Environmental Impact Statement/

Overseas Environmental Impact Statement

Point Mugu Sea Range

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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 regulations, and Council on Environmental Quality guidance. Council on Environmental Quality regulations (40 Code of Federal Regulations 1500-1508) provide the implementing procedures for NEPA. The regulations define "cumulative effects" as:

> *…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time* (40 Code of Federal Regulations 1508.7).

The Council on Environmental Quality provides guidance on cumulative impacts analysis in, *Considering Cumulative Effects Under the NEPA* (Council on Environmental Quality, 1997). This guidance further identifies cumulative effects as those environmental effects resulting "from spatial and temporal crowding of environmental perturbations. The effects of human activities will accumulate when a second perturbation occurs at a site before the ecosystem can fully rebound from the effects of the first perturbation." Noting that environmental impacts result from a diversity of sources and processes, this Council on Environmental Quality guidance observes that "no universally accepted framework for cumulative effects analysis exists," while also noting that certain general principles have gained acceptance. One such principle provides that "cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds—levels of stress beyond which the desired condition degrades." Thus, "each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters." Therefore, cumulative effects analysis normally will encompass a region of influence or geographic boundaries beyond the immediate area of the proposed action, and a time frame including past actions and foreseeable future actions, to capture these additional effects. Bounding the cumulative effects analysis is a complex undertaking, appropriately limited by practical considerations. Thus, Council on Environmental Quality guidelines observe that it "is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful."

4.1.1 Determination of Significance

Per the Council on Environmental Quality's, *Considering Cumulative Effects Under the NEPA* (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 or Geographical Boundaries for Cumulative Impacts Analysis

The region of influence or geographic boundaries for analyses of cumulative impacts can vary for different resources and environmental media. Council on Environmental Quality guidance (1997), indicates that geographic boundaries for cumulative impacts almost always should be expanded beyond those for the project-specific analyses. This guidance continues, indicating that one way to evaluate geographic boundaries 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 generally the appropriate boundaries for assessment of cumulative impacts from releases of pollutants into the atmosphere; however, greenhouse gases impact the entire 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, marine fishes, sea turtles, and marine birds, any impacts of the Proposed Action to these resources might combine with the impacts of other activities or processes within the range of their populations.

A region of influence for evaluating the cumulative impacts of the Proposed Action is defined for each resource in Section 4.4 (Resource-Specific Cumulative Impacts). The basic region of influence or geographic boundary for the majority of resources analyzed for cumulative impacts in this Environmental Impact Statement (EIS)/Overseas Environmental Impact Statement (OEIS) is the entire Point Mugu Sea Range (PMSR) Study Area (see Figure 1-1). The Study Area includes one large marine ecosystem, the California Current. 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).

4.2 Projects and Other Activities Analyzed for Cumulative Impacts

Cumulative analysis includes consideration of past, present, and reasonably foreseeable future actions. 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 qualitative description and best professional judgement 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 for 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 foreseeable future action is not planned in sufficient detail to permit complete analysis (Council on Environmental Quality, 1997).

The cumulative impacts analysis is not bounded by a specific future timeframe. The Proposed Action includes general types of activities addressed by this EIS/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., oil and gas production, maritime traffic, commercial fishing). While the United States (U.S.) Department of the Navy (Navy) testing and training 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 reasonably

foreseeable future. Navy environmental planning and compliance for testing and training activities is an ongoing process, and the Navy anticipates preparing new or supplemental environmental planning documents covering changes in testing and training 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 describes other actions that have had, continue to have, or would be expected to have some impact upon resources also impacted by the Proposed Action within the Study Area and surrounding areas. These activities are selected based on information obtained during the scoping process and Draft EIS/OEIS public comment period, communications with other agencies, a review of other military activities, literature review, previous NEPA analyses, and other available information. Table 4.2-1 focuses on identifying past, present, and reasonably foreseeable future actions (military mission, testing, and training; offshore energy development; ocean-dependent commercial industries; and research).

Table 4.2-2 focuses on other major environmental stressors or trends that tend to be widespread and arise from routine human activities and multiple past, present, and future actions. For perspective of general project locations, please refer to Figures 1-1 through 1-3, which depict the Study Area and boundaries of individual testing and training locations, and Figure 3.0-1, which depicts the relative distribution of commercial vessel traffic in the PMSR Study Area. Many of the commercial stressors are discussed in Section 3.11.4.1.1 (Ocean Transportation) (U.S. Army Corps of Engineers, 2019) (U.S. Army Corps of Engineers, 2019).

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* *C = Construction* *O = Operation*		
				Past	*Present*	*Future*
Military Mission, Testing, and Training Activities						
Fiber Optic Communications Undersea System Replacement Final EA/OEA (2018)	Naval Air Systems Command Sea Range, Point Mugu, California	The United States (U.S.) Navy proposes to replace the existing Fiber Optic Communications Undersea System-I (FOCUS-I) between Naval Base Ventura County (NBVC) Point Mugu and NBVC San Nicolas Island (SNI) and the microwave communications system link between NBVC Point Mugu with a single new system. This new FOCUS, FOCUS-II, will connect NBVC Point Mugu, NBVC SNI via new undersea fiber optic cables.	The proposed construction activities have the potential to temporarily disturb or cause behavioral reactions from local wildlife, including threatened and endangered species at Point Mugu and SNI.	O	O	C
EA for Homeporting Littoral Combat Ships (LCSs) on the West Coast (2012)	NBVC Point Mugu and Naval Base San Diego, California	The Navy has procured 35 LCSs and is shifting procurement of small surface combatants in Fiscal Year 2020 to a new frigate called the FFG(X). Three of the divisions of LCSs will be homeported in San Diego, CA (12 ships) under the current Navy plan (CRS Report, 2019). No long-term environmental impacts documented. Increased marine traffic increases risks of underwater noise and vessel strikes; however, Navy vessels will adhere to standard operating procedures that have resulted in minimizing risk of inadvertent marine species strike.	NA	C	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* *C = Construction* *O = Operation*		
				Past	*Present*	*Future*
Modifications to the Port of Hueneme Deepening Project Draft Supplemental EA (2019)	Port Hueneme, Ventura, CA	The primary project purposes of this project include efficient accommodation of larger, deep-draft vessels; increased cargo efficiency of product delivery; and reduced overall transit costs. The project would also provide beneficial uses for most of the dredged sediments as nourishment at Hueneme Beach, either directly onto the beach or into the nearby nearshore area. The plan selected (Alternative 2a with Disposal Option 1) is the National Economic Development Plan. Under this alternative, the Main Approach Channel would be dredged to -44 feet mean lower low water (MLLW), and the Entrance Channel and Turning Basin (which includes Channel A) would be dredged to -40 feet MLLW. Approximately 390 kilo-cubic yards (kcy) of material would be dredged over 2 months with 363 kcy of sand placed onto Hueneme Beach, 7 kcy place into the nearshore, and 20 kcy disposed of on the existing Confined Aquatic Disposal Site located within the harbor. In addition, if determined needed, approximately 14,000 ton of stone would be placed along the toe of the eastern slope of the Entrance Channel to stabilize the slope and prevent slumping into the deepened navigation channel.	Mitigation measures and monitoring activities would be used to avoid and minimize impacts on water quality, certain bird species, and air quality. Steps would also be in place to avoid the spreading of an invasive seaweed species.			C
Navy Hawaii-Southern California Training and Testing (HSTT) EIS/OEIS (2018)	HSTT Study Area (sea off the coasts of Hawaii and Southern California, and area traveled during vessel transit, in the Temporary Operating Area north and west of the Hawaii	The Navy has evaluated impacts from past activities as well as present training and testing activities based on changing operational requirements, new platforms, and new systems. The HSTT Study Area overlaps with a portion of the Point Mugu Sea Range to the south. The Navy uses these analyses to support incidental take authorizations under the Marine Mammal Protection Act (MMPA). The full breadth of activities, and their potential impacts, of the 2018 Final HSTT EIS/OEIS, were similar in nature to those analyzed in the 2013 EIS/OEIS, and 57,940 hours of hull-mounted mid-frequency sonar use were anticipated between 2013 and 2018; although, in practice the actual hours of sonar were significantly lower. Likewise, the detonation of a	Mitigation measures established for most in-water activities, including specific lookout procedures and recommended mitigation zones and protection focus.	O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
	Operating Area, at select Navy pierside and harbor locations, and overlaps with a portion of the Point Mugu Sea Range)	maximum of 170,105 explosives was evaluated over the 5-year period, 58 percent of which were Explosive Class 1 (0.1 to 0.25 pound). During the 2018 HSTT EIS/OEIS effort, MMPA incidental take authorizations and incidental take statements under the Endangered Species Act (ESA) were issued by the National Marine Fisheries Service (NMFS) to the Navy (Federal Register [FR] 83(247): 66846-67031, December 27, 2018; FR 79(88): 26188-26189, May 7, 2014). Negligible to no impacts have been observed to populations of marine mammals, sea turtles, birds, marine vegetation, marine invertebrates, and fish from acoustic, energy, physical disturbance and strike, entanglement, ingestion, and other secondary stressors associated with Navy training and testing activities. Monitoring occurs during training and testing events and generally through the Integrated Comprehensive Monitoring Program.	A Scientific Advisory Group of leading marine mammal scientists assisted the development of an Integrated Comprehensive Monitoring Program, which coordinated monitoring efforts across all regions where the Navy trains.			
U.S. Coast Guard Training Activities	U.S. Coast Guard District 11, California (Base Alameda, Base Los Angeles Long Beach, Training Center Petaluma, Civil Engineering Unit Oakland; Sector Air Station Humboldt Bay, Sector San Francisco, Air Station San	The U.S. Coast Guard performs maritime humanitarian, law enforcement, and safety services in estuarine, coastal, and offshore waters. Equipment utilized by the Southern California Coast Guard includes 25-feet response boats, 41-foot utility boats, and 87-foot patrol boats, as well as HH-60 helicopters. Training events include search and rescue, maritime patrol training, boat handling, and helicopter and surface vessel live-fire training with small arms. U.S. Coast Guard mission and training activities contribute vessel noise and could result in collisions with marine mammals and sea turtles. Sonar detection systems could have impacts on marine mammals, including toothed whales and pinnipeds, but only short-term, minor, adverse effects would be expected as the high frequency is not unlike common commercial fish finder systems (U.S. Coast Guard, 2013). Gunnery activities could contribute military expended material to the	Establishing and monitoring safety zones; observation for marine mammals and sea turtles; ceasing of activities in response to sightings.	O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
	Francisco, Sector/Air Station San Diego, Sector San Diego Reserve, Air Station Sacramento, Sector Los Angeles Long Beach)	benthic environment; however, results of Navy modeling efforts discussed for the Proposed Action indicate a low risk that marine mammals or sea turtles would be struck by military expended material during training activities, and it is likely that similar U.S. Coast Guard activities would have a similarly low risk. Enhanced environmental protection measures for marine protected species and areas occurring in District 11, including broadcasting Notice to Mariners advising caution in known areas of high marine protected species. concentration in bays (U.S. Coast Guard, 2010).				
U.S. Outer Continental Shelf Energy Development						
Oil and Gas Leasing Programs	Federal Waters: Outer Continental Shelf, approximately 200 nautical miles seaward from California jurisdictional boundary Outer Continental Shelf State Waters: Pacific Outer Continental	Twenty-three oil and gas production facilities, operated by six different companies, are located off the coast of California (Bureau of Ocean Energy Management, 2017a). Twenty-two of these facilities produce oil and gas, while the other is a processing facility. There are 43 active leases encompassing 217,669 acres with an associated 213 miles of pipeline in the Pacific Continental Shelf Oil Region, Southern California Planning Area. Potential impacts associated with Outer Continental Shelf federal oil and gas leasing activities include those associated with noise, traffic, waste discharges, sediment disturbance, and risk of accidental spills (Bureau of Ocean Energy Management, 2016a). These impacts are generally assumed to be negligible due to the dispersed and relatively small footprint of normal operations. In the event of small to catastrophic spills, however, impacts grow increasingly detrimental to marine life.	Avoidance/protection of sensitive benthic communities, including no activity zone within 500 feet of live bottom habitat, 1,000 feet of deep-water live corals, and 500 feet of chemosynthetic habitats. Avoidance of impacts within National Marine	C/O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* *C = Construction* *O = Operation*		
				Past	*Present*	*Future*
	Shelf, 0 to 3 miles offshore of California	The Executive Order 13795 *Implementing an America-First Offshore Energy Strategy* (April 2017) and Department of the Interior Secretary Order 3350 *Implementing the America-First Offshore Energy Strategy* (May 2017) require the immediate development of a new 5-Year Outer Continental Shelf Oil and Gas Leasing Program with full consideration of areas currently withdrawn from exploration, leasing, and development. Currently the Bureau of Ocean Energy Management (BOEM) is working under the 2017-2022 Outer Continental Shelf Oil and Gas Leasing Program. However, the BOEM is developing a new program for 2019-2024, which would supersede the 2017-2022 program. The Draft Proposed Program was released in January of 2018 (Bureau of Ocean Energy Management, 2018). Part of the Southern California Planning Area for this program intersects with the Point Mugu operating area. The Department of Defense commented that a detailed assessment of the compatibility of military and oil and gas development will be submitted during the evolution of this program. The BOEM is currently a programmatic EIS in accordance with National Environmental Policy Act (NEPA). Additionally, the Executive and Secretary Orders require a review with intent to rescind or revise the National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NMFS-OPR-55, Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (July 2016). There are four offshore wells operating in California state waters, located offshore of Orange County and Santa Barbara County, bordering the Study Area (California Department of Conservation, 2017).	Sanctuaries, and air gun exploration timing restrictions pertinent to sea turtle requirements. Site-specific mitigation measures evaluated per project at lease sale offering.			

