past, present, and reasonably foreseeable future actions. The analysis was not separated by Alternative because the data available for the cumulative effects analysis was mostly qualitative and, from a landscape-level perspective, these qualitative impacts are expected to be similar.

Under Alternative 1 or Alternative 2 of the Proposed Action, the Navy would implement the mitigation detailed in Chapter 5 (Mitigation) to avoid or reduce impacts on biological, socioeconomic, and cultural resources in the Study Area.

4.4 Resource-Specific Cumulative Impacts

By CEQ guidance (Council on Environmental Quality, 1997), the following cumulative impacts analysis focuses on impacts that are "truly meaningful." The level of analysis for each resource is commensurate with the intensity of the impacts identified in Chapter 3 (Affected Environment and Environmental Consequences) and the level to which impacts from the Proposed Action are expected to mingle with impacts from existing activities. A full analysis of potential cumulative impacts is provided for marine mammals, marine invertebrates, sea turtles, and socioeconomic resources. The rationale is also provided for an abbreviated analysis of the following resources: sediments and water quality, air quality, marine habitats, marine birds, marine vegetation, fishes, cultural resources, terrestrial species and habitats, socioeconomic resources, and public health and safety.

4.4.1 Sediments and Water Quality

In the 2015 MITT Final EIS/OEIS, the analysis in Section 3.1 (Sediments and Water Quality) indicated that training and testing activities under each alternative could result in local, short- and long-term changes in sediment and water quality. However, chemical, physical, or biological changes remained within standards, regulations, and guidelines. The short-term impacts arose from explosions and the byproducts of explosions and combusted propellants. The analysis in the 2015 MITT Final EIS/OEIS determined that it was unlikely that these short-term impacts would overlap in time and space with other future actions that produce similar constituents. Therefore, the short-term impacts did not contribute to cumulative impacts.

The long-term impacts arose from unexploded ordnance, non-combusted propellant, metals, and other materials. Long-term impacts of each alternative are cumulative with other actions that cause increases in similar constituents. However, the contribution of Alternative 1 or Alternative 2 in the 2015 MITT Final EIS/OEIS to long-term cumulative impacts was determined to be negligible because of the following:

- Most training and testing activities are widely dispersed in space and time.
- Where activities are concentrated (i.e., Farallon de Medinilla [FDM]), marine habitat conditions observed over multiple years through dive studies indicate that ecological services that maintain water quality have not been inhibited at FDM.
- Most components of expended materials are inert or corrode slowly.
- Numerically, most of the metals expended are small- and medium-caliber projectiles, metals of concern comprise a small portion of the alloys used in expended materials, and metal corrosion is a slow process that allows for dilution.
- Most of the components are subject to a variety of physical, chemical, and biological processes that render them benign.
- Potential areas of impacts would be limited to small zones immediately adjacent to the explosive, metals, or chemicals.

Under this SEIS/OEIS, the contribution of proposed changes in training and testing activities under Alternative 1 or Alternative 2 would still be negligible based on the reasons presented above. While all of the additional projects since 2015 may be measurable and result in long-term and widespread changes in environmental conditions (e.g., nutrient loading, turbidity, salinity, or pH), any changes in sediment and water quality would be subject to applicable standards and guidelines. Given that impacts on water quality as a result of the proposed training and testing activities would be considered negligible, the incremental contribution to cumulative impacts on water quality would also be negligible.

4.4.2 Air Quality

In the 2015 MITT Final EIS/OEIS, the analysis in Section 3.2 (Air Quality) indicated that training and testing activities conducted under each alternative resulted in increased criteria pollutant emissions and hazardous air pollutant emissions throughout the Study Area. Sources of the emissions included vessels and aircraft and, to a lesser extent, munitions. Potential impacts included localized and temporarily elevated pollutant concentrations; however, recovery occurs quickly as emissions disperse. The analysis in the 2015 MITT Final EIS/OEIS concluded that the impacts of Alternatives 1 or 2 were cumulative with other actions that involve criteria air pollutant and hazardous air pollutant emissions. However, the incremental contributions, from implementing activities in accordance with the 2015 MITT Final EIS/OEIS Record of Decision (ROD), to cumulative impacts were low for the following reasons:

- Most training and testing activities-related emissions are projected to occur at distances greater than 3 nautical miles (NM) from shore.
- Few stationary offshore air pollutant emission sources exist within the Study Area, and few are expected in the foreseeable future.
- International regulations by the International Maritime Organization required commercial shipping vessels to switch to lower-sulfur fuel near U.S. and international coasts beginning in 2012 (National Oceanic and Atmospheric Administration 2011).

- The Department of Defense released the *Operational Energy Strategy: Implementation Plan*, which reduced demand, diversified energy sources, and integrated energy consideration into planning (Department of Defense 2012). Since then, the Navy has released the 2016 Operational Energy Strategy, which builds on the successes of the 2012 Operational Energy Strategy (U.S. Department of Defense, 2016).

Under this SEIS/OEIS, the contribution of proposed increases in training and testing activities under Alternative 1 or Alternative 2 would still result in low cumulative impacts based on the reasons presented above. In addition, the International Maritime Organization is set to impose a new 0.5 percent sulfur cap on marine fuel emissions (International Maritime Organization, 2017). Construction-related activities associated with the additional other projects in the area could generate increased air emissions; however, air quality in the region would not be significantly impacted due to the quick dispersive nature of emissions. Based on the analysis presented in Section 3.2 (Air Quality) of this SEIS/OEIS and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts on air quality would not be significant.

In addition to the cumulative effects of criteria and hazardous air pollutants, greenhouse gas emissions would increase under the Proposed Action. Greenhouse gases contribute to climate change, which are felt on a global scale, rather than having localized effects. Although the Proposed Action would result in a decrease in greenhouse gas emissions, the Secretary of the Navy has released energy goals that aim to reduce the overall impact that the department has on climate change. Some of those goals involve using alternative energy sources for 50 percent of total consumption needs by 2020, having 50 percent of Navy and Marine Corps installations be net-zero emissions by 2020, and reducing petroleum use in the commercial fleet by 50 percent. These activities would more than offset the greenhouse gas emissions that would result from implementation of Alternative 1 or 2.

4.4.3 Marine Habitats

In the 2015 MITT Final EIS/OEIS, the analysis presented in Section 3.3 (Marine Habitats) indicated that marine habitats were affected by explosive stressors (underwater detonations) and physical disturbance or strikes (vessels and in-water devices, military expended materials, or seafloor devices). Impacts included localized disturbance of the seafloor, cratering of soft bottom sediments, and structural damage to hard bottom habitats. Impacts on soft bottom habitats were determined to be short term, and impacts on the hard bottom were determined to be long term. Alterations to marine habitats that occurred under the alternatives in the 2015 MITT Final EIS/OEIS were found to be additive to those associated with other actions. The relative incremental contributions, from implementing activities in accordance with the 2015 MITT Final EIS/OEIS ROD, to the overall alterations of marine habitats within the Study Area were low for the following reasons:

- As stated in the 2015 MITT Final EIS/OEIS, training activities utilizing bottom placed detonations would only occur in the existing underwater detonation areas at Piti, Agat, and Outer Apra Harbor. Cobble, rocky reef, and other hard bottom habitat may be scattered throughout the area, but those areas would be avoided during training to the maximum extent practicable.
- Impacts were confined to a limited area, and recovery of soft bottom habitats occurs quickly.

It can reasonably be assumed that there may be impacts on marine habitats from other actions such as seismic surveys and commercial fishing, but no specific details regarding the impacts or effects can be determined with any specificity or certainty. Seismic surveys and commercial fishing may occur in any open area of the Study Area. Seismic surveys could temporarily disturb soft bottom sediment and would

have no impacts on non-living hard-bottom habitats. Commercial fishing could temporarily disturb soft bottom sediment, and trawling or dragging the bottom of the seafloor could have moderately longer impacts on non-living hard-bottom habitats by movement of sediment; however, impacts would not change the nature of the habitat from non-living hard-bottom. For actions such as the Department of the Navy's Commonwealth of the Northern Mariana Islands Joint Military Training action, direct and indirect impacts could occur on Tinian; however, the Proposed Action is being revised to avoid or reduce direct impacts on marine habitats. Proposed training and testing activities under this SEIS/OEIS would result in minimal impacts on habitat on or around Tinian due to proposed activities such as amphibious assault; raid; noncombatant evacuation operation; humanitarian assistance/disaster relief operations; personnel insertion/extraction; parachute insertion; and intelligence, surveillance, and reconnaissance. These impacts would be minimal because proposed activities that could impact marine habitats, such as explosives, would not occur in the nearshore region of Tinian. Standard operating procedures, and mitigation measures would avoid or reduce impacts on marine habitat for the activities listed that occur near Tinian under the Proposed Action. Based on the analysis presented in Section 3.3 (Marine Habitats) and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible. Therefore, further analysis of cumulative impacts on marine habitats is not warranted.

4.4.4 Marine Mammals

4.4.4.1 Region of Influence

The range and habitat for marine mammals extends well beyond the Study Area boundaries and for some species represents only a portion of the full extent of the species' range during their life cycle. Baleen whales (e.g., humpback and blue whales) and some toothed whales (e.g., sperm whales and killer whales) seasonally migrate great distances, including into and out of the Study Area. Many of the smaller toothed whales do not migrate in the strictest sense, but some do undergo seasonal shifts in distribution both within and outside of the Study Area.

Table 3.4-1 lists the current abundance of marine mammal species in the Study Area and the general occurrence locations within the Study Area where they may be encountered. There are 26 marine mammal species known to exist in the Study Area, including 7 mysticetes (baleen whales) and 19 odontocetes (dolphins and toothed whales). Populations are varied; while the average population of certain dolphin and some whale populations include thousands of individuals, other stock populations are unknown or estimated to be in the hundreds. As with other marine resources, distribution is patchy and can be temporarily concentrated in specific areas depending on the species.

4.4.4.2 Resource Trends

Relevant information on the status, distribution, population trends, and ecology is presented for each species and stock in the Study Area in Section 3.4.1 (Affected Environment). The current aggregate impacts of past human activities are significant for some marine mammal species, many of which were in serious decline across the world's oceans. In the Pacific and specifically where the Navy has been intensively training and testing activities for decades, many marine mammal populations seem to be trending towards an increase in abundance.

4.4.4.3 Impacts of Other Actions

4.4.4.3.1 Overview

Section 3.4.1.7 (General Threats) discusses threats within the affected environment that impact marine mammal populations in the Study Area, including water quality degradation (chemical pollution), commercial industries (fisheries bycatch, explosive pest deterrents, and other interactions), noise, hunting, vessel strike, marine debris, disease and parasites, and climate change. Potential impacts of actions that affect marine mammals include mortality, injury, disturbance, and reduced fitness (e.g., reduced reproductive, foraging, and predator avoidance success). The susceptibility of marine mammals to these impacts often depends on proximity, severity, or vulnerability to the stressor, and vulnerability can be increased as multiple stressors compound on an individual.