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* *C = Construction* *O = Operation*		
				Past	*Present*	*Future*
		Activities and potential impacts for these programs are similar as described above for the federal program.				
Oil and Gas Structure Removal Operations	Outer Continental Shelf, all water depths	Decommissioning seafloor obstructions (wellheads, caissons, casing strings, platforms, and mooring devices) includes the explosive and non-explosive severing of structures and subsequent salvage and site-clearance operations (Minerals Management Service, 2005). Decommissioning operations generally occur after lease expiration, when the well or facility is no longer deemed economically viable, or when the physical condition of the structure becomes unsafe or a navigation hindrance. Potential environmental impacts, such as injury or death to marine mammals, fish, sea turtles, and other animals due to nearby underwater blasts and site-clearance trawling activities would be mitigated to negligible most of the time, with occasional impacts being potentially adverse but not significant (Minerals Management Service, 2007). The effects of bottom-disturbing activities, such as anchoring and toppling structures, on sensitive benthic habitat and resources may include physical damage to hard bottom features, increased turbidity, and covering or smothering of sensitive habitats with re-suspended sediments. Site-specific NEPA analyses will be conducted on individual applications specifying supplementary mitigation.	General blasting criteria and scenario-specific requirements such as avoidance of hard bottom habitats and anchor restrictions for support vessel and transport use; use of turtle exclusion devices and 30-minute limits for site-clearance trawling; and observation for marine mammals and turtles, pausing activities in response to sightings.	C	C	C
Commercial Wind Energy Development	Pacific Ocean Outer Continental Shelf Federal waters	Although the Bureau of Ocean Energy Management and the State of California are planning for potential leasing for offshore wind in federal waters, no projects have been developed or proposed in California to date (Bureau of Ocean Energy Management, 2017b).	Implementation of proper siting and mandatory design criteria; sonic pingers and/or			C/O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
	(approximately 200 to 350 nautical miles seaward from California jurisdictional boundary)	Most impacts occur during the construction phase, which involves the highest amount of vessel traffic, noise generation (pile driving), seafloor disturbance (transmission cabling), and air emissions; however, ongoing impacts would occur from vessel and turbine strikes; moderate operational noise; disturbance of nesting areas; alteration of key habitat; or potential fuel, oil, or dielectric fluid spills (Minerals Management Service, 2007). Potential population-level impacts on marine mammals, fish, birds, and sea turtles would be mitigated in site-specific environmental review and permitting processes. In particular, impacts on sea turtles could be minor to moderate because of the technologies' potential to impede sea turtle movement and the potential of entrainment in overtopping devices. Additionally, if related onshore facilities are located in nesting areas, operation could cause minor to moderate adverse impacts on sea turtles due to hatchling disorientation from lighting, with possible major impacts if destruction of turtle nests or aggregates of hatchlings occurs. Proper siting, design, and other mitigation measures would minimize potential impacts on coastal sediment transport processes, marine navigation, commercial shipping, fishing activities, seafloor habitats, marine life, areas of special concern, archaeological sites, and U.S. Department of Defense training and exercise activities.	turtle exclusion devices to minimize entanglement and entrainment potential; adherence to U.S. Coast Guard oil spill response plans; use of environmentally friendly chemicals.			
Marine Hydrokinetic		Emerging waterpower technologies offer the potential to capture energy from waves, thermal gradients, tides, and ocean currents. Presently, there is significant research into the performance and economic viability of hydropower technologies. Concerns regarding waterpower technologies include the potential for collisions, noise, physical disturbance, disruption of marine species' behavioral patterns, impacts on local community and fishing industry, ability to monitor projects, cumulative impacts of multiple hydrokinetic				C/O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
		projects along the coasts, habitat alteration due to anchors and cables, and release of toxins and chemicals by the projects or by vessels servicing the projects. Other considerations include habitat disturbance and the displacement of benthic organisms. These concerns provide the potential for habitat loss and changes to the ecology of a region (Pacific Fishery Management Council, 2011); however, initial studies have indicated that with appropriate protocols for siting and design, these impacts are likely to be minimal (Union of Concerned Scientists, 2008).				
Other Commercial Industries						
Boost-Back and Landing of the Falcon 9 Full Thrust First Stage Final EA (2016)	Iridium Landing Area, Vandenberg Air Force Base, California, and Offshore Landing Contingency Option	The First Stage rocket that was tested is 12 feet in diameter and 160 feet in height and includes nine engines and two tanks holding 662,250 pounds of aluminum liquid oxygen and 260,760 pounds of rocket propellant. The First Stage successfully landed on concrete padding at SLC-4W in October of 2018, creating a trio of sonic booms and a visual experience similar to a comet (Clark, 2018). The boost-back and landing of the first stage is also a capability on a conditional landing area on an autonomous barge located at least 27 nautical miles offshore of Vandenberg Air Force Base, and on an autonomous barge within the Iridium Landing Area (U.S. Department of the Air Force, 2016). Environmental effects from potential unsuccessful autonomous barge landing include the discharge of RP-1 jet fuel and debris into the marine environment. Negligible risk to marine animals from direct strike or behavioral or physiological impacts from explosion (Level B Harassment). Vessel noise and traffic may affect, but are not likely to adversely affect: the Guadalupe fur seal, blue whale, fin whale, gray	Recovery of all marine debris to the greatest extent practicable	O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
		whale, humpback whale, sei whale, sperm whale, and sea turtles (green, loggerhead, olive Ridley, hawksbill, and leatherback).				
United Launch Alliance Delta IV Rocket Program	Vandenberg Air Force Base, California	The Delta IV rocket has flown 36 missions since the first launch in 2002. The launch system is available in three configurations, including the Delta IV Medium with two solid rocket motors, the Delta IV Medium with four solid rocket motors, and the Delta IV Heavy (United Launch Alliance, 2019). The Delta IV Heavy, with its most recent launch in January of 2019 at Vandenberg Air Force Base, is a heavy lift launch vehicle, delivering missions for the National Reconnaissance Office, U.S. Air Force, and NASA. Liquid hydrogen and liquid oxygen are the required fuels for the Delta IV rocket. It is launched abroad a Delta IV Heavy configuration Evolved Expendable Launch Vehicle (EELV). The U.S. Air Force plans to use the EELV until at least 2030. Currently the U.S. Air Force has a Letter of Authorization (LOA) for Launching of Space Launch Vehicles, Missiles, and Aircraft and Helicopter Operations at Vandenberg Air Force Base (2019-2024). This LOA was issued in a final rule published in the *Federal Register* in April 2019 (84 FR 14314). The five-year LOA is for take of marine mammals incidental to activities related to the launching of space launch vehicles and missiles, and aircraft operations at VAFB. These activities have been previously authorized by NMFS via LOAs issued under incidental take regulations. Those regulations were effective from March 26, 2014 through March 26, 2019 (79 FR 10016). This would potentially cumulatively impact pinnipeds in the Study Area. The Delta IV rocket launches do not significantly add to the cumulative impacts on air quality as the rocket only passes through PMSR airspace for a few seconds after launching.		C/O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
SpaceX Falcon 9 Rocket Program	Vandenberg Air Force Base, California	The Falcon 9 rocket, designed and manufactured by SpaceX, transports satellites into orbit. Liquid oxygen and kerosene fuels the launches. Falcon 9 is reusable as the first stage can re-enter the atmosphere. It supports the U.S. Air Force, NASA, and other commercial customers. Under agreement with NASA, SpaceX is actively working towards the ability to deliver humans into space utilizing the Falcon 9 rocket. It has launched 14 times from Vandenberg Air Force Base since the first flight in 2006, with the most recent being in January of 2019. Future missions from Vandenberg Air Force Base have already been planned (SpaceX, 2019). This activity has the potential to cumulatively impact pinnipeds in the same way as the Delta IV rocket program previously described per the LOA (84 FR 14314). The Falcon 9 rocket launches do not significantly add to the cumulative impacts on air quality as the rocket only passes through PMSR airspace for a few seconds after launching.		C/O	O	O
Commercial Fishing (Section 3.11.4.2, Commercial and Recreational Fishing)	Pacific Ocean	Fisheries in Southern California include groundfishes (e.g., flatfishes, skates, some sharks, and rockfishes), highly migratory species (e.g., tuna, billfish, some sharks, dorado, and swordfish), coastal pelagic species (e.g., anchovies, mackerel, and sardines), and invertebrates (e.g., California spiny lobster, several crab species), and market squid are harvested and sold commercially. The NMFS issues fishing vessel, dealer, and commercial operator permits and fishing authorizations as required under the various Federal Fishery Regulations. Commercial landings for regional commercial fisheries in 2018 in the PMSR Study Area waters exceeded 30 million pounds (see Table 3.11-1). Commercial fishing can adversely affect fish populations, non-target species, and habitats. Bycatch includes the unintentional capture of fish, marine mammals, sea turtles, seabirds, and other non-targeted species that occur incidental to normal fishing operations. Fisheries	Various bycatch mitigation technologies, quotas, and seasonal restrictions required per the fishery-specific permit process. Operational regulations, seasonal restrictions, licensing, and	O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
		bycatch has been identified as a primary driver of population declines in several groups of marine species, including sharks, mammals, seabirds, and sea turtles (Wallace et al., 2010). Recreational fishing is significant in southern California, where over 3.3 million days of recreational fishing were recorded in 2013 (National Marine Fisheries Service, 2015a). More than 200 for-hire fishing vessels operate from 15 separate ports between Point Conception and the U.S.–Mexico border (California Marine Life Protection Act Initiative, 2009). Recreational fishing includes impacts from vessel traffic (strike, noise, water pollution, marine debris) and can compound impacts on fish stocks already experiencing exploitation. Recreational fishing and boat traffic usually occurs nearshore rather than in the deeper open ocean, and recreational traffic typically frequents popular locations, which can concentrate damage in these areas from anchors or other bottom-disturbing equipment.	quotas used to manage mitigate negative effects of recreational fishing.			
Coastal Land Development and Tourism (Section 3.11.4.3, Other Recreational Activities/ Tourism)	California Coastline	Coastal land development adjacent to the Study Area is both intensive and extensive, including development of homes, businesses, recreation, vacation, and ship traffic at port facilities and marinas. The Study Area coastline also includes extensive coastal tourism (hotels, resorts, restaurants, food industry, and vacation homes) and its supporting infrastructure (retail businesses, marinas, fishing tackle stores, dive shops, fishing piers, recreational boating harbors, beaches, and recreational fishing and whale watching). New development in the coastal zone requires a permit from the state or local government per the Coastal Zone Management Act (Chapter 6, Other Regulatory Considerations). Tourism is a substantial industry in Southern California (National Ocean Economics Program, 2015).	Site-specific mitigation often determined during Coastal Consistency Review by the respective state's Coastal Zone Management Program	C/O	C/O	C/O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
		Coastal development intensifies use of coastal resources through dune and nearshore habitat loss and disturbance, point and nonpoint source water pollution, entrainment in outflows and other structures, and air quality degradation. SCUBA diving and snorkeling have the potential to degrade reef systems through disturbance and specimen collecting, and collisions between whale watching ships and whales are common.				
Undersea Communications Cables	Oceans worldwide	Submarine cables provide the primary means of voice, data, and Internet connectivity between the mainland United States 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 dug into the seabed in shallow areas. Over 550,000 miles of cables currently exist in the world's oceans. Potential impacts of installation and maintenance activities would include noise and vessel strikes 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, 2016b).	Continued adherence to international marine construction and operational regulations.	C/O	C/O	C/O
Aquaculture	7.2 kilometers (4.5 statute miles.) west of Mission Bay in San Diego, California	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, 2015d). 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	Ongoing monitoring of seafloor chemistry below cages (sediments, water quality) and benthic infaunal	C/O	C/O	C/O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
		percent per year globally. Forty-seven percent of aquaculture operations occur in the Pacific Ocean. The threats of aquaculture operations on wild fish populations include reduced water quality, competition for food, predation by escaped or released farmed fishes, 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, 2015e). Establishment of the first commercial-scale offshore aquaculture project in U.S. federal waters, which will gradually expand to produce up to 5,000 metric tons per year (expected by year eight) of yellowtail jack, white seabass, and striped bass (Hubbs-Seaworld Research Institute, 2008; U.S. Army Corps of Engineers, 2015). Submersible sea cages will be deployed and improved as the project progresses. The project could have potential impacts on marine biological resources and water quality, both of which will be extensively mitigated, in order to minimize marine mammal, sea turtle, bird, and predator fish entanglement, proper mesh size netting will be used and the farm will be located away from known seal and sea lion haulout areas. The project will also implement a comprehensive health management program to prevent the transfer of pathogens or diseases to wild fish stocks as well as a comprehensive loss-control plan to prevent escape from containment and potential impacts on genetic integrity of wild population.	communities; abatement measures due to excess feed, fecal matter, antibiotics, and other chemicals; appropriate exclusion netting to avoid entanglement of marine mammals, sea turtles, birds, and predator fish species; avoidance of anchoring on hard bottom habitats; vessel operation protocols			

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* C = Construction O = Operation		
				Past	*Present*	*Future*
Research and Conservation						
Geological and Geophysical Oil and Gas Survey Activities	Outer Continental Shelf	Offshore geological and geophysical research may include seismic airgun surveys and high resolution geophysical surveys supporting oil and gas, renewable energy, and marine minerals exploration (Bureau of Ocean Energy Management, 2014b). Seismic surveys are accomplished by towing a sound source such as an air gun array that emits acoustic energy in timed intervals behind a research vessel. Seismic pulses are typically emitted at intervals of 5 to 60 seconds and source levels are 230.7 decibels referenced to 1 micropascal (dB re 1 µPa) for the large air gun array and 210.3 dB re 1 µPa for the small array. Seismic air gun surveys are loud enough to penetrate hundreds of km into the ocean floor, even after going through thousands of m of ocean (Weilgart, 2013). Oil exploration is less prevalent in the Pacific Ocean as it is in the Gulf of Mexico and may potentially become in the Atlantic, but it may occur or increase within the existing Pacific Ocean lease tracts discussed above. Vessel strikes and especially seismic sound production in excess of 180 decibels could cause adverse impacts on marine mammals (Bureau of Ocean Energy Management, 2014a). Additionally, air guns are known to kill zooplankton for at least 0.75 mile from the point of origination (Tollefson, 2017). All seismic surveys conducted by U.S. vessels are subject to required mitigation measures, the MMPA authorization process administered by the NMFS, as well as the NEPA process associated with issuing MMPA.	Typically include establishing and monitoring (visual, passive acoustic, and active acoustic) safety and acoustic exclusion zones and enforcing delay/suspension and spacing protocols. Seasonal management may include avoidance of critical habitat for specific vulnerable species. Maximum sound level thresholds established and enforced.	O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* *C = Construction* *O = Operation*		
				Past	*Present*	*Future*
Academic Research	Global	Wide-scale academic research is conducted in the study area by federal entities, such as the Navy and the National Oceanic and Atmospheric Administration/NMFS, as well as state and private entities and other partnerships, such as the California Cooperative Oceanic Fisheries Investigations program. Although academic research aims to capture data without disturbing the ambient conditions of the ocean environment, vessels contribute 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 air gun survey activities.	NMFS and states manage scientific research permits for certain activities	O	O	O
Field Operations at National Marine Sanctuaries and Marine National Monuments (see Section 6.1.2, Marine Protected Areas)	Sanctuaries located in the West Coast	NOAA conducts field operations within Marine Sanctuaries and Monuments, which include vessel operations; vessel maintenance; aircraft operations; non-motorized craft operations; SCUBA or snorkel operations; onshore field work; deployment of autonomous underwater vehicles, remotely operated vehicles, gliders, or drifters; deployment of remote sensing equipment (including sonar); deployment of equipment on the seafloor; and other sampling activities (FR 83 [152]: 38684–38685, August 7, 2018). The field operations primarily support resource protection, research, and education objectives of the National Marine Sanctuaries Act. The Programmatic Environmental Assessment (EA) of Field Operations in the West Coast National Marine Sanctuaries (Office of National Marine Sanctuaries, 2018b) and the Programmatic EA of Field Operations in the Pacific Islands National Marine Sanctuaries (Office of National Marine Sanctuaries, 2018a) analyze the options of maintaining the status quo and existing level of operations in National Marine Sanctuaries and Monuments for the next 5 years, or increasing the	Mitigation measures are determined on a project-by-project basis in accordance with the ESA, MMPA, Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation Management Act, and the National Historic Preservation Act.	O	O	O

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

Project	*Location*	*Project Description*	*Summary of Impact Minimization and Mitigation Measures*[1]	*Project Timeframe* *C = Construction* *O = Operation*		
				Past	*Present*	*Future*
		number of small boat operations and stopping the requirement for small boat best management practices in some locations. These discontinued management practices may include existing actions such as enforcing permit and consultation mitigations, vessel speed restrictions, night operation prohibitions, onboard marine mammal and other species observer (unless specified as required or recommended mitigation measures), restrictions on transporting live organisms and ballast water discharges, disinfecting research tools and gear, and safe distance requirements from protected species.				

Notes: EA = Environmental Assessment, EELV = Evolved Expendable Launch Vehicle, FR = Federal Register, ft. = foot/feet, HF = high frequency sonar, M3 = Mid-frequency sonar bin, MMPA = Marine Mammal Protection Act, NMFS = National Marine Fisheries Service, U.S. = United States

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends

Stressor	*Location*	*Description*
Climate Change (Section 3.1, Air Quality; Section 3.2.4.1.3, Climate Change and Sediment Quality; 3.2.4.2.3, Climate Change and Water Quality)	Global	Predictions of long-term negative environmental impacts 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. 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, and alteration of carbonate chemistry, 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 to 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 likely to negatively impact the Study Area and will contribute added stressors to all resources in the Study Area (as noted in the discussion for each resource in the sections to follow).
Noise	Global	Ambient noise is the collection of ever-present sounds of both natural and human origin. Ambient noise in the ocean is generated by sources that are natural physical (earthquakes, rainfall, waves breaking, and lightning hitting the ocean); natural biological (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 windfarms), 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 3.0.5.5.1 (Vessel Noise).

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends (continued)

Stressor	*Location*	*Description*
Marine Debris (Section 3.2.4.2.2, 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. An estimated 75 percent or more of marine debris consists of plastic, and approximately 80 percent of marine debris originates onshore and 20 percent from offshore sources (Derraik, 2002; Hardesty & Wilcox, 2017). Marine debris is governed internationally by the 1972 London Convention and 1996 London Protocol and regulated in the U.S. through the Marine Protection, Research, and Sanctuaries Act. Marine debris has been discovered to be accumulating in gyres throughout the oceans, and two major accumulation zones exist in the Pacific Ocean and in the Atlantic east of Bermuda. Within the North Pacific Gyre debris consolidates from various areas of the Pacific Ocean. Anthropogenic marine debris is also widespread along the continental shelf and upper slope of the U.S. West Coast (Washington to southern California). Military expended materials (ammunition boxes, helmets, rocket boosters and launchers, etc.) were the highest contributors to recovered metals in deeper waters off California in areas known for Navy activities and military dump sites, including around Catalina and San Clemente Islands (Keller et al., 2010). Recent studies in the Southern California Bight found that marine debris (primarily plastic) occurred in about one-third of seafloor areas surveyed (Moore et al., 2016). Microplastic particles were more prevalent in shallow nearshore areas (ports, marinas, bays, and estuaries) than in offshore areas. Marine debris degrades marine habitat and water quality and poses ingestion and entanglement risks to marine life and birds (National Marine Fisheries Service, 2006).
Pollution (Section 3.2, Sediments and Water Quality)	Global	Common ocean pollutants are generally 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 nonpoint sources (stormwater runoff from watersheds), point sources (wastewater treatment plant discharges), other land-based sources (windblown debris), spills, dumping, vessels, and atmospheric deposition. Bilge water is a mix of water, oily fluids, lubricants and grease, cleaning fluids, and other wastes that are pumped out periodically from vessel holding tanks, either to a reception facility on shore 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.

Table 4.2-2: Ocean Pollution and Ecosystem Alteration Trends (continued)

Stressor	*Location*	*Description*
Pollution (Section 3.2, Sediments and Water Quality) - continued	Global	In 1969, a federal platform offshore Santa Barbara experienced a blowout in one of its wells; an estimated 80,000 barrels (3,360,000 gallons) of oil was released into the ocean. Since 1969, about 883 barrels of oil have been spilled due to natural gas and oil operations offshore California. This spillage represents the cumulative loss from small spills ranging in size from a few drops to a 163-barrel spill from a pipeline in State waters carrying Outer Continental Shelf production to shore. Several redundancies are provided in all platform systems associated with drilling and production operations to ensure safety and to prevent flow from wells during a contingency such as an earthquake. Sewage outflow systems in California can impact nearshore water quality. For example, during wet weather/heavy rain events, hundreds of millions of gallons of untreated wastewater can enter the inshore waters of the Southern California Range Complex in San Diego resulting in beach closures and impacts on training due to stormwater runoff from Mexico's Tijuana River (U.S. Department of the Navy, 2015).
Harmful Algal Blooms (Section 3.2.1.2.3, Coastal Water Quality; and Section 3.4.4.1.2.3, Disease and Parasites)	Global	Elevated nutrient loading has also been identified as a potential contributing cause of the increased incidence of harmful algal blooms, proliferations of certain marine and freshwater toxin-producing algae (National Oceanic and Atmospheric Administration, 2016, 2017a). Of the 5,000 known species of phytoplankton, there are about 100 species known to be toxic or harmful. Harmful algal blooms cause human illness and animal mortalities, including species of fish, bird, and marine mammals (Anderson et al., 2002; Corcoran et al., 2013; Sellner et al., 2003). Harmful algal blooms can be natural phenomena but are occurring in increasing size and frequency due to human-induced nonpoint source water pollution (National Oceanic and Atmospheric Administration, 2016, 2017a). With the projection of warming ocean waters, these harmful blooms may become more prevalent—beginning earlier, lasting longer, and covering larger geographic areas (Edwards, 2013; Moore et al., 2008).
Hypoxic Zones (Section 3.6.4.1.4.1, Water Quality)	Global	Hypoxia, or low oxygen, is an environmental phenomenon where the concentration of dissolved oxygen in the water column decreases to a level that can no longer support living aquatic organisms. Hypoxia occurs from the rapid growth and decay of algal blooms in response to excess nutrient loading (primarily nitrogen and phosphorus from agriculture runoff, sewage treatment plants, bilge water, and atmospheric deposition). Animals that encounter the Dead Zones flee, experience physiological stress, or suffocate (National Oceanic and Atmospheric Administration, 2016; Texas A&M University, 2011, 2014). Hypoxic zones can be natural phenomena but are occurring in increasing size and frequency due to human-induced nonpoint source water pollution (National Oceanic and Atmospheric Administration, 2016, 2017a).