The activities as described in Table 4.2-1 each potentially create multiple stressors in the Study Area experienced by marine mammals, including vessel traffic, underwater noise, and water pollution. For example, most Navy actions include marine vessel operations, which contribute to underwater noise and the risk of vessel strikes, but Navy vessels are a negligible fraction of the overall vessel presence and, thus, vessel noise in the Study Area. Tens of thousands of cargo vessels annually transit through the Study Area to and from ports in Asia as part of the global network of commercial ship movement (Kaluza et al., 2010). Many human activities also contribute underwater noise from sources other than vessels, including commercial fishing, seismic surveys, construction activities, and other military operations. Bycatch and entanglement, the main threats to marine mammal populations, are chiefly associated with fishing (National Marine Fisheries Service, 2016; Read et al., 2006). While Table 4.2-1 discusses these stressors for individual actions, their aggregate impacts specific to marine mammals are detailed in Section 3.4.1.7 (General Threats) and further described below. Data availability is inconsistent between species and activities, but quantitative estimations are presented where available.

4.4.4.3.2 Commercial Fishing

Several commercial foreign fisheries operate in the Study Area. Potential impacts from these activities include marine mammal injury and mortality due to bycatch and entanglement. Fisheries have also resulted in substantial changes to the structure and function of marine ecosystems that adversely affect marine mammals (National Marine Fisheries Service, 2016). As discussed below, future commercial fishing activities in the Study Area are expected to result in significant impacts on some marine mammal species based on the relatively high injury and mortality rates associated with bycatch and entanglement. This mortality could result in or contribute to population declines for some species. Ecological changes brought about by commercial fishing are also expected to adversely impact marine mammals in the Study Area.

4.4.4.3.2.1 Bycatch

Potential impacts from commercial fishing activities include marine mammal injury and mortality from bycatch, when animals are caught in commercial fishing operations targeting a different species. In 1994, the MMPA was amended to formally require the development of a take reduction plan when U.S. bycatch exceeds a level that is considered unsustainable by the marine mammal population and will lead to marine mammal population decline for U.S. stocks of marine mammals. Although marine mammal bycatch associated with U.S. fisheries has generally declined since the implementation of take reduction measures, and new management practices and consistent regulatory oversight could result in future reductions, this only affects U.S. fisheries; bycatch is expected to remain a leading cause of mortality for

the reasonably foreseeable future (Baker et al., 2006; Lent & Squires, 2017; Read et al., 2006; Song, 2017).

The potential biological removal level is the number of animals that can be removed each year without preventing a stock from reaching or maintaining its optimal sustainable population level. The impacts of bycatch on marine mammal populations vary based on removal rates, population size, and reproductive rates. Small populations with relatively low reproductive rates are most susceptible. At least in part as a result of the MMPA bycatch amendment, estimates of bycatch in the Pacific declined by a total of 96 percent from 1994 to 2006 (Geijer & Read, 2013). Cetacean bycatch declined by 85 percent from 342 in 1994 to 53 in 2006, and pinniped bycatch declined from 1,332 to 53 over the same time period.

Fisheries operations also result in substantial changes to the structure and function of marine ecosystems that adversely affect marine mammals, including loss of prey species and alteration of benthic structure. Overfishing of many fish stocks results in significant changes in trophic structure, species assemblages, and pathways of energy flow in marine ecosystems (Jackson et al., 2001; Myers & Worm, 2003). These ecological changes may have important, and likely adverse, consequences for populations of marine mammals (DeMaster et al., 2001). For instance, depletion of preferred prey could lead to a less-nutritious diet and decreased reproductive success.

4.4.4.3.2.2 Entanglement

As discussed in Section 3.4.1.7 (General Threats), entanglement in fishing gear, such as abandoned or partial nets, fishing line, and the ropes and lines connected to fishing gear, is another threat to marine mammals in the Study Area. The National Oceanic and Atmospheric Administration Marine Debris Program (2014) reports that abandoned, lost, or otherwise discarded fishing gear still constitutes the vast majority of mysticete entanglements.

4.4.4.3.2.3 Hunting

With the enactment of the MMPA, hunting-related mortality has decreased over the last 40 years; however, unregulated harvests and extensive legal and illegal whaling activity still occur in areas outside of U.S. waters. Between 1948 and 1979, the Union of Soviet Socialist Republics' whale harvest totaled 195,783 in the North Pacific Ocean. Subsistence harvest of marine mammals by Russian and Alaska Natives occurs in the North Pacific, Chukchi Sea, and Bering Sea, affecting marine mammal stocks that may be present in the Study Area.

4.4.4.3.3 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and vessel traffic is expected to continue to increase in the Study Area due to continued economic globalization, widening of the Panama Canal, and increases in offshore energy development and other offshore activities (see for example (Kaluza et al., 2010)). While increased risks come with increased vessel traffic, risks of vessel strikes could be minimized by ongoing and future education and awareness, marine mammal reporting, and maritime traffic planning and management. The most vulnerable marine mammals are thought to be those that spend extended periods at the surface or species whose unresponsiveness to vessel sound makes them more susceptible to vessel collisions (Gerstein, 2002; Laist & Shaw, 2006; Nowacek et al., 2004). Marine mammals such as dolphins and porpoises, which can move quickly throughout the water column, are not as susceptible to vessel strikes.

4.4.4.3.4 Ocean Pollution

As discussed in Table 4.2-1, multiple pollutants from numerous sources are present in, and continue to be released into, the oceans. These releases that affect marine mammals include water pollution as well as the discharge of marine debris and the proliferation of ambient as well as impulsive noise in the underwater ecosystem. Section 3.4.1.7 (General Threats) provides an overview of these potential impacts, which include morbidity and mortality from acute toxicity (although mortality has not yet specifically been shown in marine mammals); disruption of endocrine cycles and developmental processes causing reproductive failures or birth defects; suppression of immune system function; and metabolic disorders resulting in cancer or genetic abnormalities (Reijnders et al., 2009). The effects of exposure to and concentration of persistent organic pollutants in marine mammals, especially from pesticides, includes the accumulation of dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenyls (PCBs) in certain species, and high concentrations of organochlorines in tissues appear to have occurred with increasing frequency, based on disease outbreaks involving marine mammals. In addition, experimental and other evidence has shown that persistent contaminants often found in the tissues of marine mammals have deleterious effects on reproduction and the immune system (O'Shea et al., 1999).

4.4.4.3.5 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-1 and as specific stressors to marine mammals in Section 3.4.1.7 (General Threats). Noise is of particular concern to marine mammals because many species use sound as a primary sense for navigating, finding prey, avoiding predators, and communicating with other individuals. Noise can cause behavioral disturbances; mask other sounds (including their own vocalizations); and may result in injury, including hearing loss in the form of temporary threshold shift or permanent threshold shift (PTS) or, in some cases, death.

Anthropogenic noise is generated from a variety of sources throughout the Study Area, including commercial shipping, oil and gas exploration and production activities (including air gun, drilling, and explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, acoustic deterrent, and harassment devices), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, and telemetry).

The military activities addressed in Table 4.2-1 include various training and testing operations that contribute vessel noise, in-water and in-air explosions, and sonar. While sonar activity can impact individual marine mammals, impacts on populations are not expected. Although various other training and testing activities involve surface or undersea detonations or gunnery exercises, these are generally mitigated through monitored exclusion zones and are infrequent, isolated events. As noted in Table 4.2-1, many activities incorporate best management practices or standard operating procedures to minimize noise generation; in particular, in-water construction at naval piers regularly utilizes dampening and attenuation technologies and other practices that reduce impacts on bottlenose dolphins and other sensitive receptors in the vicinity of pile-driving activities.

4.4.4.3.6 Marine Debris and Ingestion

Interactions between marine mammals and marine debris, including derelict fishing gear (as discussed in Section 4.4.4.3.2.2, Entanglement) and plastics, are significant sources of injury and mortality (Baulch & Perry, 2014), and the percentage of marine mammal species with documented records of entanglement in or ingestion of marine debris has increased from 43 to 66 percent over the past 18 years (Bergmann

et al., 2015). Ingestion of plastic bags and Styrofoam has been identified as a cause of injury or death of minke whales and deep-diving odontocetes, including beaked whales, pygmy sperm whales, pilot whales, and sperm whales.

4.4.4.3.7 Disease and Parasites

Section 3.4.1.7.8 (Disease and Parasites) discusses the effects of disease and parasites in marine mammals. Just like humans, older animals are more likely to be affected by disease and likewise can spread disease through a population, affecting a significant number of otherwise healthy individuals. Mass die-off events can also occur as a result of toxic algal blooms, which may be increasing in frequency due to human nutrient input and climate change, and the spread of certain parasites from the feces of feral cats (toxoplasmosis, hookworms, lungworms, and thorny-headed worms) to marine mammals in storm runoff.

4.4.4.4 Impacts of the Proposed Action that May Contribute to Cumulative Impacts

Impacts of the Proposed Action are detailed in Section 3.4 (Marine Mammals). Impacts that may contribute to cumulative impacts on marine mammals can be generally categorized as mortality, injury (Level A harassment under the MMPA), and behavioral responses and temporary threshold shift (TTS) (Level B harassment under the MMPA). These impacts would be associated with certain acoustic (sonar and other transducers), physical disturbance, and strike stressors. Although behavioral impacts are possible from the remaining stressors (as defined in Section 3.4.2, Environmental Consequences), these stressors are not expected to result in harassment, TTS, PTS, injury, or mortality of marine mammals.

The analysis presented in Section 3.4 (Marine Mammals) concluded that some stressors associated with the Proposed Action could impact individuals of certain marine mammal species, but impacts are not expected to decrease the overall fitness of any marine mammal population. Species most likely to be impacted by training and testing activities are dwarf sperm whales and pygmy sperm whales along with delphinids species (dolphins and small whales), which are the most abundant species in the Study Area. From a cumulative perspective, any potential impacts on species with small populations, especially Endangered Species Act (ESA)-listed species, are of particular concern, and the Navy has consulted with the National Marine Fisheries Service, as required by Section 7(a)(2) of the ESA, in that regard. The Navy will implement mitigation to avoid or reduce impacts from acoustic, explosive, and physical disturbance and strike stressors on marine mammals, as described in Chapter 5 (Mitigation).