Notes: NOAA = National Oceanic and Atmospheric Administration

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 and experience were used to make a qualitative assessment of impacts. Due to the large-scale of the Study Area and multiple activities and stressors interacting in the ocean environment (Table 4.2-1 and Table 4.2-2), the analysis for 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 cumulative effects in a meaningful sense. To a great extent, the Chapter 3 (Affected Environment and Environmental Consequences) analysis is cumulative in that it takes into account the current condition of each resource as impacted by past and present human activity, and by prospects for recovery reflecting relevant future activity. Chapter 3 (Affected Environment and Environmental Consequences) includes 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., on range). Therefore, 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, when specific past, present, and reasonably foreseeable future actions are added to the analysis.

In this chapter, cumulative impacts were analyzed for each resource addressed in Chapter 3 (Affected Environment and Environmental Consequences) for the Proposed Action. Analysis was not separated by Alternative because the data available for the cumulative effects analysis was mostly qualitative in nature and, from a landscape-level perspective, these qualitative impacts are expected to be generally similar.

Under the Proposed Action, the Navy would implement the mitigation detailed in Chapter 5 (Standard Operating Procedures and Mitigation) to avoid or reduce potential impacts on biological, socioeconomic, and cultural resources in the Study Area.

4.4 Resource-Specific Cumulative Impacts

In accordance with Council on Environmental Quality 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) or the level to which impacts from the Proposed Action are expected to mingle with similar impacts from existing activities. A full analysis of potential cumulative impacts is provided for marine mammals, and sea turtles. Rationale is also provided for an abbreviated analysis of the following resources: air quality, sediments and water quality, marine habitat, marine vegetation, marine invertebrates, marine fishes, marine mammals, sea turtles, marine birds, cultural resources, socioeconomics, recreation, sea and airspace, and public health and safety.

4.4.1 Air Quality

4.4.1.1 Region of Influence

As described in Section 3.1.2 (Region of Influence), the region of influence for air quality is dependent on the type of pollutant, emission rates, other emission sources, and meteorology. For inert pollutants, the region of influence is generally limited to a few miles downwind from the source. For a photochemical

pollutant, such as ozone, the region of influence may extend much farther downwind. The concentration of many small emission sources in a particular air basin, under the right circumstances, could incrementally contribute to regional air quality degradation.

The context for air quality analysis provided in Section 3.1 (Air Quality) includes adherence to state and federal plans enacted to achieve and maintain air quality, and these plans were developed with direct, indirect, and cumulative impacts in mind. As the plans are developed, the establishment of significance criteria includes an inventory of existing emissions and the development of thresholds that ensure new activities avoid or mitigate significant air quality impacts. A majority of the activities included in the Proposed Action are ongoing, and any emissions associated with these activities that reach land are captured in any ambient air monitoring data collected and used to quantify area air quality.

Unlike other resource areas, the analytical construct for this air quality analysis in Section 3.1 (Air Quality) is effectively a quantified look at applicable testing and training activity emissions and a region's ability to maintain or recover air quality as measured by the criteria air pollutants in light of other, existing emissions. As a whole, the air quality throughout the Study Area is generally very good or excellent as shown by ongoing monitoring of all criteria pollutants against National Ambient Air Quality Standards and State Ambient Air Quality Standards (Section 3.1.4.2, Existing Air Quality). A small proportion of nonattainment and maintenance areas are generally concentrated in the inland, urban, industrialized areas off the coast of Southern California. Much of the air pollutants found in offshore areas are transported there from adjacent land areas by low-level offshore winds, so concentrations of criteria air pollutants generally decrease with increasing distance from land. The good quality of the ocean atmosphere results from the relatively low number of air pollutant sources, as well as the size, topography, and prevailing meteorological conditions throughout the Study Area.

4.4.1.2 Impacts of Other Actions

Other activities in the Study Area that contribute to emissions of criteria air pollutants include other vessel traffic and oil and gas production activities, as well as landside power-generating stations, petroleum refining, agriculture, other industry, and vehicle traffic. Oil and gas production is regulated under state and federal programs to ensure new activities avoid or mitigate significant air quality impacts (Bureau of Ocean Energy Management, 2016c). Sulfur dioxide, nitrogen dioxide, and particulate matter air emissions from non-military vessel operations operating within 200 miles of coastal areas off the U.S. and Canada and the U.S. Caribbean Sea area (around Puerto Rico and the U.S. Virgin Islands) are regulated by the International Maritime Organization. These areas are known as Emission Control Areas and were created because of the ability of these pollutant emissions to travel long distances, thus potentially impacting coastal zones and further inland.

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

As noted above, the majority of proposed activities are ongoing and would be captured in California's air quality measurements. As detailed in Section 3.1 (Air Quality) sources of emissions from the proposed alternatives would include Navy vessels, aircraft and, to a lesser extent, munitions testing and training activities conducted throughout the Study Area. The Proposed Action would result in localized and temporarily elevated emissions, but criteria pollutant emissions in nonattainment or maintenance areas would not exceed *de minimis* thresholds. Hazardous air pollutant emissions are anticipated to be small and were dismissed as a stressor of impact.

4.4.1.3.1 Cumulative Impacts on Air Quality

It is anticipated that a large portion of emissions resulting from the Proposed Action would be released outside of state waters and would quickly disperse in the open ocean environment. These emissions would largely disperse rather than concentrate due to meteorological and air chemistry processes, and these emissions could mix with emissions from other vessel traffic in the open ocean. The incremental additive impacts from these combined emissions occurring beyond state water boundaries would be minor, localized, intermittent, and unlikely to contribute to future degradation of the ocean atmosphere in a way that would harm ocean ecosystems or nearshore communities. Thus, based on the analysis presented in Section 3.1 (Air Quality) and given the meteorology of the Study Area, the frequency and isolation of proposed testing and training activities, and the quantities of expected emissions, it is anticipated that the incremental contribution of the Proposed Action beyond state waters, when added to the impacts of all other past, present and reasonably foreseeable future actions would not result in measurable additional impacts on air quality in the Study Area or beyond.

A cumulative analysis of greenhouse gas emissions and climate change is provided in Section 3.1 (Air Quality).

4.4.2 Sediments and Water Quality

4.4.2.1 Region of Influence

The region of influence for sediments and water quality includes estuaries, nearshore areas, and the open ocean. Although most impacts from anthropogenic sources tend to be geographically isolated in proximity to the source, more widespread impacts can extend over time into the offshore ocean environment due to transport through currents, storms, and persistent winds as well as vertical mixing in the water column. The fate of materials deposited in the marine environment and the formation of degradation or corrosion products depends on geochemical conditions that may influence precipitation by chemical reaction, adsorption, and biodegradation. Transport mechanisms, such as advection by currents, dispersion, and dissolution can cause wide distribution of chemicals and small, buoyant particle debris. While this dynamic movement generally causes chemical contaminants and debris to degrade or dilute, it can also concentrate materials in areas of the seafloor or water column. Persistent currents, upwelling, eddies, and large-scale gyres can result in convergence zones that accumulate debris, particularly plastics, in the marine environment (e.g., the “garbage patches” in the North Pacific Ocean and east of Bermuda).

In order to protect sediment and water quality, several U.S. and international laws govern the discharge of fouling materials into the marine environment. The U.S. Environmental Protection Agency and state environmental programs through the Clean Water Act National Pollutant Discharge Elimination System regulate both nearshore discharge as well as discharges from open ocean activities and vessels in federal waters. The deliberate disposal of waste or other matter into the ocean is governed internationally by the 1972 London Convention and 1996 London Protocol, implemented in the U.S. through the Marine Protection, Research, and Sanctuaries Act. The International Convention for the Prevention of Pollution from Ships is incorporated into U.S. law and addresses pollution generated by normal vessel operations (Section 3.2.3, Approach to Analysis, lists applicable water and sediment quality standards, regulations, and guidelines).

Sediment quality of the Study Area is detailed in Section 3.2.4.1 (Sediments) and is generally rated “good” by the U.S. Environmental Protection Agency with most instances of lower quality in nearshore waters adjacent to population centers or areas that are geologically more enclosed (Tables 3.2-1 and

3.2-2; Figure 3.2-3). Off the California coast, sediments are rated "good" except for areas adjacent to Los Angeles (outside of the Study Area), and farther south in the Southern California Bight from Santa Catalina Island to the Mexico border. The outer continental shelf and submarine canyons are experiencing decreasing sediment quality, likely due to the migration of sediments contaminated in the past by poorly regulated waste and chemical disposal processes.

Water quality of the Study Area is detailed in Section 3.2.4.2 (Water Quality). Threats to water quality are detailed in Section 3.2.4.2.2 (Marine Debris and Water Quality). Population growth is the primary cause of impacts on coastal water quality, including marine debris, land-based garbage, and solid wastes that deposit toxic chemicals and nutrients in the ocean. Water quality in the open ocean portion of the Study Area tends to be rated "good", but in nearshore areas water quality ranges from good to poor, and is often compromised due to increased use of and development in coastal waters (see Figure 3.2-6). Persistent organic pollutants such as polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and pesticides; nutrients; bacteria; and some metals are common components of discharge into rivers, bays, and the ocean. The major pollutant encountered in the open ocean is oil from accidental spills (including chemical dispersants used in response to spills) as well as natural seeps.

4.4.2.2 Impacts of Other Actions

All past, present, and reasonably foreseeable activities listed in Table 4.2-1, and the stressors listed in Table 4.2-2, affect marine sediments and water quality. In particular, activities contributing to climate change, continued runoff and discharge from nearshore land uses and coastal land development, maritime traffic, leakages and spills from oil and gas development, commercial fishing, mineral extraction, offshore energy development and removal operations, and marine trash impact water and sediment quality. Commercial, recreational, and institutional vessels discharge water pollutants into the Study Area as part of normal operations. Shipboard waste-handling procedures governing the discharge of PMSR nonhazardous waste streams have been established for commercial and Navy vessels. These categories of wastes include solids (garbage) and liquids, including "black water" (sewage); "grey water" (water from deck drains, showers, dishwashers, laundries, etc.); and oily wastes (oil-water mixtures). Global climate change is linked to increasing ocean acidity (pH), increasing sea surface temperatures, and increasing frequency and intensity of storms. These factors influence marine chemistry and the transport and persistence of chemical contaminants within sediment and the water column. Chemicals that remain in particulate form below a certain temperature may dissolve into the water column at a higher rate as water temperatures rise, and they may become more widely dispersed due to storms or changing currents. Particularly in nearshore areas and bays, the concentration of Navy stressors in designated ranges and ports may combine with non-Navy stressors, which may also be concentrated in these areas, to exacerbate already impacted sediments and water quality.

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

The analysis in Section 3.2 (Sediments and Water Quality) indicates that certain testing and training activities could result in localized, short- and long-term impacts on sediment and water quality. Activities that use explosive munitions would introduce explosives byproducts, metals, and other constituent chemicals directly into the water column when the munition detonates, or into marine sediments if an explosive munition fails to detonate. Explosives byproducts from munitions that detonate are expected to disperse rapidly near the water's surface after detonation. Explosive materials and metal corrosion products from munitions that fail to detonate and thus reside on the seafloor would be released into adjacent sediments (within a few feet) over the long-term (years to decades). However, analysis of decades-old munitions dump sites in multiple locations indicates that chemical contaminant

concentrations in impacted sediment would not be expected to differ substantially from the chemical composition of control sediments located within the general area of impact (see Section 3.2.5, Environmental Consequences). Other military expended materials, such as marine markers and flares, chaff, unrecovered towed and stationary targets, and miscellaneous plastic and rubber components of other expended objects are expected to sink to the seafloor and become buried in sediments. Depending on the environmental conditions, including the availability of oxygen in sediments, water temperature at the seafloor, and the type of material (e.g., metal or plastic), expended material may degrade relatively quickly or persist in the environment indefinitely. Plastics and other buoyant, persistent materials could incrementally contribute to marine debris accumulation zones or other areas with accumulated debris.