As determined in Section 3.4 (Marine Mammals), it is not anticipated that the Proposed Action would result in significant impacts on marine mammal populations. The majority of the proposed activities are unit-level training and testing activities, which are conducted in the open ocean. Unit-level events occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few hours or less). Additionally, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual marine mammal would be exposed to stressors from multiple activities within a short timeframe. Furthermore, research and monitoring efforts have included before, during, and after-event observations and surveys, data collection through conducting long-term studies in areas of Navy activity, occurrence surveys over large geographic areas, biopsy of animals occurring in areas of Navy activity, and tagging studies where animals are exposed to Navy stressors. To date, the findings from the research and monitoring and the regulatory conclusions from previous analyses by the National Marine Fisheries Service (NMFS) (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013) are that the

majority of impacts from Navy training and testing activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of marine mammals.

Mitigation measures discussed in Chapter 5 (Mitigation) are designed to avoid or reduce potential impacts of explosives, especially higher-order impacts such as injury and mortality to the greatest extent practicable. The acoustic analysis indicates that pressure waves resulting from explosive detonations would not lead to mortality for any of the marine mammals in the Study Area. The effectiveness of procedural mitigation measures is conservatively considered in the Navy's quantitative analysis process.

There are no records of a marine mammal ever being struck by a vessel during training and testing activities in the Study Area, and a vessel strike resulting from the Proposed Action is not anticipated.

4.4.4.5 Cumulative Impacts on Marine Mammals

As discussed above, fishery bycatch, vessel strikes, and entanglement in marine debris are leading causes of direct mortality to marine mammals (Carretta et al., 2017; Helker et al., 2017; Lent & Squires, 2017; National Marine Fisheries Service, 2016; National Oceanic and Atmospheric Administration Marine Debris Program, 2014; Read et al., 2006). Although Navy activities are mitigated to the greatest extent practicable, the Proposed Action could also result in injury and mortality to individuals of some marine mammal species from in-water explosions and vessel strikes. Implementation of measures discussed in Chapter 5 (Mitigation) would help avoid or reduce, but not absolutely eliminate, the risk for potential impacts, and any incidence of injury and mortality that might occur under the Proposed Action could be additive to injury and mortality associated with other actions in the Study Area. While it is more likely that an individual of an abundant, common stock or species would be affected, there is a chance that a less abundant stock could be affected.

Ocean noise, globally and specifically in the Study Area, is already significantly elevated over historic, natural levels, and acoustic stressors (in-water explosions and sonar, as well as increased Navy vessel noise) associated with the Proposed Action could also result in additive acoustic impacts on marine mammals. However, sonar is not known to make up a significant portion of the overall ocean noise budget (Bassett et al., 2010; Baumann-Pickering et al., 2010; International Council for the Exploration of the Sea, 2005; McDonald et al., 2006). Other current and future actions such as construction, and operation of offshore energy projects; seismic surveys; and construction, operation, and removal of offshore energy facilities could result in underwater sound levels that could cause behavioral harassment, TTS, PTS, or, to a less extent, injury or mortality. Additionally, the constant elevation in ambient noise may produce physiological stress in individuals to which the Proposed Action would contribute.

Sounds from many of these sources travel over long distances, and it is possible that some would overlap in time and space with sounds from in-water explosions or Navy sonar use, in particular commercial shipping noise, which is more widespread and continuous. It is not known whether the co-occurrence of shipping noise and sounds associated with in-water explosions and sonar use would result in harmful additive impacts on marine mammals. However, these training and testing activities are widely dispersed, the sound sources are intermittent, and mitigation measures would be implemented. Furthermore, standard operating procedures would preclude some training and testing activities in the immediate vicinity of other actions, further reducing the likelihood of simultaneous or overlapping exposure. For these reasons, it is unlikely that an individual marine mammal would be simultaneously exposed to sound levels from multiple actions that could cause behavioral harassment, TTS, PTS, or injury.

If the health of an individual marine mammal were compromised, it is possible this condition could alter the animal's expected response to stressors associated with the Proposed Action. The behavioral and physiological responses of any marine mammal to a potential stressor, such as underwater sound, could be influenced by various factors, including disease, dietary stress, body burden of toxic chemicals, energetic stress, percentage body fat, age, reproductive state, and social position. Synergistic impacts are also possible; for example, animals exposed to some chemicals may be more susceptible to noise-induced loss of hearing sensitivity (Fechter & Pouyatos, 2005). While the response of a previously stressed animal might be different from the response of an unstressed animal, no data are available at this time that accurately predict how stress caused by various ocean pollutants would alter a marine mammal's response to stressors associated with the Proposed Action.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on some marine mammal species in the Study Area. The Proposed Action could contribute incremental stressors to individuals, which would both further compound effects on a given individual already experiencing stress and, in turn, have the potential to further stress populations, some of which may already be in significant decline or in the midst of stabilization and recovery.

Furthermore, the regulatory process administered by NMFS, which includes Stock Assessments for all marine mammals, as well as five-year reviews for all ESA-listed species, provides a backstop that informs decisions on take authorizations and Biological Opinions. Stock Assessments include estimates of Potential Biological Removal that stocks of marine mammals can sustainably absorb. MMPA take authorizations require the minimization of adverse effects and are explicitly limited to small numbers, with no more than a negligible impact on species and stocks of marine mammals. MMPA authorizations are reinforced by monitoring and reporting requirements so that NMFS is kept informed of deviations from what has been approved. Biological Opinions for federal and non-federal actions are similarly grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. These processes help to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Actions would not have a measurable effect on the resource.

4.4.5 Sea Turtles

4.4.5.1 Region of Influence

The general region of influence for sea turtles includes open ocean and coastal water off Guam, Rota, Tinian, Saipan, and FDM. The 2015 MITT Final EIS/OEIS analyzes amphibious landings on the beaches of Guam, Rota, and Tinian where sea turtles are known to nest. As this SEIS/OEIS only addresses sea-based training and testing activities in the Study Area, the impacts of amphibious landings on sea turtle nesting and other land-based impacts of amphibious landings are not addressed or analyzed in this SEIS/OEIS. The sea turtle species occurring in the Study Area include green sea turtles (*Chelonia mydas*) (Central West Pacific DPS), hawksbill sea turtle (*Eretmochelys imbricata*), loggerhead sea turtle (*Caretta caretta*), olive ridley sea turtle (*Lepidochelys olivacea*), and leatherback sea turtle (*Dermochelys coriacea*). In general, sea turtles spend most of their time at sea, with female turtles returning to land to nest and often migrating long distances between feeding grounds and nesting beaches. As with other marine resources, distribution is patchy and can be concentrated in specific areas depending on the species, season, habitat, activity, and age of the individuals.

4.4.5.2 Resource Trends

All sea turtles in the Study Area have experienced significant decline in population numbers over the past hundred years and are ESA-listed (Table 3.5-1). Because sea turtles are so long-lived, and because reliable data are only available for approximately the past 20 years, it is not possible to determine a reliable trend in abundance for most species. In addition, leatherback sea turtles, loggerhead sea turtles, and olive ridley sea turtles are not expected to occur in nearshore waters of the Study Area, increasing the difficulty of tracking trends of these species in pelagic waters. Recent information, however, shows significant increases of green sea turtles and hawksbill sea turtles in nearshore waters of Guam. Jones and Martin (2016) analyzed five decades of aerial surveys (from 1962 through 2012), calculated a population growth rate of approximately 90 percent over the past five decades for these two species, and estimated that 85 percent of the sea turtles were green sea turtles, and 15 percent were hawksbill sea turtles. The Navy is currently funding in-water tagging of sea turtles to further understand resource trends in waters off of Guam, Tinian, and Saipan. Since November 2015 when tagging began, Falcone et al. (2017) report that the majority of sea turtles observed or captured (65 of 68 total sea turtles observed, or 96 percent) have been green sea turtles.

4.4.5.3 Impacts of Other Actions

4.4.5.3.1 Overview

Section 3.5.1.5 (General Threats) discusses the specific stressors within the affected environment that impact sea turtle populations in the Study Area, which include water quality (marine debris and chemical contaminants), commercial industries (fisheries bycatch and other interactions), hunting/exploitation, vessel strike, oil and gas development, wind energy development, shoreline development and recreation, dredging, military activities, invasive species, disease, habitat destruction (loss of seagrass habitat and nesting beaches), and climate change. Potential impacts of actions that affect sea turtles include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success.

The susceptibility of sea turtles to these outcomes often depends on proximity, severity, or vulnerability to the stressor, and vulnerability can be increased as multiple stressors compound on an individual. The abundance of the species, potential impacts that may affect localized nesting sites, and individual fatalities could have considerable impacts in localized populations.

The activities as described in Table 4.2-1 each potentially contribute multiple stressors in the Study Area experienced by sea turtles, including vessel traffic, underwater noise, and water pollution. For example, most actions include the operation of marine vessels, which contribute to vessel strikes and underwater noise. Bycatch and entanglement, among the main threats to sea turtle populations in the Study Area, are chiefly associated with fishing and are discussed separately. While Table 4.2-1 discusses these stressors for individual actions, their aggregate impacts specific to sea turtles are detailed in Section 3.5.1.5 (General Threats) and further described below.

4.4.5.3.2 Commercial Fishing and Harvest

Past and present commercial fishing activities have had a global effect on the recovery and conservation of marine turtle populations and, despite continued improvements in bycatch avoidance and the implementation of regulatory efforts, fisheries interactions continue to be the primary human-related source of mortality for most sea turtles (National Research Council of the National Academies, 1990; Wallace et al., 2010). Among fisheries that incidentally capture sea turtles, certain types of trawl, gillnet, and longline fisheries generally pose the greatest threat. One comprehensive study estimated that

worldwide, 447,000 turtles are killed each year from bycatch in commercial fisheries (Wallace et al., 2010). In United States' fisheries, bycatch resulted in 71,000 sea turtle deaths per year prior to effective protective sea turtle regulations (enacted in the mid-1990s); but current mortality estimates are 94 percent lower than pre-regulation estimates (Finkbeiner et al., 2011).

Globally, large-scale commercial exploitation also contributes to global decline in marine turtle populations. Currently, 42 countries and territories allow some form of take of turtles and collectively remove in excess of 42,000 turtles per year, the majority of which (more than 80 percent) are green sea turtles (Humber et al., 2014). Illegal fishing for turtles and nest harvesting also continues to be a major cause of sea turtle mortality, both in countries that allow sea turtle take and in countries that outlaw the practice (Lam et al., 2011; Maison et al., 2010). For example, Humber et al. (2014) estimated that 65,000 sea turtles have been illegally harvested in Mexico since 2000. The authors, however, have seen legal and illegal direct take of sea turtles trending downward over the past three decades—citing a more than 40 percent decline in green sea turtle take since the 1980s, a more than 60 percent decline in hawksbill and leatherback take, and a more than 30 percent decline in loggerhead take (Humber et al., 2014).

4.4.5.3.3 Maritime Traffic and Vessel Strikes

Maritime traffic has increased over the past 50 years, and vessel traffic is expected to continue to increase in the Study Area in response to continued economic globalization, increases in energy development, and other offshore activities. Vessel strike has been identified as one of the important mortality factors in several nearshore turtle habitats worldwide. Precise data are lacking for sea turtle mortalities directly caused by ship strikes; however, live and dead turtles are often found with deep cuts and fractures indicative of collision with a boat hull or propeller (Hazel et al., 2007; Lutcavage et al., 1997). Some vessel strikes could cause temporary impacts, such as diverting the turtle from its previous activity or causing minor injury. Major strikes could cause permanent injury or death from bleeding, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition. Numerous living sea turtles bear scars that appear to have been caused by propeller cuts or collisions with vessel hulls (Hazel et al., 2007; Lutcavage et al., 1997), suggesting that not all vessel strikes are lethal. While increased risks come with increased vessel traffic, risks of vessel strikes could be minimized by ongoing and future education and awareness, ship-speed reduction measures, and maritime traffic planning and management.

4.4.5.3.4 Coastal Land Development

Although sea turtle nesting sites within the Mariana Islands are not included in the Study Area for this SEIS/OEIS, impacts on sea turtle nesting sites from activities not associated with training and testing activities may impact overall populations of sea turtles within the region of influence for this SEIS/OEIS.

Female sea turtles migrate to their natal beaches to lay eggs, and pervasive coastal development often interferes with successful nesting at these locations. Shared use between turtles and human interests on increasingly populated and utilized beach areas has intensified the tendency for female turtles and their hatchlings to encounter various barriers and hazards accessing, nesting, and leaving these beaches. The following factors prevent beach access and emigration of sea turtles: beachfront construction of homes, hotels, restaurants, roads, seawalls, and shoreline armoring; beach erosion; ports and marinas; beach replenishment; nearshore dredging; and oil and gas activities. Beach-going vehicles and watercraft cause injury and mortality to sea turtles. Abandoned debris and equipment are often insurmountable obstacles for both mother and offspring (SeeTurtles.org, 2017). Populated areas also often have excess

nighttime lighting that confuses hatchlings' instincts to orient toward the moon to arrive at the ocean, and in this journey, they often fall into and can remain trapped within pits and scars left on the beach. Conservation awareness has increased on many popular U.S. beaches and tourist destinations, but nesting success remains imperiled in many others.

4.4.5.3.5 Ocean Pollution

As discussed in Table 4.2-1, multiple pollutants from numerous sources are present in, and continue to be released into, the oceans. Section 3.5.2 (Environmental Consequences) provides an overview of these potential impacts on sea turtles, which include the ingestion of and entanglement in marine debris as well as toxicity from bisphenol-A, phthalates, and heavy metals. Sea turtles often mistake debris for prey; one study found 37 percent of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al., 2009). Other marine debris, including derelict fishing gear and cargo nets, can entangle and drown turtles in all life stages.

4.4.5.3.6 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-1. Anthropogenic noise is generated from a variety of sources throughout the Study Area, including commercial shipping, oil and gas exploration and production activities (including air gun, drilling, explosive decommissioning), commercial and recreational fishing (including vessel noise, fish-finding sonar, fathometers, acoustic deterrent and harassment devices), shoreline construction projects (including pile driving), recreational boating and whale-watching activities, offshore power generation (including offshore windfarms), and research (including sound from air guns, sonar, telemetry). The military activities addressed in Table 4.2-1 include various training and testing activities that also contribute vessel noise, in-air and in-water explosions, and sonar; however, due to the low risk of encounter and the implementation of required mitigation measures, the Surveillance Towed Array Sensor System Low Frequency Active Sonar training and testing activities are not expected to result in mortality to any sea turtles, and minimal injury or behavioral changes are anticipated.

In general, the potential concerns associated with ocean noise and sea turtles are not as well defined as those for marine mammals. While it is well known that many species of marine mammals use sound as a primary sense for navigating, finding prey, and communicating with other individuals, little is known about how sea turtles use sound in their environment. Based on knowledge of their sensory biology (Bartol & Musick, 2003; Bartol & Ketten, 2006; Ketten & Moein-Bartol, 2006; Levenson et al., 2004), there is evidence that sea turtles may be able to detect objects within the water column (e.g., vessels, prey, predators) via some combination of auditory and visual cues. However, research examining the ability of sea turtles to avoid collisions with vessels shows they may rely more on their vision than auditory cues (Hazel et al., 2007). Similarly, while sea turtles may rely on acoustic cues from breaking waves to identify nesting beaches, they also appear to rely on other non-acoustic cues for navigation, such as magnetic fields (Lohmann & Lohmann, 1992, 1996) and light (Avens, 2003). Additionally, sea turtles are not known to produce sounds underwater for communication. As a result, sound may play a limited role in a sea turtle's environment.

Nonetheless, as discussed in Section 3.5.2.1 (Acoustic Stressors), sea turtles could experience a range of impacts from ocean noise, depending on the sound source. The impacts could include permanent or temporary hearing loss, changes in behavior, physiological stress, and auditory masking. In addition, potential impacts from use of explosives could range from physical discomfort to non-lethal and lethal injuries.

4.4.5.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

The cumulative impacts analysis includes green, hawksbill, olive ridley, leatherback, and loggerhead turtles, all of which are ESA-listed species. The analysis presented in Section 3.5 (Sea Turtles) concludes that some stressors associated with the Proposed Action could impact individuals of certain sea turtle species, but impacts are not expected to decrease the overall fitness of any sea turtle population. From a cumulative perspective, potential impacts on listed species are of particular concern, and mitigation measures designed to avoid or reduce the potential impacts are discussed in Chapter 5 (Mitigation).

Impacts from the Proposed Action that may contribute to cumulative impacts on sea turtles can be generally categorized as behavioral responses, temporary and PTSs, non-auditory injury (modeled as slight lung injury and gastrointestinal tract injury), and mortality. As summarized below, these impacts would be associated with certain acoustic and physical strike stressors. The use of sonar and other transducers may result in behavioral responses, and temporary and PTSs in sea turtles, including ESA-listed sea turtles. Explosives may result in behavioral responses, TTS, PTS, injury, and mortality in sea turtles, including ESA-listed sea turtles. Vessel strikes may cause injury or mortality in sea turtles, including ESA-listed sea turtles.

The remaining acoustic stressors (noise from air guns, weapons firing/launch/impact, aircraft overflight, vessels), energy stressors (electromagnetic, high energy lasers), physical disturbance and strike stressors (in-water devices, military expended materials, seafloor devices), entanglement stressors (cables, wires, decelerators/parachutes), ingestion stressors (military expended materials – munitions and military expended materials – other than munitions), and secondary stressors are not expected to result in temporary or PTSs, injury, or mortality of sea turtles under the Proposed Action, including ESA-listed sea turtles. The Proposed Action would not introduce significant light sources that would disorient nesting turtles or their hatchlings. Because the Navy's training and testing activities covered under this SEIS/OEIS do not co-occur with nesting activities, it is unlikely that stressors presented to sea turtles would contribute to other anthropogenic threats not caused by Navy activities.

Although sea turtles could be exposed to sound and energy from explosive detonations throughout the Study Area, the estimated impacts on individual sea turtles are unlikely to impact populations. Injured sea turtles could suffer reduced fitness and long-term survival. Sea turtles that experience temporary or PTSs may have reduced ability to detect relevant sounds such as predators or prey, although some with temporary threshold shift would recover quickly, possibly in a matter of minutes. It is uncertain whether some permanent hearing loss over a part of a sea turtle's hearing range would have long-term consequences for that individual because the sea turtle hearing range is already limited (Section 3.5.2.1, Acoustic Stressors). Any significant behavioral reactions to acoustic stimuli could lead to a sea turtle expending energy and missing opportunities to secure resources. However, most individuals are not likely to experience long-term consequences from behavioral reactions because exposures would be intermittent and widely spaced, allowing exposed individuals to recover. Since long-term consequences for most individuals are unlikely, long-term consequences for populations are not expected.

In summary and as determined in Section 3.5 (Sea Turtles), it is not anticipated that the Proposed Action would result in significant impacts on sea turtles. Due to the wide dispersion of stressors, speed of the platforms, and general dynamic movement of many training and testing activities, it is very unlikely that a sea turtle would remain in the potential impact range of multiple sources or sequential exercises. Additionally, the majority of the proposed activities are unit-level training and small testing activities, which are conducted in the open ocean. Unit-level exercises occur over a small spatial scale (one to a few square miles) and with few participants (usually one or two) or short duration (the order of a few

hours or less). Likewise, training and testing activities are generally separated in space and time in such a way that it would be unlikely that any individual sea turtle would be exposed to stressors from multiple activities within a short timeframe. Furthermore, research and monitoring efforts have included before, during, and after-event observations and surveys; data collection through conducting long-term studies in areas of Navy activity; occurrence surveys over large geographic areas; biopsy of animals occurring in areas of Navy activity; and tagging studies where animals are exposed to Navy stressors. To date, the findings from the research and monitoring and the regulatory conclusions from previous analyses by NMFS (National Marine Fisheries Service, 2015a; National Oceanic and Atmospheric Administration, 2013) are that majority of impacts from Navy training and testing activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of sea turtles.

4.4.5.5 Cumulative Impacts on Sea Turtles

The fact that all five species of sea turtles occurring in the Study Area are ESA-listed provides a clear indication that the current aggregate impacts of past human activities are significant for sea turtles. Bycatch, vessel strikes, coastal land development, and ocean pollution are the leading causes of mortality and population decline for sea turtles, and, although mitigated/avoided to the greatest extent practicable, the Proposed Action could result in stress, injury, and mortality to individuals of some sea turtle species from in-water explosions and vessel strikes. Implementation of observation and delay measures discussed in Chapter 5 (Mitigation) would help avoid or reduce, but not absolutely eliminate, the risk for potential impacts, and any incidence of injury and mortality that might occur under the Proposed Action could be additive to injury and mortality associated with other actions in the Study Area.

According to scientific studies, sea turtles may rely primarily on senses other than hearing for interacting with their environment and appear to recover quickly from noise stressors (Section 3.5.2.1, Acoustic Stressors); thus, the acoustic stressors produced by Navy activities are anticipated to have minimal cumulative impact on sea turtles. The Proposed Action would not affect turtle nesting habitat, and contaminants and debris discharged into the marine environment are expected to be negligible and not persistent (Section 4.4.1, Sediments and Water Quality). Effects from the Proposed Action to sea turtle food sources are avoided or insignificant (Section 4.4.7, Marine Vegetation, and Section 4.4.8, Marine Invertebrates). Likewise, Navy actions generally would not overlap in space and time with other stressors as they occur as dispersed, infrequent, and isolated events that do not last for extended periods.