Short-term impacts from activities using vessels may include increased turbidity and suspension of sediments in the water column (dependent on water depth). Most explosives are fully consumed in detonation, and chemical, physical, or biological changes to sediments or water quality, if detectable, would be below applicable standards, regulations, and guidelines and would be within existing conditions or designated uses. Military expended materials associated with the Proposed Action do not generally include the same chemical constituents typically affecting coastal water quality. No activities related to this EIS would be conducted within bays or harbors, therefore, it is unlikely that short-term increases in turbidity from testing and training activities would overlap in time and space with other past, present, or future actions. For example, testing and training with explosives would not occur near an oilrig structure-removal operation that could use explosives or at the same time or place as other bottom-disturbing activities such as trawling or laying electrical transmission or communications cables.

4.4.2.3.1 Cumulative Impacts on Sediments and Water Quality

Although impacts on sediment and water quality may occur coincident with other impacts in areas with degraded existing conditions, most of the Navy impacts on water quality, such as increases in turbidity, are expected to be isolated and short-term, with disturbed sediments and particulate matter quickly dispersing within the water column or settling to the seafloor and turbidity conditions returning to background levels. The Proposed Action could incrementally contribute to increases in persistent metal and plastic materials accumulating in the offshore marine environment. However, the relatively minute concentrations as a result of testing and training activities are not likely to meaningfully contribute to sediment or water quality degradation, and 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 sediment or water quality in the Study Area or beyond.

4.4.3 Marine Habitats

4.4.3.1 Region of Influence

Habitats refers to the marine and estuarine nonliving (abiotic) substrates found throughout the Study Area, which are often colonized by biotic (vegetation and invertebrate) communities. Habitats vary according to geographic location, underlying geology, hydrodynamics, atmospheric conditions, and suspended particulate matter. Habitat types within the Study Area are described in Table 3.3-1 and depicted on Figure 3.3-3. There are basically three types of abiotic substrates based on the grain size of unconsolidated material, referred to as soft, intermediate, and hard. The soft habitats are generally comprised of fine grains that are more fluid and dynamic, whereas hard substrate does not repair and thus is susceptible to long-term scarring and damage. Artificial structures, such as shipwrecks oil and gas

platforms, underwater cables, and outflows also provide habitat for many marine organisms. Additionally, as detailed in Chapter 6 (Other Regulatory Considerations), there are 896 square nautical miles (NM^2) of designated National Marine Sanctuaries in the total PMSR Study Area (approximately 2.5 percent of the total Study Area).

4.4.3.2 Impacts of Other Actions

Section 3.3.4.1.7 (General Threats) includes an extensive discussion of the existing stressors to abiotic marine habitats, including urbanization (modification of shorelines and estuaries, dredging and maintenance of ports, bays, and harbors, and creation of artificial structure habitats such as breakwaters, jetties, rock groins, seawalls, oil and gas platforms, docks, piers, wharves, underwater cables and pipelines, artificial reefs); water quality; commercial industries (oil/gas development, telecommunications infrastructure, steam and nuclear power plants, desalinization plants, alternative energy development, shipping and cruise vessels, commercial fishing, aquaculture, and tourism operations); and marine debris. The impact of commercial fishing trawling practices (discussed in Table 4.2-2) has a significant impact on bottom habitats. Most activities in Table 4.2-1 are conducted under permits and regulations that require the avoidance and minimization of impacts on marine habitats, especially shoreline and sensitive hard bottom and biogenic habitats (e.g., reefs and shellfish beds). Tourism is an additional stressor in urbanized areas. Within highly urbanized Southern California, human visitation and disturbances impact rocky intertidal (trampling, overturning of rocks, collecting) and sandy beach (mechanical beach grooming) habitats.

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

The analysis presented in Section 3.3 (Marine Habitats) indicates that military expended materials associated with testing and training activities are not likely to result in the degradation or loss of habitat in the Study Area. Therefore, it is anticipated that the incremental contribution of the Proposed Action would not be cumulatively significant because much of the Study Area encompasses sandy bottom and rocky substrate that is not considered "sensitive" and would not be affected by military expended materials. In addition, Proposed Action activities are not likely to occur at the same time/place as other activities in the Study Area, including commercial fishing operations, which have a large effect on bottom habitats. Thus, it is likely that soft bottom habitats would have the opportunity to recover from or would not be affected by the Proposed Action before impacts from fishing or other operations could interact or compound additional stress to the ecosystems.

4.4.3.3.1 Cumulative Impacts on Marine Habitats

Although it is anticipated that testing and training activities are not likely to result in the degradation or loss of habitat, many other activities in the ocean are also impacting ocean bottom habitat. However, it is not likely that past, present, and future impacts would overlap with Proposed Action activities in place or time. Likewise, hard bottom habitat would be less likely to be impacted by military expended materials. Based on the analysis presented in Section 3.3 (Marine Habitats) and the reasons summarized above, 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 habitats, including National Marine Sanctuaries, in the Study Area or beyond.

4.4.4 Marine Vegetation

4.4.4.1 Region of Influence

Vegetation of the Study Area includes algae (phytoplankton and seaweeds), and vascular plants that include seagrasses and eelgrass. Commercial activities are conducted under permits and regulations that require companies to avoid and minimize impacts on sensitive vegetation, and some harvested seaweeds are managed under Fishery Management Plans.

4.4.4.2 Impacts of Other Actions

The effects of other past, present, and reasonably foreseeable actions on vegetation occur primarily in the coastal and inshore waters and are associated with coastal development, maritime commerce/dredging, and the discharge of sediment and other pollutants. Seagrasses are susceptible to damage from storms and human activities but can regrow quickly if the root structure is intact and the substrate is not eroded away. Stressors include decreased light penetration and impacts on photosynthesis, particularly from sustained turbidity and nutrient loading, which can cause algal blooms. They are also susceptible to changes in environmental factors such as salinity, pH, water temperature, and physical damage. General threats to marine vegetation include diminished water quality from excessive nutrient input, siltation, pollution (from oil, oil spills, and cleanup chemicals; sewage; and trash), climate change, fishing practices (trawling and raking), anchoring, shading from structures, propeller/vessel traffic, construction and dredging, commercial harvest, and introduced or invasive species.

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

Potential impacts on marine vegetation would be by physical disturbance and strike from military expended materials. The analysis presented in Section 3.4 (Marine Vegetation) indicates that impacts on marine vegetation are limited to destroying or damaging individual plants, and no persistent or large-scale effects on the growth, survival, distribution, or structure of vegetation are anticipated due to relatively fast growth, resilience, and abundance of the affected species in anticipated activity areas. Likewise, the short-term, localized nature of most activities further diminishes the potential effects on marine vegetation.

4.4.4.3.1 Cumulative Impacts on Marine Vegetation

The Proposed Action is not expected to substantially contribute to losses of vegetation that would interfere with recovery in these regions. The incremental contribution of the Proposed Action would be insignificant as most of the proposed activities would occur in areas where seagrasses and other attached marine vegetation such as kelp do not grow occur. The Proposed Action would not compound impacts that have been historically significant to marine vegetation (loss of habitat due to development; nutrient loading; shading; turbidity; or changes in salinity, pH, or water temperature). 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 vegetation in the Study Area or beyond.

4.4.5 Marine Invertebrates

4.4.5.1 Region of Influence

Marine invertebrates occur in all habitats and depths within the Study Area, including both the water column and benthic habitat. Marine invertebrates are classified within major taxonomic groups, generally referred to as a phylum. Major invertebrate phyla—those with greater than 1,000 species

(Roskov et al., 2015; World Register of Marine Species Editorial Board, 2015)—and the general zones they inhabit in the Study Area are listed in Table 4.2-1.

4.4.5.2 Resource Trends

As discussed in Section 3.5.4.1 (General Background), marine invertebrates are ecologically and economically important, performing essential ecosystem services such as coastal protection, nutrient recycling, food for other animals, and habitat formation, 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, crabs, scallops, clams, 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.

Two abalone species (black abalone and white abalone) found in the Study Area are listed as endangered under the ESA, and two additional abalone species (green abalone and pink abalone) are designated as Species of Concern. Abalones occur on hard substrate from the intertidal zone to depths of 30 to 60 m, depending on the species. Additional information on ESA-listed abalone species is provided in Section 3.5.4.2.5.1 (Black Abalone [*Haliotis cracherodii*]) and Section 3.5.4.2.5.2 (White Abalone [*Haliotis sorenseni*]).

4.4.5.3 Impacts of Other Actions

General threats to marine invertebrates come from overexploitation and destructive fishing practices, habitat degradation resulting from pollution and coastal development, disease, invasive species, oil spills, oil and gas seismic air gun exploration, global climate change and ocean acidification, human-generated noise, and bioprospecting for pharmaceutical products. Additional information on general threats to marine invertebrates is provided in Section 3.5.4.1.4 (General Threats).

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

The analysis presented in Section 3.5.5 (Environmental Consequences) indicates that the Proposed Action could impact marine invertebrates through surface explosions, physical disturbance or strikes (military expended materials), 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 abalone species would be negligible because the Navy does not typically conduct testing and training activities that use military expended material in shallow-water, rocky areas where ESA-listed black and white abalones occur.

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 because most of the proposed activities would impact small, dispersed, deep water areas where marine invertebrates are more sparsely distributed. Navy activities may occur in the same general area (ranges), but do not occur at the same specific point each time and would therefore be unlikely to affect the same individual invertebrates. 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 potentially impact marine invertebrates

4.4.5.4.1 Cumulative Impacts on Marine Invertebrates

The Proposed Action is not likely to incrementally contribute to population-level stress and decline of the resource. 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.

4.4.6 Marine Fishes

4.4.6.1 Region of Influence

Fishes are the most numerous and diverse of the major vertebrate groups (Moyle & Cech, 2004). It is estimated that there are currently over 34,000 species of fishes worldwide (Eschmeyer & Fong, 2017), with greater than half that number of species inhabiting the oceans. Marine fishes can be broadly categorized by their distributions within the water column or habitat usage. Moyle and Cech (2004) define the major marine habitat categories as estuaries, coastal habitats, reefs, the epipelagic zone, the deep sea, and the Polar regions. In the Study Area, the major habitat categories include all of the aforementioned except the Polar regions.

4.4.6.2 Resource Trends

Taxonomic categories of the most common fish groups found in the Study Area are provided in Table 3.6-1 and are based on the organization presented by Moyle and Cech (2004), Nelson (2006), Helfman et al. (2009), and Froese and Pauly (2016). These groupings are intended to organize the extensive and diverse list of fishes that occur in the Study Area and serve as a means to structure the analysis of potential impacts on fishes with similar physiological characteristics and habitat use. Exceptions to these generalizations exist within each group and are noted wherever appropriate in the analysis of potential impacts. For simplicity, the fishes are presented in generally accepted evolutionary order. Only the common taxonomic groups that have the potential to be impacted by project activities are discussed below. Taxonomic groups that are associated with deep water benthic habitats are not discussed further because they would not be affected by project activities.

Only one ESA-listed species, the ocean-migrating (anadromous) form of rainbow trout (*Oncorhynchus mykiss*) or steelhead (Myers, 2018) occurs in the Study Area and the closest critical habitat for this species is located to the north at the Santa Clara and Ventura rivers, and to the south at Arroyo Sequit and Malibu Creek (U.S. Department of the Navy, 2013).

4.4.6.3 Impacts of Other Actions

Fish populations can be influenced by various natural factors and human activities. There can be direct effects, from disease or from commercial and recreational activities such as fishing, or indirect effects, such as those associated with reductions in prey availability or lowered reproductive success of individuals. The additional threat of living in a noisy environment, such as produced by offshore wind energy developments, construction noise within inshore waters such as pile-driving, sonar, seismic activity, shipping, and offshore construction projects, may contribute to cumulative stress as experienced by some fish populations.

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

It is anticipated that the Proposed Action would potentially impact fish species within the Study Area. The analysis presented in Section 3.6 (Marine Fishes) indicates that fishes could be affected by surface

explosives, energy stressors (high-energy lasers), physical disturbance or strikes (military expended materials), and ingestion of military expended materials. The majority of potential impacts would be short-term behavioral and physiological responses. Overall, long-term consequences for most individual fishes or populations are unlikely because exposures from the majority of stressors are intermittent, transient, and unlikely to repeat over short periods.