The potential exists for the impacts of ocean pollution (disease, malnourishment), injury, nesting habitat loss, starvation, and the composite increased underwater noise environment to contribute multiple stressors to an individual, and it is possible that the response of a previously stressed animal to impacts associated with the Proposed Action could be more severe than the response of an unstressed animal, or impacts from the Proposed Action could make an individual more susceptible to other stressors. For example, if a Navy vessel were to strike and injure an otherwise healthy sea turtle, exposure to multiple other stressors in the area may hinder the individual's recovery from any injury sustained in the accident. Likewise, a sea turtle near an in-water explosion or sonar activity may become stressed or disoriented, and the time to recover may be increased if that individual is likewise experiencing disease, malnutrition, or other strike injury that may increase its vulnerability to predation or decrease its ability to forage.

In summary, the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on all sea turtle species in the Study Area as evident by their scarce populations. The Proposed Action could contribute incremental stressors to individuals, which would both further compound effects on a given individual already experiencing stress and in turn has the potential to further stress populations in significant decline or recovery efforts thereof. Additionally, as with marine mammals, the NMFS regulatory process includes Stock Assessments and five-year reviews for all ESA-listed species, which provides a backstop that informs decisions on take authorizations and Biological Opinions. Biological Opinions for federal and non-federal actions are grounded in status reviews and conditioned to avoid jeopardy and to allow continued progress toward recovery. This process helps to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Action would not have a measurable effect on the resource into the future.

4.4.6 Marine Birds

In the 2015 MITT Final EIS/OEIS, the analysis in Section 3.6 (Marine Birds) indicated that birds were impacted by acoustic stressors (sonar and other transducers, in-water explosions, weapons firing noise, aircraft noise, vessel noise), energy stressors (electromagnetic devices), physical disturbance and strikes (aircraft, aerial targets, vessels and in-water devices, military expended materials), and ingestion (military expended materials – munitions and military expended materials – other than munitions). Potential responses included a startle response, which includes short-term behavioral (e.g., movement) and physiological components (e.g., increased heart rate). Recovery from the impacts of most stressor exposures occurs quickly, and impacts are localized. Some stressors, including in-water explosions, physical strikes, and ingestion of plastic military expended materials, result in mortality. However, the number of individual birds affected was expected to be low, and no population-level impacts were expected. The impacts of the alternatives were determined to be cumulative with other actions that caused short-term behavioral and physiological impacts and mortality to birds. However, the incremental contribution of those alternatives to cumulative impacts on birds were determined to be low for the following reasons:

- Most of the proposed activities were widely dispersed in offshore areas, where bird distribution is patchy and concentrations of individuals are often low. Therefore, the potential for interactions between birds and training and testing activities was low.
- As discussed in Section 3.6 (Marine Birds), there have been no statistically significant declines in numbers of indicator species that nest on FDM, despite a long history of military use of FDM.
- It is unlikely that training and testing activities influenced nesting because most activities take place in water and away from nesting habitats on land. Alternatives 1 or 2 did not result in destruction or loss of nesting habitat.
- For most stressors, impacts were short term and localized, and recovery occurs quickly.
- While a limited amount of mortality could occur, no population-level impacts were expected.
- None of the alternatives were likely to adversely affect ESA-listed bird species.

Under this SEIS/OEIS, the contribution of proposed increases in training and testing activities under Alternative 1 or Alternative 2 would still be negligible based on the reasons presented above. While all of the additional projects since 2015 may be measurable and contribute to the cumulative impacts on marine birds, the number of individual marine birds affected is expected to be low, and no population-level impacts are expected. Based on the analysis presented in Section 3.6 (Marine Birds)

and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible. Further analysis of cumulative impacts on marine birds is not warranted.

4.4.7 Marine Vegetation

In the 2015 MITT Final EIS/OEIS, the analysis presented in Section 3.7 (Marine Vegetation) indicated that marine vegetation was affected by explosive stressors (in-water explosions), physical stressors (vessels and in-water devices, military expended materials, or seafloor devices), and secondary stressors (impacts associated with sediments and water quality) and is still valid in this SEIS/OEIS analysis. Potential impacts included localized disturbance and mortality. As discussed in the 2015 MITT Final EIS/OEIS, the analysis indicated that recovery would occur quickly, and population-level impacts were not anticipated. Impacts of the alternatives in the 2015 MITT Final EIS/OEIS were considered to be cumulative with other actions that caused disturbance and mortality of marine vegetation.

The current aggregate impacts of past, present, and reasonably foreseeable future actions presented in Table 4.2-1 may affect marine vegetation. Aggregate impacts from vessel movement, increased sedimentation, and other stressors associated with other actions discussed in Table 4.2-1 could result in injury and mortality. Although this SEIS/OEIS does address some of these projects, developments, and actions listed in Table 4.2-1, many of these other actions and their associated cumulative impacts on marine vegetation cannot be determined with any specificity or certainty. However, it can reasonably be assumed that there may be marine vegetation that could be affected by these actions, but no specific details are known regarding the impacts or effects to individuals or populations. Alternatives 1 or 2 could also result in injury and mortality to marine vegetation from in-water explosions and strikes. Injury and mortality that might occur would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 or 2 to the overall injury and mortality would be low compared to other actions for the following reasons:

- Most training and testing activities would occur in areas where seagrasses and other attached marine vegetation do not grow.
- Impacts would be localized, recovery would occur quickly, and no population-level impacts would be expected.
- Proposed training and testing activities would not result in impacts that have historically affected marine vegetation. For example, Alternatives 1 or 2 would not increase nutrient loading, which can cause algal blooms, decrease light penetration, and impact photosynthesis of seagrasses.

Under this SEIS/OEIS, the contribution of proposed increases in training and testing activities under Alternative 1 or Alternative 2 would still be low, based on the reasons presented above. Impacts on marine vegetation from projects such as pollution, and climate change could result in long-term or widespread changes in secondary stressors to the environment that would change environmental conditions, such as turbidity, salinity, pH, or water temperature that would impact marine vegetation. However, these impacts are expected to be localized, recovery would occur quickly, and no population-level impacts would be expected. Based on the analysis presented in Section 3.7 (Marine Vegetation) and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts on marine vegetation would be negligible. Therefore, further analysis of cumulative impacts on marine vegetation is not warranted.

4.4.8 Marine Invertebrates

4.4.8.1 Region of Influence

The region of influence for invertebrates includes the entire Study Area as invertebrates occur in all habitats and depths, including both the water column and benthic habitat, and many species have pelagic larvae, such as corals, that can drift in the ocean currents until they settle on reefs. Invertebrate groups in the Study Area are listed in Section 3.8 (Marine Invertebrates) and include microscopic zooplankton that drift with currents (e.g., invertebrate larvae, copepods, protozoans), larger invertebrates living in the water column (e.g., jellyfish, shrimp, squid), and benthic invertebrates that live on or in the seafloor (e.g., clams, corals, crabs, worms).

4.4.8.2 Resource Trends

As discussed in Section 3.8.1.2 (General Threats), marine invertebrates are ecologically and economically crucial, performing essential ecosystem services such as coastal protection, nutrient recycling, food for other animals, and habitat, as well as providing income from tourism and commercial fisheries. The health and abundance of marine invertebrates are vital to the marine ecosystem and the sustainability of the world's fisheries. Invertebrates are fished for food (e.g., shrimps, lobsters, and crabs; scallops, clams, and oysters; sea urchins, sea cucumbers, squids, and octopuses); harvested for jewelry, curios, and the aquarium trade; and some are known to secrete medicinal compounds of interest to the health industry.

Corals occur throughout the Study Area and include three species (*Acropora globicep*s, *A. retusa*, and *Seriatopora aculeata*) that are listed under the ESA. Raymundo et al. (2017) reported a catastrophic mass mortality event of more than 50 percent in shallow staghorn (*Acropora*) coral in Guam that was initiated in 2013 by anomalous warm sea surface temperatures.

In 2017, NMFS determined that seven species of giant clam (*Hippopus, H. porcellanus, Tridacna costata, T. derasa, T. gigas, T. squamosa*, and *T. tevoroa*) were candidates that may warrant listing under the ESA (82 Federal Register 28946). A status review is currently being done for these species. Two species, *H. hippopus* and *T. gigas*, have historically been found in the Study Area but are believed to have been locally extirpated (Meadows, 2016).

4.4.8.3 Impacts of Other Actions

Section 3.8.1.2 (General Threats) includes an extensive discussion of the existing stressors to marine invertebrates, including overexploitation and destructive fishing practices, habitat degradation resulting from pollution and coastal development, disease, invasive species, oil spills, noise, global climate change, and ocean acidification. Tourism and recreation also pose threats to marine invertebrates. Beaches such as Chulu Beach, when not used for training, are open to the public, who may disturb or potentially injure marine invertebrates and nearshore hard bottom habitat. Stressors specific to reef-building corals, which are generally located in more shallow zones with adequate sunlight penetration and a mean annual water temperature more than about 64 degrees Fahrenheit, include thermal stress, disease, tropical storms, coastal development and pollution, erosion and sedimentation, tourism/recreation, fishing, trade in coral and live reef species, vessel anchoring or groundings, marine debris, predation, invasive species, and hydrocarbon exploration. Primary threats to deep-water or cold-water corals include bottom fishing, hydrocarbon exploration and extraction, petroleum contamination, cable and pipeline installation, and other various bottom-disturbing activities. Deep corals are susceptible to physical disturbance due to the branching and fragile growth form of some species, slow growth rate (colonies can be hundreds of years old), and low reproduction and recruitment rates. All

activities described in Table 4.2-1 have the potential to impact marine invertebrates due to their ubiquitous presence and relative vulnerability.

4.4.8.3.1 Climate Change

The primary threat to corals is global climate change, which has and is projected to continue to seriously impact coral reefs in the near and known future. The effects of climate change include increased water temperature, ocean acidification, increased frequency or intensity of cyclonic storm events, and sea level rise, which can cause direct damage to these crucial and sensitive ecosystems as well as increase their susceptibility to and decrease their resilience from encounters with all other threats, including disease, pathogens, and genetic disorders.

Increases in ocean temperature can lead to coral stress, bleaching, and mortality. Coral and other marine invertebrate (e.g., anemones, giant clams) bleaching, which occurs when corals expel the symbiotic algae living in their tissues, is a stress response often tied to atypically high sea temperatures or changes in light availability but also can be attributed to nutrients, toxicants, and pathogens (National Oceanic and Atmospheric Administration, 2017). Bleaching events have increased in frequency in recent decades, and coral bleaching on a global scale has occurred during the summers of 2014, 2015, and 2016. Likewise, ocean acidification has the potential to reduce calcification and growth rates in species with calcium carbonate skeletons, including shellfish, corals, and sponges, and possibly even lobsters and sea cucumbers. In addition to physical effects, increased acidity may result in behavioral changes in some species, such as burrowing behavior and juvenile dispersal patterns of the soft-shell clam and reduction in the loudness and number of snaps in the snapping shrimp.

Although the potential effects that climate change could have on future storm activity are uncertain, numerous researchers suggest that rising temperatures could result in little change to the overall number of storms, but that storm intensity could increase. Increased storm intensity could result in increased physical damage to individual corals and reefs constructed by the corals (which support numerous other invertebrate taxa), overturning of coral colonies, and a decrease in structural complexity (due to disproportionate breakage of branching species). However, large storms such as hurricanes may also have positive impacts on corals, such as lowering the water temperature and removing less resilient macroalgae from reef structures, which can overgrow corals.

Sea level rise could affect invertebrates by modifying or eliminating habitat, particularly estuarine and intertidal habitats bordering steep and artificially hardened shorelines. Likewise, changes in ocean circulation patterns could affect the planktonic food supply of filter- and suspension-feeding invertebrates. Cumulative effects of threats from fishing, pollution, and other human disturbance may reduce the tolerance of corals and other invertebrates to global climate change.

4.4.8.4 Impacts of the Proposed Action That May Contribute to Cumulative Impacts

The analysis presented in Section 3.8 (Marine Invertebrates) indicates that the Proposed Action could impact marine invertebrates through acoustic stressors (sonar and other transducers, air guns, vessel noise, weapons noise), explosives, energy stressors (in-water electromagnetic devices, high-energy lasers), physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices, pile driving), entanglement (wires and cables, decelerators/parachutes), and ingestion of military expended materials. Potential impacts include short-term behavioral and physiological responses (Celi et al., 2015; Edmonds et al., 2016; Roberts et al., 2016). Some stressors could also result in injury or mortality to a relatively small number of individuals. The potential for impacts on ESA-listed corals would be avoided by mitigation designed to avoid locations where they are present, except at

vital designated locations and nearshore training areas where seafloor resources will be avoided to the maximum extent practicable. For example, the Navy will not conduct certain activities within a specified distance of shallow-water coral reefs, live hard bottom, artificial reefs, and shipwrecks (Chapter 5, Mitigation) as much as is practicable. Employment of these measures will help avoid or reduce potential impacts on invertebrates that inhabit these areas.

4.4.8.5 Cumulative Impacts on Marine Invertebrates

Some direct impacts on invertebrates are expected, and the impacts of the Proposed Action could be cumulative with other actions that cause disturbance and mortality of marine invertebrates. However, it is anticipated that the incremental contribution of the proposed alternatives would be insignificant for the following reasons:

- Invertebrates are generally abundant and relatively short-lived; thus, with the exception of sessile species located near areas of repeated Navy activities (e.g., pierside locations), few individuals would likely be affected repeatedly by the same event.
- Invertebrates generally have high reproductive rates, short reproductive cycles, and resilient dispersal mechanisms; thus, local communities are likely to reestablish quickly.
- Most of the proposed activities would occur over dispersed, deep water areas where marine invertebrates are more sparsely distributed but not at the same specific point each time and, therefore, would be unlikely to affect the same individual invertebrates.
- Marine invertebrates are not particularly susceptible to energy, entanglement, or ingestion stressors resulting from Navy activities, and none of the alternatives would result in or interact with impacts that have been historically significant to marine invertebrates, such as overfishing, nutrient loading, disease, or the presence of invasive species.
- None of the alternatives would result in long-term or widespread changes in environmental conditions, such as turbidity, salinity, pH, or water temperature that could impact marine habitats or interact with existing trends affecting these parameters.
- The Navy will not conduct certain activities within a specified distance of shallow coral reefs, live hard bottom, artificial reefs, or submerged cultural resources such as shipwrecks (except designated locations, where these resources will be avoided to the maximum extent practicable). Underwater detonations that would occur in the nearshore areas are only conducted in designated locations and away from known seafloor resources such as shallow coral reefs, live hard bottom, artificial reefs, or submerged cultural resources such as shipwrecks, to the maximum extent practicable. All features that have been identified are included in Chapter 5 (Mitigation).

Although the aggregate impacts of other stressors in the ocean environment continue to have significant impacts on some marine invertebrate species in the Study Area, particularly the effects of global climate change on corals, the Proposed Action is not likely to incrementally contribute to population-level stress and decline of the resource. Due to the effects of global climate change, corals may be less resilient to additional stressors; however, it is not anticipated that the Navy will cause direct effects to coral reef systems. As impacts would be isolated, localized, and not likely to overlap with other relevant stressors, it is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past, present and reasonably foreseeable future actions, would not result in measurable additional impacts on marine invertebrates in the Study Area or beyond.

4.4.9 Marine Fishes

In the 2015 MITT Final EIS/OEIS, the analysis presented in Section 3.9 (Fishes) indicated that fishes, including ESA-listed scalloped hammerhead sharks, oceanic whitetip sharks, and giant manta rays could be affected by acoustic stressors (sonar and other transducers, explosives, swimmer defense air guns; weapons firing, launch, and impact noise; aircraft noise; and vessel noise), energy (electromagnetic devices), physical disturbance or strikes (vessels and in-water devices, military expended materials, seafloor devices), entanglement (fiber optic cables and guidance wires, decelerator/parachutes), and ingestion (military expended materials – munitions and military expended materials – other than munitions) and remains valid in this SEIS/OEIS.

Overfishing is discussed as a threat to marine fishes in the Study Area in the socioeconomic resources analysis in this SEIS/OEIS (Section 3.12.1.4.1.1, Guam; and 3.12.1.4.1.2, Commonwealth of the Northern Mariana Islands). While target fish species may be less available, which may have a greater impact on the success of traditional practices like subsistence fishing, overall traditional fishing practices on Guam and in the Commonwealth of the Northern Mariana Islands have not changed appreciably since the 2015 MITT Final EIS/OEIS, and the analysis in the 2015 MITT Final EIS/OEIS remains valid. Refer to Section 3.12.2.3 (Subsistence Use) of the 2015 MITT Final EIS/OEIS for a discussion of subsistence fishing practices on Guam and in the Commonwealth of the Northern Mariana Islands.

The current aggregate impacts of past, present, and reasonably foreseeable future actions presented in Section 4.2 (Projects and Other Activities Analyzed for Cumulative Impacts) may potentially affect fishes, including ESA-listed scalloped hammerhead sharks, oceanic whitetip sharks, and giant manta rays. Aggregate impacts associated with the other actions discussed in Section 4.2 (Projects and Other Activities Analyzed for Cumulative Impacts) and Table 4.2-1 could result in injury and mortality. Although this SEIS/OEIS does address some of these other actions listed in Section 4.2 (Projects and Other Activities Analyzed for Cumulative Impacts), many of these actions and their associated cumulative impacts on fish cannot be determined with any specificity or certainty at this time. However, it can reasonably be assumed that there may be fish that could be affected by these other actions, but no specific details are known regarding the impacts or effects to individuals or populations. Alternatives 1 or 2 could also result in injury and mortality to fish from in-water explosions, entanglement, and strikes. Injury and mortality that might occur under Alternatives 1 or 2 would be additive to injury and mortality associated with other actions. However, the relative contribution of Alternatives 1 or 2 to the overall injury and mortality would be low compared to other actions for the following reasons:

- Most potential impacts would be short-term behavioral and physiological responses.
- Any impacts from the Proposed Action resulting in injury or mortality would be to a relatively small number of individuals.
- No population-level impacts are anticipated.

Under this SEIS/OEIS, the contribution of proposed increases in training and testing activities under Alternative 1 or Alternative 2 would still be negligible based on the reasons presented above. Based on the analysis presented in Section 3.9 (Fishes) and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible. Further analysis of cumulative impacts on fishes is not warranted.

4.4.10 Terrestrial Species and Habitats

The only terrestrial location included in the region of influence for this SEIS/OEIS is FDM. Military use of FDM as a bombing range has occurred for decades, with the lease agreement formalized with the newly formed CNMI in 1983 (United States of America and Commonwealth of the Northern Mariana Islands, 1983). Since the late 1990s, the Navy has established restrictions on the types of ordnance used on FDM and where ordnance can be targeted in compliance with past biological opinions and Sikes Act obligations. These measures confine the impacts on discrete impact zones on the island, in contrast to island-wide targeting prior to the establishment of restrictions. By establishing these restrictions, the impacts of decades of military use of the island are reduced (e.g., not targeting a remnant forest patch on the north end of the island and allowing its recovery), and current and future ordnance use on the island are confined to discrete impact zones on the island. The activities that only occur on FDM other than training activities described in this SEIS/OEIS and the 2015 MITT Final EIS/OEIS include: (1) biennial range maintenance activities and periodic ordnance cleanup actions (U.S. Department of the Navy, 2013), and (2) ecological monitoring of natural resources on the island. Both of these activities are interrelated. For example, range clearance activities are required to maintain a suitable training environment on the range (e.g., ordnance cleanup, target maintenance). Surveys are conducted on the island in compliance with biological opinions and Sikes Act obligations associated with military use of the island. All of these activities are authorized and scheduled by the Navy, and entrance rights are conveyed to the Navy through the lease agreement with CNMI. In summary, there are no additional actions that would occur on FDM; therefore, an analysis of cumulative impacts is not warranted.

4.4.11 Cultural Resources

In the 2015 MITT Final EIS/OEIS, Alternatives 1 or 2 concluded that physical disturbance and strike stressors including vessel strikes, use of towed in-water devices, use of seafloor devices, and ground disturbance during training and testing activities would not adversely affect historic properties within U.S. territorial waters or on Guam and the Commonwealth of the Northern Mariana Islands because measures have been previously implemented to protect these resources and would continue to be implemented according to the conservation measures and procedures identified and described in the 2009 Mariana Islands Range Complex Programmatic Agreement.

The contribution of proposed increases in training and testing activities under Alternative 1 or Alternative 2 in this SEIS/OEIS would be negligible because the Navy routinely avoids locations of known obstructions, which includes submerged cultural resources, to prevent damage to sensitive Navy equipment and vessels and to avoid or reduce impacts on known submerged resources. The current aggregate impacts of past, present, and reasonably foreseeable future actions presented in Section 4.2 (Projects and Other Activities Analyzed for Cumulative Impacts) may have an effect on cultural resources. Actions that would contribute to cumulative impacts on cultural resources would involve some form of disturbance to the ocean bottom in areas where cultural resources are present. Actions that would disturb the ocean bottom could impact submerged cultural resources if those resources are not avoided.