4.4.6.4.1 Cumulative Impacts on Marine Fishes

The aggregate impacts of past, present, and other reasonably foreseeable future actions contributing multiple water quality, noise, and physical risks to fishes would likely continue to affect individual fishes and fish populations. However, Navy testing and training activities occur in previously established locations (typically in deep offshore areas), are spatially distributed and not generally concentrated in any one location for any extended period of time, have few participants, and are of a short duration. Although it is possible that the Proposed Action could contribute incremental stressors to a small number of individuals, which would further compound effects on a given individual already experiencing stress, it is not anticipated that the Proposed Action has the potential to put additional stress on entire populations. Therefore, 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 significant impacts on marine fishes in the Study Area or beyond, including ESA-listed steelhead.

4.4.7 Marine Mammals

4.4.7.1 Region of Influence

The general region of influence for marine mammals extends beyond the Study Area boundaries as for some species the Study Area represents only a portion of the full extent of the species' range during their lifecycle. Baleen whales (e.g., humpbacks) and toothed whales (e.g., sperm whales and killer whales) seasonally migrate great distances, as do some pinnipeds (e.g., elephant seals, fur seals, sea lions). Pinnipeds will spend time on land, and except for brief excursions, otters occur mostly in coastal habitats remaining close to the coast. Activities are evaluated for their potential impact on individual marine mammals, on stocks and populations as appropriate, and on species or distinct population segments listed under the ESA.

Table 3.7-1 lists the current abundance of marine mammal species that utilize the Study Area and describes the locations within the Study Area that they may be encountered. There are 34 marine mammal species expected in the Study Area, including 6 mysticetes (baleen whales), 22 odontocetes (toothed cetaceans), 5 pinnipeds (seals and sea lions), and 1 mustelid (southern sea otter). Populations are varied; while the average population of certain dolphin and some whale populations include thousands of individuals (such as the short-beaked common dolphin), other stock populations are unknown or estimated to be in the hundreds (such as the killer whale). As with other marine resources, distribution is patchy and can be temporarily concentrated in specific areas depending on the species.

4.4.7.2 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 3.7.4 (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. Other populations, such as the humpback whale, are increasing in abundance in much of their range (National Marine Fisheries Service, 2015b). All marine

mammals in the U.S. are protected under the MMPA, and some species receive additional protection under the ESA. Of the 34 species of marine mammals known to exist within the Study Area, there are 9 populations listed as endangered or threatened under the ESA (blue whale, fin whale, gray whale [Western North Pacific stock], humpback whale [Mexico Distinct Population Segment {DPS} and Central America DPS], sei whale, sperm whale, Guadalupe fur seal, and southern sea otter).

4.4.7.3 Impacts of Other Actions

4.4.7.3.1 Overview

Section 3.7.4.1.6 (General Threats) discusses the specific stressors within the affected environment that impact marine mammal populations in the Study Area, which include water quality degradation (chemical pollution), commercial industries (fisheries bycatch, explosive pest deterrents, and other interactions), noise, hunting, vessel strike, marine debris, disease and parasites, power plant entrainment, and climate change. Potential impacts of actions that affect marine mammals include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success. The susceptibility of marine mammals 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.

Stranded marine mammals include alive or dead individuals that swim or float to shore and are incapable of returning to sea or individuals that have wandered outside of their "normal" habitat. Investigations of stranded marine mammals can provide indications of the general threats to marine mammals in a given location, and causes of strandings include navigation error, predator avoidance, population and climate shifts, infectious disease, parasite infestation, starvation, pollution exposure, trauma (e.g., injuries from ship strikes or fishery entanglements), sound (human-generated or natural), harmful algal blooms and associated biotoxins, tectonic events such as underwater earthquakes, and ingestion or interaction with marine debris (National Marine Fisheries Service, 2016). The activities as described in Table 4.2-1 each potentially contribute multiple stressors in the region of influence experienced by marine mammals, including vessel traffic, underwater noise, and water pollution (Table 4.2-2). For example, most actions include marine vessel operations, which contribute to vessel strikes and underwater noise. Many of the actions also contribute underwater noise from sources other than vessels, including use of explosives for oil rig removal, seismic surveys, construction activities, and other military operations. Bycatch and entanglement, the main threats to marine mammal populations, are chiefly associated with fishing. While Table 4.2-1 discusses these stressors for individual actions, their aggregate impacts specific to marine mammals are detailed in Section 3.7.4.1.6 (General Threats) and further described below. Data availability is inconsistent between species and activities, but quantitative estimations are presented where available.

4.4.7.3.2 Commercial Fishing and Entanglement

Past and present commercial fishing activities have had a profound effect on some marine mammal species 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 marine mammal stocks (Knowlton et al., 2012; Roman et al., 2013; Van der Hoop et al., 2013). In recent years, the overall number of commercial fishing vessels has decreased, which may be attributed to changes in environmental conditions, fishing regulations, and market forces (California Department of Fish and Wildlife, 2008). Eleven ports in Southern California contain both commercial fishing fleets and commercial passenger fishing vessels (i.e., recreational) that use the ocean areas within the Study Area (Naval Undersea Warfare Center, 2009).

4.4.7.3.2.1 Bycatch

Potential impacts from commercial fishing activities include marine mammal injury and mortality from bycatch, which refers to when animals are caught in commercial fishing operations targeting a different species. Total bycatch interactions are difficult to estimate as numbers are based on observations by NMFS staff or on numbers received from individual operations that self-report bycatch interactions. In 1994, the MMPA was amended to formally require the development of a take reduction plan when bycatch exceeds a level considered unsustainable by the marine mammal population and will lead to marine mammal population decline. Although marine mammal bycatch has generally declined since the implementation of take reduction measures, and new management practices and consistent regulatory oversight could result in future reductions, bycatch is expected to remain a leading cause of mortality for the reasonably foreseeable future (Read et al., 2006).

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. 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. Bycatch rates for about 12 percent of United States marine mammal stocks (almost all cetaceans) exceed their Potential Biological Removal levels (Read, 2008). 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.

Fisheries operations also result in profound 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 nutritional diet and decreased reproductive success.

4.4.7.3.2.2 Entanglement

As discussed in Section 3.7.4.1.6 (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 major threat to marine mammals in the Study Area. 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. Off San Diego from 2010 through 2014, there were 36 marine mammal bycatch entanglements from civilian fishing activities (Carretta et al., 2016). For the area off the coasts of northern California, Oregon, and Washington between 1982 and 2010, Saez et al. (2013) reported there were 272 large whales entangled in fishing gear (whales in this area of the United States West Coast are generally from the same stock as in the Study Area).

4.4.7.3.2.3 Recreational Fishing and Hunting

Recreational fishing also impacts marine mammals. Along the U.S. West Coast, hook and line entanglements and gunshot wounds are two of the primary causes of pinniped injuries found in strandings (Carretta et al., 2013). Off San Diego from 2010 through 2014, there were 50 marine mammal hook and line interactions (48 pinnipeds, 2 dolphins) reported (Carretta et al., 2016). With the enactment of the MMPA, hunting-related mortality has decreased over the last 40 years; however,

unregulated harvests and extensive 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. For example, in two years of hunting (2010 and 2011) on St. Paul Island and St. George Island in the Bering Sea there were 878 northern fur seals harvested for subsistence (Testa, 2012). In Russian waters in 2013, there were 127 gray whales "struck" during subsistence whaling by the inhabitants of the Chukchi Peninsula between the Bering and Chukchi Sea (Ilyashenko & Zharikov, 2014). These gray whales, harvested in Russian waters, may be individuals from either the endangered Western North Pacific stock or the non-ESA-listed Eastern North Pacific stock that may migrate through the Study Area.

4.4.7.3.2.4 Other Fishery Interactions

Common practice in offshore waters off Southern California, Washington, and Alaska include the routine use of non-military explosives at-sea for explosive pest control, or marine mammal deterrents known as "seal bombs." Seal bombs are used by commercial fishermen to deter marine mammals from preying upon their catch or to prevent interaction or entanglement with fishing gear (U.S. Department of the Navy, 2016). In the Southern California region, several fisheries including purse seine and set gillnet fisheries use seal bombs as deterrents (Baumann-Pickering et al., 2013). In the seven months from May to November 2013, over 24,000 explosions identified as seal bombs were recorded at a passive acoustic monitoring site off Long Beach, California (Debich et al., 2015). The prevalent and continued use of seal bombs seems to indicate that, while a potential threat, their use has had no significant effect on populations of marine mammals given that it is likely that individuals, if not larger groups of marine mammals, have been repeatedly exposed to this explosive stressor.

4.4.7.3.3 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 energy development and other offshore activities. 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, ship speed reduction measures, and maritime traffic planning and management. An examination of vessel traffic within the Southern California determined that Navy vessel occurrence is two orders of magnitude lower than that of commercial traffic. The study also revealed that while commercial traffic is relatively steady throughout the year, Navy vessel use is episodic and based on specific exercises being conducted at different times of the year (Mintz, 2012); however, Navy vessel use within inshore waters occurs regularly and routinely consists of high-speed small vessel movements.

Most reported marine mammal vessel strikes involve commercial vessels and occur over or near the continental shelf (Laist et al., 2001). 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, porpoises, and pinnipeds that can move quickly throughout the water column are not as susceptible to vessel strikes.

Off San Diego from 2010 through 2014, there were seven marine mammal vessel or boat strikes reported (Carretta et al., 2016). In 2015 through 2019 there were 41 marine mammal vessel or boat

strikes reported off the coast of California (National Marine Fisheries Service, 2019). The strikes were on two California sea lions, one fin whale, two gray whales, and two humpback whales. None of these strikes were from Navy vessels or boats (National Marine Fisheries Service, 2015a). Navy whale strikes have diminished generally since implementing the U.S. Navy Marine Species Awareness Training for lookouts.

4.4.7.3.4 Pollution

As discussed in Table 4.2-2, 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 3.7.4.1.6 (General Threats) provides an overview of these potential impacts, which include morbidity and mortality from acute toxicity; 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 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).

4.4.7.3.5 Ocean Noise

Ocean noise as a general stressor in modern oceans is described in Table 4.2-2 and specific stressors to marine mammals in Section 3.7.4.1.6 (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 or, and, in some cases, death.

Anthropogenic noise is generated from a variety of sources throughout the region of influence, 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).

Shipping channels leading to and from the ports of Los Angeles and Long Beach between the Channel Islands National Marine Sanctuary and the coast may have degraded the habitat for blue, fin, and humpback whales due to the loss of communication space where important habitat for these species overlaps with elevated noise from commercial vessel traffic (Redfern et al., 2017). The San Pedro Channel is south of the Study Area and is where the Traffic Separation Scheme's southern entrance and exit is located for these same ports (Los Angeles and Long Beach). A similar concentration of commercial vessel traffic moving through the San Pedro Channel into and out of the Study Area is also likely to impact marine mammal communication space in a similar manner.

The military activities addressed in Table 4.2-1 include various testing and training operations that contribute vessel noise, underwater and surface explosions, and sonar. Use of mid-frequency sonar

between 1950 and 2001 has been correlated with 12 of 126 beaked whale mass strandings during five separate exercises (U.S. Department of the Navy, 2017). Of these exercises, four were multi-nation (North Atlantic Treaty Organization countries) and one was solely an U.S. Navy exercise occurring near the Bahamas. In the Bahamas event, 7 stranded animals died, and 10 returned to the water. Although sonar activity has historically been correlated to various negative impacts on marine mammals, with the implementation of required mitigation measures, sonar operations are not expected to result in mortality to any stock of marine mammals and minimal injury or behavioral changes are anticipated. Although various other military testing and training activities involve surface or undersea detonations or gunnery exercises, these are generally mitigated through monitored exclusion zones, and are infrequent, isolated events. As described in Table 4.2-1, many activities incorporate best management practices or standard operating procedures to minimize noise generation. Likewise, any in-water construction that may occur at naval piers would utilize dampening and attenuation technologies and other practices that reduce impacts on bottlenose dolphins and other sensitive receptors in the vicinity of pile driving activities.

Rocket and Missile Launch Noise

As discussed in Table 4.2-1, the U.S. Air Force has a Letter of Authorization for launching of spacecraft, rockets, missiles, and aircraft and helicopter operations at Vandenberg Air Force Base (VAFB). These authorizations under the MMPA are for take of hauled-out pinnipeds resulting from launch noise associated with the launching of spacecraft, rockets, missiles, and aircraft operations at VAFB. Scientific literature investigating the transferal of shock wave impulse overpressure across the air-water interface from sonic booms above the ocean (Bolghasi et al., 2017; Chapman & Godin, 2004; Cheng & Edwards, 2003; Moody, 2006; Sawyers, 1968; Waters & Glass, 1970) demonstrates that most sound energy from a sonic boom is reflected by the ocean's surface; thus, in-air sound should not impact submerged marine mammals under the provisions of the MMPA. There are pinniped haulout areas on the shoreline at VAFB that could receive overpressures exceeding the in-air behavioral threshold for pinnipeds. Such impacts would be temporary and of a short duration. Mitigation measures at VAFB include marine mammal monitoring requirements (e.g., avoiding launch scheduling during the pupping seasons), monitoring haulout areas during applicable events, and other measures that reduce impacts on hauled-out pinnipeds.

4.4.7.3.5.1 Marine Debris and Ingestion

Interactions between marine mammals and marine debris, including derelict fishing gear (as discussed in Section 4.4.7.3.2.2, 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, and sperm whales. On the United States West Coast, marine debris resulted in mortalities to 90 pinnipeds (the majority was California sea lions), two gray whales, and one each of the following species: humpback whale, minke whale, bottlenose dolphin, long-beaked common dolphin, and harbor porpoise (Carretta et al., 2016). Off San Diego from 2010 through 2014, there were six marine mammal entanglements in marine debris (four pinnipeds, two dolphins) from marine debris reported (Carretta et al., 2016).

4.4.7.3.6 Power Plant Entrainment

Coastal power plants use seawater as a coolant during power plant operation. Intakes into these plants can sometimes trap (i.e., entrain) marine animals that swim too close to the intake pipe. There were 97 marine mammal power plant entrainments (all pinnipeds) reported from San Diego, CA between 2010 and 2014 (Carretta et al., 2016).

4.4.7.3.7 Disease, Parasites, and Algae

Section 3.7.4.1.6.3 (Disease and Parasites) discusses the effects of disease and parasites in marine mammals. Just like humans, older animals are affected by disease and likewise can disease spread 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 (toxoplasmosis, hookworms, lungworms, and thorny-headed worms) to seals, sea lions, otters, and pinnipeds from feral cats.

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

Impacts of the Proposed Action are detailed in Section 3.7 (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 TTS (Level B harassment under the MMPA). For the PMSR, there are no mortalities or non-auditory injuries predicted from use of explosive stressors (see Section 3.7.5.4.1, Acoustic Stressors) or physical disturbance and strike stressors (see Section 3.7.5.4.2, Physical Disturbance and Strike Stressors Under Alternative 1 [Preferred Alternative]). Although minor behavioral impacts are possible from the remaining acoustic stressors (noise from air guns, weapons firing/launch/impact, aircraft, and vessels), energy stressors (in-water electromagnetic devices and high energy lasers), physical disturbance and strike stressors (in-water devices, military expended materials, and seafloor devices), entanglement stressors (wires and cables, decelerators/parachutes, and biodegradable polymers), ingestion stressors (munitions and military expended materials other than munitions), and secondary stressors; these stressors have *de minimis*, discountable, or negligible impacts, or no impacts and therefore would not contribute to cumulative impacts on marine mammals. This finding is consistent with previous recent documents (U.S. Department of the Navy, 2018a, 2018b), regulations, a Letter of Authorization from NMFS (83 FR 66849; December 27, 2018), and a recent Biological Opinion (National Marine Fisheries Service, 2018b) involving the same types of Navy activities and the same populations of protected marine mammals occurring in the PMSR Study Area.

The analysis presented in Section 3.7 (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 testing and training activities are those that are most abundant in the Study Area, primarily delphinid species (dolphins and small whales) that have stocks with tens of thousands of animals. From a cumulative perspective, any potential impacts on species with small populations, especially ESA-listed species, are of particular concern, and the Navy will consult with the NMFS, as required by Section 7(a)(2) of the ESA.

It is not anticipated that the Proposed Action will result in measurable impacts on marine mammal populations. The majority of the proposed activities are unit level training and small 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, testing and training 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 Navy 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 (U.S. Department of the Navy, 2017) and the regulatory conclusions from previous analyses by NMFS (National Marine Fisheries Service, 2015e; National Oceanic and Atmospheric Administration, 2013) are that the majority of Navy testing and training activities are not expected to have deleterious impacts on the fitness of any individuals or long-term consequences to populations of marine mammals.

4.4.7.4.1 Mortality

There is no mortality predicted by the Navy's modeling of the Proposed Action and none expected based on the past history of conducting testing and training activities in the PMSR Study Area. In addition, and although not factored into the modeling at PMSR, mitigation measures discussed in Chapter 5 (Standard Operating Procedures and Mitigation) are designed to avoid or reduce potential impacts of explosives, especially higher-order impacts such as injury and mortality. The acoustic analysis predicts no marine mammal species would be exposed to underwater pressure waves from explosive detonations that could lead to mortality or even non-auditory recoverable injury.

The other potential cause of a mortality or serious injury resulting from Navy's Proposed Action at PMSR would be the potential for a vessel strike to a marine mammal. Given that there is no record of a vessel strike to a marine mammal ever occurring during testing and training at PMSR and that the Navy vessel use will remain relatively constant, the potential for a vessel strike to occur in the future is unlikely. The potential for a vessel strike to occur is further reduced through implementation of standard operating procedures and mitigation. Based on historical records and the analysis presented in Section 3.7.5.2.3 (Vessels as a Strike Stressor), the Navy does not anticipate that any marine mammals would be struck by vessels engaged in testing and training activities in the Study Area.

4.4.7.4.2 Cumulative Impacts on Marine Mammals

As provided in detail in Section 3.7.4.1.6 (General Threats), fishery interactions, vessel strikes, and entanglement are leading causes of injury and direct mortality to marine mammals throughout the region of influence. Implementation of mitigation discussed in Chapter 5 (Standard Operating Procedures and Mitigation) would help avoid or reduce the risk for potential impacts that might occur under the Proposed Action could synergistically be associated with other actions (such as bycatch or commercial vessel strike) in the region of influence.

In their 2018 Biological Opinion for the adjacent SOCAL Range Complex (National Marine Fisheries Service, 2018b), NMFS determined that only acoustic stressors and explosive stressors could potentially result in harassment and/or the incidental taking of marine mammals from Navy training and testing activities and that none of the other stressors would result in significant adverse impacts or jeopardize the continued existence of any ESA listed marine mammals. In addition, NMFS determined that the vast majority of impacts expected from sonar exposure and underwater detonations are behavioral in nature, temporary and comparatively short in duration, relatively infrequent, and specifically not of the

type or severity that would be expected to be additive for the small portion of the stocks and species likely to be exposed, and they therefore would not contribute to cumulative impacts.

The aggregate impacts of other past, present, and reasonably foreseeable future actions are expected to result in significant impacts on marine mammal populations (including some ESA-listed) in the PMSR Study Area based on available data. These impacts are considered significant because the cumulative effects of vessel strikes, bycatch, and entanglement associated with other non-Navy actions are expected to result in relatively high rates of injury and mortality that could cause population declines in some species. While quantitative total estimates of marine mammal mortality from other non-Navy actions are not available, the minimum numbers of mortality and serious injuries leading to mortality for marine mammals are available from some sources including the latest five-year reporting periods by NMFS (Carretta et al., 2019; Helker et al., 2019). These sources report a total of 2,591 interactions resulting in a mortality to a marine mammal (Carretta et al., 2019; Helker et al., 2019). This included, for example in the two-year period between 2015 and 2016, a minimum of 133 fishery or marine debris entanglements involving humpback, gray, blue, fin, and killer whales populations off the U.S. West Coast (National Marine Fisheries Service, 2018a; National Oceanic and Atmospheric Administration, 2017b). Some of these interactions involved ESA-listed species. For sperm whales in the north Pacific from 2012 through 2016, there were an estimated six interactions with fishing gear resulting in serious injury (Helker et al., 2019). In 2018 alone off the U.S. West Coast, there were reports of entangled animals involving 34 ESA-listed humpbacks, 11 gray whales, one fin whale, one blue whale, and two that were unidentified (National Oceanic and Atmospheric Administration, 2019). In addition to entanglements, non-Navy vessel strikes are a source of injury and mortality to ESA-listed marine mammals. Within Alaska waters, there were a minimum of 28 marine mammal vessel strikes between 2012 and 2016 with 21 of these to humpback whales (Helker et al., 2019). For the U.S. West Coast between 2013 and 2017, there were 65 reported vessel strikes to marine mammals (Carretta et al., 2019). In 2016 and 2017 there were a minimum of seven vessel strikes to humpback whales along the U.S. West Coast involving either the Mexico DPS or the Central America DPS individuals (Carretta et al., 2019). In contrast to the minimum reported serious injuries and mortalities reported for other non-Navy actions and except for the remote possibility that a Navy vessel might strike an ESA-listed species, the Navy's analysis and modeling estimates no injury or mortality to any ESA-listed marine mammals within the Action Area.

Navy activities will add to the noise associated with other actions in the action area. As detailed previously, Navy use of the waterspace is a small fractional percentage of overall anthropogenic activity in the action area. All predicted impacts from Navy detonations at or near the water surface are relatively infrequent and not of the type of impact that would be expected to be additive for the small portion of the stocks and species likely to be exposed. It is unlikely that other, non-Navy actions and underwater explosions or sonar use in the Offshore Area would overlap in time and space because Navy activities are dispersed and the sound sources are intermittent. The routine use of non-military explosives at-sea corresponding with known fishing seasons or activity and identified as explosive marine mammal deterrents commonly known as "seal bombs" have been documented in waters off Alaska, Washington, and California from passive acoustic monitoring efforts since 2009 (Baumann-Pickering et al., 2013; Bland, 2017; Debich et al., 2014; Kerosky et al., 2013; Rice et al., 2015; Trickey et al., 2015; U.S. Department of the Navy, 2016; Wiggins et al., 2019). Seal bombs are intended to create a behavioral harassment to deter marine mammals, particularly pinnipeds, from preying upon catch and to prevent marine mammals from interacting and potentially becoming entangled with fishing gear (National Marine Fisheries Service, 2015c). At one monitoring site adjacent to Quinault Canyon (off the coast of Washington) these explosions identified as seal bombs were present during daylight hours 68

percent of the cumulative hours per week (Wiggins et al., 2017). Based on the number of explosions recorded over the past several years in Alaska, Washington, and Southern California (Baumann-Pickering et al., 2013; Bland, 2017; Emmons et al., 2019; Oleson & Hildebrand, 2012; Trickey et al., 2015; Wiggins et al., 2019), the use of seal bombs is much more prevalent than might be expected. For example, in the seven months from May to November 2013, over 24,000 explosions identified as seal bombs were recorded at a passive acoustic monitoring site (Site "M") off Long Beach, CA (Debich et al., 2015). Since this passive acoustic monitoring device only recorded a sample of the total time, it is reasonable to assume there were more than 24,000 seal bomb explosions in that seven-month period. By comparison, in the 12-month period from August 2012 to August 2013, there were fewer than 400 underwater explosions recorded that were a result of Navy training and testing in Southern California (Baumann-Pickering et al., 2013). The noise from these activities could combine with testing and training events to result in additive impacts over time to the marine mammals in the area. However, most of these other actions are not compatible with testing and training activities and are not likely to take place at the same time and proximate location.