Other actions that result in ocean bottom disturbance require federal agencies to take into account the effects of their undertakings on historic properties. If it is determined that there would be an adverse effect to a cultural resource that qualifies for the National Register, the federal agency would work to avoid, minimize, or mitigate the adverse effect. For example, the Bureau of Ocean Energy Management has procedures in place to identify the probability of the presence of submerged historic properties

shoreward from the 148-foot (45-meter) isobaths, informing the Navy to avoid locations of known obstructions, which includes submerged cultural resources. It also has procedures for project redesign or relocation to avoid identified resources (Minerals Management Service, 2007). Nonetheless, inadvertent impacts could occur if submerged cultural resources are present, but are greatly reduced when avoidance measures are put in place.

Effects to submerged historic properties from other actions would typically be avoided or mitigated through compliance with federal regulations. However, impacts could occur if avoidance measures were not implemented or if inadvertent disturbance or destruction of the characteristics or the historic property that qualify it for inclusion on the National Register occurs. Disturbance or destruction of submerged historic properties, including shipwrecks, would diminish the overall record for these properties and decrease the potential for meaningful research. When considered with other actions, Alternatives 1 or 2 would not contribute to cumulative impacts on submerged historic properties because the Navy avoids locations of known obstructions, which includes submerged cultural resources.

4.4.12 Socioeconomic Resources

In Section 3.12 (Socioeconomic Resources) of the 2015 MITT Final EIS/OEIS, the analysis determined that training and testing activities under Alternatives 1 or 2 would limit public access to certain nearshore areas used for commercial and recreational fishing, certain tourism activities, and subsistence fishing. However, limits on accessibility to these areas were not expected to significantly impact socioeconomic resources, because the majority of restrictions would be temporary, lasting hours, with the exception of the 3 NM danger zone surrounding FDM, which is permanently closed to ensure public safety. Other surface danger zones and temporary exclusion areas would be accessible to the public for fishing, transiting, or other activities when military activities are not occurring. When an area is closed for a training and testing activity, mariners are not permitted to transit directly through a danger zone to a destination outside of the danger zone and are not allowed to anchor or loiter within the danger zone. Military activities utilizing the danger zone or restricted area would be halted until the danger zone or restricted area is cleared of transiting vessels.

Under this SEIS/OEIS, cumulative impacts on fishing may occur from frequent or extended, but also temporary, closures of restricted areas and danger zones in the Study Area. The Navy attempts to mitigate these impacts by using a variety of communication methods (e.g., Notices to Mariners [NOTMARs], e-mails, Facebook posts) to inform the public of upcoming events that may limit access to certain areas. Dates and times of scheduled closures are provided in announcements to allow fishers, tour boat operators, and any other commercial or recreational vessels that may be in the area to plan accordingly.

As a result of previous discussions with fishers, the Navy no longer restricts access to the northern portion of W-517 while military activities are conducted in the southern portion of the warning area, which allows fishers to access popular fishing sites south of Guam. The fishing bank areas (Galvez Bank, Santa Rosa Reef, and White Tuna Banks) are not automatically restricted from public access when W-517 is scheduled for training and testing. Galvez Bank and Santa Rosa Reef are not within W-517, while a portion of White Tuna Banks does exist within W-517. Mariners near Galvez Bank or Santa Rosa Reef may be warned of their proximity or told not to enter W-517 as a precautionary measure. It is vital that units training or testing within W-517 give proper notice to mariners and aviators in the area before they enter W-517, in order to keep members of the public and military safe. On days that W-517 is in use for military training or testing that affects mariners, a Broadcast Notice to Mariners is always sent by

the U.S. Coast Guard to inform the public, in addition to press releases and other communication from Joint Region Marianas. The 120-day average (over a two-year period) that Broadcast Notice to Mariners (NOTMARS) are issued does not constitute 24 hours in the day. Many training or testing events last less than a full day and may hinder access to W-517 for only a short period of time.

The Navy also informs the public of extended periods of time when the restricted area (beyond 3 NM from shore) surrounding FDM will be accessible. The military will continue to collaborate with local communities and stakeholders to develop efficient and effective communication with the public. The goals of these on-going and evolving efforts are (1) to reduce socioeconomic impacts associated with limiting access to areas used by the public, and (2) to ensure the safety of the public and military personnel. Under this SEIS/OEIS, the contribution of proposed increases in training and testing activities under Alternative 1 or Alternative 2 would still be negligible based on the analysis summarized above and described in greater detail in the 2015 MITT Final EIS/OEIS, Section 3.12 (Socioeconomic Resources and Environmental Justice).

4.4.12.1 Resource Trends

Trends in commercial transportation and shipping are described in Section 3.12.1.1 (Commercial Transportation and Shipping) and indicate that commercial shipping has remained consistent over the past five years. Trends in commercial fishing and tourism are described in Section 3.12.1.2 (Commercial and Recreational Fishing) and Section 3.12.1.3 (Tourism), respectively. Commercial fisheries landing in Guam declined steadily from 2010 through 2015 mainly due to the declining abundance of reef fish around the island, which make up a large percentage of the target species (Weijerman et al., 2016). Trends in commercial fisheries around the CNMI are less clear. Landings from 2010 through 2015 were highest in 2013 and 2014 but declined to their lowest totals in 2015. Tourism trends are mixed for both Guam and the CNMI. The number of visitors from Japan, the largest market, has been declining in recent years, but tourism from other Asian nations, particularly China, has increased and is expected to continue to grow. Trends in recreational fishing are partially driven by trends in tourism. While both recreational fishing and subsistence fishing by residents of Guam and the CNMI remain popular, there are no data that indicate specific trends in either resource.

4.4.12.2 Onshore and Offshore Fishing for Economic Self-Sustainability

NMFS is responsible for the regulation and enforcement of policies for onshore and offshore fishing for economic self-sustainability. Both the CNMI and Guam are categorized as “fishing communities” by the Western Pacific Regional Fishery Management Council. This designation is based on the portion of the population that is dependent upon fishing for subsistence; the economic importance of fishery resources to the islands; and the geographic, demographic, and cultural attributes of the communities (Western Pacific Regional Fishery Management Council, 2009, 2019). Fishing is an integral part of the culture and way of life in the CNMI and Guam. Most fishers do not fish exclusively for commercial, recreational, or subsistence benefit but rather for some combination of the three (Hospital & Beavers, 2012; Hospital & Beavers, 2014; Tibbats & Flores, 2012; Western Pacific Regional Fishery Management Council, 2019). However, the increasing costs of fishing gear, tackle, boats and associated maintenance, and particularly fuel have made it increasingly difficult for fishers in Guam and the CNMI to make a living as commercial fishers. In addition to costs, fishers are concerned about impacts associated with increased tourism (e.g., pollution and damage to reefs) and competition from foreign fishers reducing the market for locally caught fish (Ayers, 2018; Hospital & Beavers, 2014; Western Pacific Regional Fishery Management Council, 2019). Fishing will continue as an integral part of the culture and tradition

of communities on Guam and in the CNMI; however, commercial productivity is likely to vary with changes in the local and global economies.

4.4.12.3 Impacts of Other Actions

The impacts of actions related to coastal development and infrastructure development listed in Table 4.2-1 would generally contribute positively to socioeconomic conditions on Guam and in the CNMI. Water quality and wastewater treatment on Saipan should improve; additional jobs in tourism and retail are likely with further coastal development; and tourism, the largest economic driver, should also be supported by these projects. Other military activities that limit access to popular fishing sites could increase cumulative socioeconomic impacts on commercial, recreational, and subsistence fishers beyond impacts associated with the Proposed Action. Increases in marine debris and pollution (Table 4.2-1) in waters surrounding Guam and the CNMI would potentially impact tourism and fisheries and contribute to cumulative impacts on socioeconomic resources or restrict vessel movement in the Study Area. The effects of climate change on the marine environment could have similar, long-term, cumulative impacts on fisheries and tourism in the region if the marine resources that support these industries are diminished.

4.4.12.4 Cumulative Impacts on Socioeconomic Resources

The current aggregate impacts of past, present, and reasonably foreseeable future actions have the potential to result in significant cumulative impacts on certain socioeconomic resources in the Study Area. The impacts would be considered significant if they resulted in extensive limitations on accessibility by residents, businesses, and tourists to ocean areas needed for commercial, recreational, and subsistence fishing and tourism. If tourism continues to expand, the desire to transit to and access popular ocean areas may also increase. Maintaining efficient and effective communication methods with the public is expected to avoid or reduce conflicts between military and civilian activities in the Study Area.

4.4.13 Public Health and Safety

In the 2015 MITT Final EIS/OEIS, the analysis presented in Section 3.13 (Public Health and Safety) indicated that the impacts of Alternatives 1 or 2 on public health and safety would be negligible. Under this SEIS/OEIS, Alternatives 1 or 2 are not expected to contribute incrementally to cumulative health and safety impacts. Therefore, further analysis of cumulative impacts on public health and safety is not warranted.

4.5 Summary of Cumulative Impacts

Marine mammals, marine invertebrates, sea turtles, and socioeconomic resources are the primary resources of concern for cumulative impacts analysis:

- Past human activities have impacted these resources to the extent that several marine mammals, sea turtles, and marine invertebrates occurring in the Study Area are ESA listed. Several marine mammal species and stocks are also classified as strategic stocks under MMPA.
- The use of sonar and other non-impulsive sound sources under Alternative 1 and Alternative 2 has the potential to disturb or injure marine mammals and sea turtles.
- Explosive detonations under Alternative 1 and Alternative 2 have the potential to disturb, injure, or kill marine mammal, and sea turtle species.
- Under Alternative 1 or Alternative 2, proposed danger zones could potentially restrict access to fishing and recreational areas when ranges are in use.

In summary, based on the analysis presented in Sections 3.4 (Marine Mammals), 3.5 (Sea Turtles), 3.8 (Marine Invertebrates), and 3.12 (Socioeconomic Resources and Economic Justice), the current aggregate impacts of past, present, and other reasonably foreseeable future actions are not significantly different than the assessment in the 2015 MITT Final EIS/OEIS. For marine mammals, sea turtles, and marine invertebrates Alternatives 1 or 2 would contribute to an increase cumulative impacts, but the relative contribution would be low compared to other actions. Cumulative effects on socioeconomic resources may have short-term impacts on accessibility to public services, fishing sites, and tourism resources, but they are not expected to have long-term negative impacts on these resources or the economy of Guam and the CNMI. No new information or circumstances are significant enough to warrant further cumulative impact review.

4.6 Public Comments

The public raised a number of issues during the scoping period in regard to cumulative impacts. The issues are summarized in the list below. Comments received from the public during the Draft Supplemental EIS (SEIS)/OEIS commenting period related to cumulative impacts are addressed in Appendix K (Public Comment Responses).

- **Analyze the cumulative effects of all Department of Defense actions in the Mariana Islands, including CNMI Joint Military Training EIS –** The CNMI Joint Military Training EIS would establish a series of live-fire and maneuver ranges and training areas within the CNMI and include amphibious operations on Tinian. The proposed action for the CNMI Joint Military Training EIS is to expand existing ranges and training areas and construct new ranges and training areas within the CNMI. The resources evaluated that could contribute to cumulative impacts include geology and soils, water resources, air quality, noise, airspace, land and submerged land use, recreation, terrestrial biology, marine biology, cultural resources, visual resources, transportation, utilities, socioeconomic resources and environmental justice, hazardous materials and waste, and public health and safety. The Navy is drafting a revised EIS that would reduce impacts on resources as a result of the proposed action. The analysis of cumulative impacts contained in this chapter addresses cumulative effects of all Department of Defense actions on the Mariana Islands, including the CNMI Joint Military Training EIS.
- **Cumulative impacts from military-expended material and debris on water quality and marine biology –** The analysis of cumulative impacts on water quality from military expended material and debris concluded that although military expended material would occur in the Study Area as a result of training and testing activities, the Navy has defined standard operating procedures and committed to mitigation measures to offset potential impacts from military training and testing to sediment and water quality in the Study Area. The impact analysis conducted on marine biology (e.g., marine mammals, sea turtles, marine birds, marine vegetation, marine invertebrates, and fish) from military expended material and debris concluded that the military expended material and debris would not have a significant impact on water quality or habitat, therefore it would not have a significant impact on marine biology in the Study Area. Further analysis of cumulative impacts on water quality can be found in Section 4.4.1 (Sediments and Water Quality). Further analysis of cumulative impacts on marine biology can be found in Sections 4.4.4 through 4.4.9 (Marine Mammals, Sea Turtles, Marine Birds, Marine Vegetation, Marine Invertebrates, and Marine Fishes).
- **Cumulative impacts on marine mammals from use of explosives and sonar –** The cumulative impact analysis for marine mammals from the use of explosives and sonar concluded that the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to

have significant impacts on some marine mammal species in the Study Area. Proposed training and testing activities could result in additional stressors to individuals, which would both further compound effects on a given individual already experiencing stress and, in turn, have the potential to further stress populations, some of which may already be in significant decline or in the midst of stabilization and recovery. However, implementation of standard operating procedures would reduce the likelihood of overlap in time and space with other stressors, and implementation of mitigation measures would further reduce the likelihood of impact. Therefore, the incremental stressors anticipated from proposed training and testing activities are not anticipated to be significant. Further analysis of cumulative impacts on marine mammals can be found in Section 4.4.4 (Marine Mammals).

- Cumulative impacts on seagrass, coral reef, and other invertebrate from sedimentation around FDM, military expended materials as marine debris, and sonar disrupting larval recruitment – The cumulative impact analysis on seagrass and marine vegetation concludes that sedimentation around FDM and military expended materials as marine debris would have minimal impacts on seagrass and marine vegetation in the Study Area. Based on the analysis presented in Section 3.7 (Marine Vegetation) and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible. Further cumulative impact analysis on seagrass and marine vegetation can be found in Section 4.4.7 (Marine Vegetation). The cumulative impact analysis on coral reef and other invertebrates from sedimentation around FDM, military expended materials as marine debris, and sonar disrupting larval recruitment concluded that although the aggregate impacts of other stressors in the ocean environment continue to have significant impacts on some marine invertebrate species in the Study Area, particularly the effects of global climate change on corals, proposed training and testing activities are not likely to incrementally contribute to population-level stress and decline of the resource. Further cumulative impact analysis on marine invertebrates can be found in Section 4.4.8 (Marine Invertebrates).
- **Cumulative impacts on sea turtles, fish populations and their habitat –** The cumulative impacts analysis on sea turtles concluded that the aggregate impacts of past, present, and other reasonably foreseeable future actions continue to have significant impacts on all sea turtle species in the Study Area. Proposed training and testing activities could contribute incremental stressors to individuals, which would both further compound effects on a given individual already experiencing stress and in turn has the potential to further stress populations in significant decline or recovery efforts thereof. The cumulative impacts analysis on fish populations concluded that based on the analysis presented in Section 3.9 (Fishes) and the reasons summarized above, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible. The cumulative impacts analysis on marine habitat concluded that based on the analysis presented in Section 3.3 (Marine Habitats) and the reasons summarized in Section 4.4.3 (Marine Habitats), the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be negligible. Further analysis for cumulative impacts on sea turtles and fish can be found in Section 4.4.5 (Sea Turtles) and 4.4.9 (Marine Fishes) respectively.
- **Cumulative impact on the loss of access to FDM for traditional fishing practices –** The socioeconomic resources section analyzes traditional fishing practices that were identified by residents of Guam and the CNMI as having the potential to be impacted by the proposed training and testing activities occurring at sea and on FDM. Training and testing activities have the potential to temporarily limit access to areas of the ocean, which has the potential to impact traditional fishing practice in the Study Area. The military requests that the U.S. Coast Guard issue NOTMARs to warn the public of upcoming training and testing activities requiring the

exclusive use of sea space and to ensure the safety of the public and military personnel. Data on the number of NOTMARs issued from the years 2013 through 2017 for FDM and W-517 were added to the previous three years of data presented in the 2015 MITT Final EIS/OEIS. The number of days affected by activities occurring at FDM and W-517 has varied over the eight-year period from the years 2010 through 2017. The data indicate an increasing trend in affected days and potential impacts on accessibility; however, the peak totals are not substantially different from the previous eight years, and the trend appears to be cyclical (increases followed by decreases). Access to waters around FDM between 3 and 12 NM was restricted for an average of 160 days per year (peak of 201 in the year 2012), and access to waters under W-517 was restricted for an average of 91 days per year (peak of 136 in the year 2016). Access to waters within 3 NM of FDM is restricted at all times to ensure public safety during military activities using explosive munitions (33 Code of Federal Regulations 334, Danger Zone and Restricted Area Regulations).

Traditional fishers in Guam and the CNMI would also be impacted by temporary restrictions limiting access to certain areas where traditional fishing practices take place. As described in Section 3.12.1.4.1 (Traditional Fishing Practices), many fishers identifying as traditional fishers also participate in recreational and commercial fishing, and it is not clear when fishers are engaging in traditional fishing, which has communal and cultural significance, and when they are fishing for financial gain or leisure or some combination of one or more of these motivations, which can occur even on a single fishing trip (Allen, 2013). These data suggest that traditional fishing likely occurs in the same locations as commercial and recreational fishing, and that traditional fishers would not be disproportionately impacted by temporary limits on access to fishing sites. Other fishing sites in the Study Area would be available to traditional fishers, and significant impacts on traditional fishing in the Study Area are not anticipated. Further cumulative analysis for socioeconomic resources can be found in Section 4.4.12 (Socioeconomic Resources).

- Cumulative impact on reduced fishing access, recreational fishing, commercial fishing and transport between the Mariana Islands from the restricted areas – Access to certain areas of the Study Area around islands and in the open ocean is temporarily restricted during potentially hazardous training and testing activities to ensure the safety of the public and military personnel. Danger zones may result from other Department of Defense actions in Guam and the Mariana Islands such as the Guam and Commonwealth of the Northern Mariana Islands Military Relocation and CNMI Joint Military Training. These other actions would occur mainly on land and around Tinian. As a result of the training and testing activities associated with this SEIS/OEIS, areas within 3 NM of FDM are permanently restricted to maintain public safety. Even when hazardous activities are not occurring at FDM, the potential occurrence of unexploded ordnance in waters surrounding the island is a constant threat to public safety. Transiting between Guam, Saipan, Tinian, or other islands located to the south of FDM and the Islands Unit (Northern Mariana Islands) would potentially be impacted by limiting access to the 12 NM danger zone around FDM. Considering that an average of 3.8 trips per year has occurred over the past 30 years (as stated in Section 3.12.3, Public Scoping Comments), the probability of military activities interfering with trips to the Islands Unit is low. Furthermore, the military will announce when FDM is not in use in addition to notifying mariners of planned activities at FDM, which will enable mariners to better plan trips to the Islands Unit. Further analysis can be found for recreational and commercial fishing and transport in Section 4.4.12 (Socioeconomic Resources).

- **Cumulative effects analysis of the ocean as an ecosystem –** The cumulative impacts analysis for water resources concluded that based on the analysis presented in Section 3.1 (Sediments and Water Quality) and the reasons summarized above, the changes in sediment and water quality would be measurable, but would still be below applicable standards and guidelines; therefore, the incremental contribution of Alternatives 1 or 2 to cumulative impacts would be low and further analysis of cumulative impacts is not warranted. Further analysis of the ocean as an ecosystem and cumulative impacts can be found in Section 4.4.1 (Sediments and Water Quality) and Section 4.4.3 (Marine Habitats).
- **Assess cumulative effects to consider a resource response to change and capacity to withstand stress –** Stressors are considered in the cumulative effects analysis for each resource. These resources are analyzed in Sections 4.4.1 through 4.4.13.

  Cumulative effects analysis should reflect the beach landing activity addressed in the 2015 MITT ROD (no Amphibious Assault Vehicle or Landing Craft Air Cushion landing on Tinian beaches) – Beach landing activities would continue as discussed in the 2015 MITT Final EIS/OEIS. This SEIS/OEIS is an update to the in-water activities in the Study Area. Land activities are addressed in the 2015 MITT Final EIS/OEIS and can be found in Section 3.5 (Sea Turtles) of that document.

  Cumulative impacts assessing the length and frequency of each individual training activity and the potential rate of resource recovery – The cumulative impacts assessment takes into account the length and frequency of each training and testing activity and resource recovery as they are analyzed in their individual resource sections (Sections 3.1 through 3.13).
- **Utilize Caltrans/Federal Highways Administration cumulative impacts methodology/eight-step process –** The Caltrans/Federal Highways Administration cumulative impacts eight-step methodology is very similar to the cumulative impacts chapter analysis used in this document. The similarities are as follows: (step 1) The Navy has identified resources to consider; (step 2) defined the region of influence for each resource; (step 3) described the current health and historical context of each resource in Chapter 3 (Affected Environment and Environmental Consequences); (step 4) identified the direct and indirect impacts of the Proposed Action in the Environmental Consequences section of Chapter 3; (step 5) identified current and reasonably foreseeable future actions or projects in Table 4.2-1; (step 6) assessed the potential cumulative impacts in this chapter; (step 7) reported the results of the cumulative impact analysis in this chapter; and (step 8) assessed the need for mitigation and recommendations for actions by other agencies in Chapter 5 (Mitigation).

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