The potential also exists for other non-Navy impacts from stressors such as ocean pollution, marine debris, or commercial industry noise to be additive or synergistic with Navy's impacts. The scale and pervasive spatial and temporal extent of those other non-Navy stressors are such that the Navy's Proposed Action should be insignificant and negligible. For example, as detailed in Section 3.7.4.1.6.2 (Commercial Industries), the vessel Traffic Separation Scheme lanes for the ports of Los Angeles/Long Beach run through the PMSR. Data from the ports of Los Angeles/Long Beach indicate there are, on average, in excess of approximately 7,000 commercial vessel transits per year associated with visits to just those ports (American Association of Port Authorities, 2017; McKenna et al., 2012; McKenna et al., 2015; Port of Los Angeles, 2017; U.S. Army Corps of Engineers, 2017). This large number of vessel port calls at Los Angeles/Long Beach does not account for a substantial number of additional commercial vessels transiting offshore of Point Mugu that may have stopped at or be bound for other major U.S. ports such as Seattle/Tacoma or San Francisco. Drilling and oil extraction also creates underwater noise and there are 43 leases in producing status in Southern California and in the nearshore waters of the Santa Barbara Channel in the central portion of the PMSR; there are already 15 active offshore oil and gas production facilities and another 7 farther to the south off the Long Beach area.

In summary, the current aggregate minimum known impacts of past and present actions and reasonably foreseeable future actions may result in impacts on most ESA-listed marine mammal species in the Study Area. Therefore, cumulative impacts on marine mammals would be significant without consideration of the impacts of the Navy's proposed activities. The Navy's proposed activities have the potential to contribute to and increase cumulative behavioral impacts, but the relative contribution of these impacts would be negligible and an insignificant contribution, if any, to the overall cumulative effects resulting from other past and present actions and reasonably foreseeable future actions.

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 further compound effects on a given individual already experiencing stress. However, with the implementation of standard operating procedures reducing the likelihood of overlap in time and space with other stressors, and the implementation of mitigation measures reducing the likelihood of impacts, the incremental stressors associated with the Proposed Action are not anticipated to be significant.

Furthermore, the regulatory process administered by NMFS, which includes stock assessments for all marine mammals and a seven-year review 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 that the Proposed Action have no more than a negligible impact on species or stocks, and that the Proposed Action imposes the least practicable adverse impact on the species. 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 after taking into account the effects of incidental take. These processes help to ensure that, through compliance with these regulatory requirements, the Navy's Proposed Action will not have a measurable effect on the resource.

4.4.8 Sea Turtles

4.4.8.1 Region of Influence

Based on the descriptions of sea turtle habitat preferences in Section 3.8.4.2 (Sea Turtles in the Study Area), specifically a species' preferred range of sea surface temperatures and tolerance for colder water temperatures, only leatherback and loggerhead sea turtles are expected to occur regularly in the Study Area in substantial numbers. Furthermore, large numbers of loggerhead sea turtles would only occur when anomalously warm sea surface temperatures occur in the Study Area, such as during the El Niño phase of the El Niño Southern Oscillation when warmer surface waters from the central Pacific enter the Study Area and coastal upwelling of cooler waters is suppressed. The El Niño phase occurs cyclically, typically every few years rather than annually, and varies in strength and duration, which likely influences the occurrence and abundance of loggerheads in the Study Area (see Section 3.8.4.2.2.1, Habitat and Geographic Range, for more information).

The analysis of impacts is focused to the potential effects of the proposed testing and training activities on leatherback sea turtles and to a lesser extent on loggerhead sea turtles, given that their less frequent occurrence in the Study Area would reduce any potential impacts. No impacts on green, hawksbill, and olive ridley sea turtles are expected due to their rare or extralimital occurrence in the Study Area.

4.4.8.2 Impacts of Other Actions

Section 3.8.4.1.5 (General Threats) discusses the specific stressors within the affected environment that impact sea turtle populations in the Study Area, which include water quality; commercial industries (e.g., commercial fisheries, oil and gas development, shoreline development, and recreation); disease and parasites; invasive species; climate change; and marine debris. Potential impacts from actions that

affect sea turtles include mortality, injury, disturbance, and reduced fitness, including reproductive, foraging, and predator avoidance success.

The activities as identified and briefly described in Table 4.2-1 create multiple stressors that have the potential to impacts sea turtles in the Study Area. Activities using vessels have the potential to disturb or strike a sea turtle, created underwater noise that may limit the ability for sea turtles to detect biologically relevant sounds, and emit pollutants into the marine environment (Table 4.2-2). Many of the activities listed in Table 4.2-1 also contribute underwater noise from sources other than vessels, including noise from explosives used for oil rig removal, seismic surveys, construction activities, and military operations. Bycatch and entanglement are among the main threats to sea turtle populations in the Study Area and worldwide. These two stressors are chiefly associated with fishing, but entanglement stressors are by other activities as well, including military activities. Marine debris, particularly plastic debris, is emerging as the most widespread and perhaps most damaging threat to sea turtles because of its global impacts on the marine ecosystem. While Table 4.2-1 discusses these stressors for individual actions, their aggregate impacts specific to sea turtles are described in detail in Section 3.8.4.1.5 (General Threats).

The U.S. Navy considered all potential stressors resulting from the proposed testing and training activities and identified the following stressors as potentially affecting sea turtles (specifically leatherback and loggerhead sea turtles) in the Study Area: explosives, physical disturbance and strike, ingestion, and entanglement.

Past and present commercial fishing activities have had a profound global effect on the recovery and conservation of sea 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. In the Pacific, NMFS requires measures (e.g., gear modifications, changes to fishing practices, and time/area closures) to reduce sea turtle bycatch in the California-based pelagic longline fisheries and the California/Oregon drift gillnet fishery.

Maritime vessel 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 (Hazel et al., 2007; Lutcavage et al., 1997). Some vessel disturbances or 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. While increased risks come with increased vessel traffic, risks of vessel strikes could be minimized by education and awareness, ship-speed reduction measures, and maritime traffic planning and management.

As summarized in Table 4.2-1 and Table 4.2-2, multiple actions introduce pollutants from numerous sources into the marine environment. Sections 3.8.4.1.5.1 (Water Quality) and 3.8.4.1.5.6 (Marine Debris) provide 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 are known to mistake debris for prey; one study found 37 percent of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al., 2009). Narazaki et al. (2013) noted an

observation of a loggerhead exhibiting hunting behavior on approach to a plastic bag, possibly mistaking the bag for a jellyfish. Even small amounts of plastic ingestion can cause an obstruction in a sea turtle's digestive track and subsequent mortality (Bjorndal et al., 1994; Bjorndal, 1997). In 2014, Schuyler et al. (2014) reviewed 37 studies of debris ingestion by sea turtles, showing that young oceanic sea turtles are more likely to ingest debris (particularly plastic) than sea turtles foraging in shallow coastal waters, and that oceanic green and leatherback sea turtles are the most at risk for lethal and sub-lethal impacts from ingesting debris. Other types of marine debris, including derelict fishing gear and cargo nets, can entangle and drown sea turtles in all life stages, but larger juvenile and adult sea turtles are particularly susceptible to entanglement.

Ocean noise as a general stressor in modern oceans is described in Table 4.2-2. Noise in the ocean environment is generated by both natural and anthropogenic sources. Natural sources include waves crashing and rain impacting the water's surface. Anthropogenic noise in the ocean is generated from a variety of sources that occur throughout the Study Area. These include 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 windfarm construction operation); and scientific research (including sounds from air guns, sonar, telemetry). The military activities addressed in Table 4.2-1 include various testing and training activities that also contribute vessel noise, underwater and surface explosions, and sonar. Sonar would not be used in the Proposed Action, but explosives would be detonated near the water's surface during some testing and training activities. Although various other military testing and training activities conducted along the U.S. West Coast involve explosives, many potential injury impacts from these activities are generally mitigated by monitoring a predefined area around the detonation site.

Based on knowledge of their sensory biology (Bartol & Musick, 2003; Bartol & Ketten, 2006; Ketten & Moein-Bartol, 2006; Levenson et al., 2004), 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 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 minimal role in how a sea turtle gathers information about its environment.

Nonetheless, as discussed in Section 3.8.5.2.1 (Explosives), sea turtles could experience a range of impacts from explosive and other impulsive sources including lethal and non-lethal injury, permanent or temporary hearing impairment, changes in behavior, physiological stress, and auditory masking.

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

The analysis presented in Section 3.8 (Sea Turtles) concludes that some stressors associated with the Proposed Action could affect individual leatherback and loggerhead sea turtles occurring in the Study Area, but impacts are not expected to decrease the overall fitness of individual sea turtles to forage for prey, engage in reproductive behaviors, or migrate. Neither short-term nor long-term impacts on leatherback and loggerhead populations are anticipated. Refer to Table 3.8-2 for a summary of potential impacts from explosives, physical disturbance and strike associated with vessel use and military

expended materials, ingestion stressors, and entanglement risk due to the Proposed Action. Cumulative impacts on listed species, including leatherback and loggerhead sea turtles, are of particular concern. Mitigation measures designed to avoid or reduce potential impacts are discussed in Chapter 5 (Standard Operating Procedures and Mitigation).

4.4.8.4 Cumulative Impacts on Sea Turtles

Leatherback and loggerhead sea turtles occurring in the Study Area are ESA-listed species and part of larger populations occurring in the Pacific Ocean and subject to the variety of threats present throughout their oceanic ranges. The leatherback sea turtles that occur in the Study Area undertake multiple trans-Pacific migrations throughout their long lifetimes encountering anthropogenic threats that are pervasive, like marine debris, and localized, like poaching on nesting beaches. The loggerhead sea turtles that move into the Study Area during anomalously warm water conditions, likely spend time in the central North Pacific and occur more frequently off the coast of Mexico south of the Study Area. Both sea turtle species are exposed to the aggregate impacts of past and current human activities throughout these wide-ranging areas. Bycatch, vessel strikes, coastal land development, and marine debris are the leading causes of mortality and population decline for many sea turtles, and, although mitigated or reduced to the greatest extent practicable, the Proposed Action could result in stress, behavioral reactions, injury, and mortality to leatherback and loggerhead sea turtles from explosives, strikes or disturbance from vessel or expended materials, ingestion, or entanglement. Implementation of mitigation measures discussed in Chapter 5 (Standard Operating Procedures and Mitigation) would help reduce, but not absolutely eliminate, the potential for impacts, and any injury and mortality that might occur under the Proposed Action could be additive to injury and mortality associated with other actions throughout the ranges of each species.

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 that impacts from the Proposed Action could make an individual more susceptible to other stressors. For example, if a Navy vessel were to strike 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, depending on many factors, such as distance from and intensity of the stressor, a sea turtle near a detonation 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 both in the Study Area and throughout their ranges. The Proposed Action could contribute incremental stressors to individuals, which would further compound effects on a given individual already experiencing stress. However, with the implementation of standard operating procedures reducing the likelihood of overlap in time and space with other stressors and the limited distribution of leatherbacks and the infrequent occurrence of loggerheads in the Study Area reducing the likelihood of encounter with a stressor, any incremental impacts associated with the Proposed Action are not anticipated to significantly contribute to overall cumulative impacts on individual leatherbacks and loggerheads or to leatherback and loggerhead populations.

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 contribution to cumulative impacts by the Navy's Proposed Actions will be imperceptible.

4.4.9 Marine Birds

4.4.9.1 Region of Influence

Although not uniformly distributed, the region of influence for cumulative impacts on marine birds includes shorelines and adjacent nearshore coastal habitats, surface water, and airspace throughout the Study Area within the Southern California Bight. The majority of species encountered in the Study Area are marine birds (waterbirds, including seabirds, shorebirds, and waterfowl) that use Study Area habitat for breeding, foraging, roosting, and migration. More than 195 species of birds use coastal or offshore aquatic habitats in the Southern California Bight, and several seabirds nest on NBVC Point Mugu, San Nicolas Island, and the other Channel Islands.

4.4.9.2 Impacts of Other Actions

All projects in the Study Area (detailed previously in Table 4.2-1) that affect ESA-listed species, species protected under the Migratory Bird Treaty Act (and clarified under the Migratory Bird Rule and EO 13186), and U.S. Fish and Wildlife Service Birds of Conservation Concern, are subject to regulatory processes and permitting that provide a landscape management perspective of population trends and conservation measures. ESA-listed species are described in Table 3.9-1. Despite numerous protective laws and regulations, seabirds are some of the most threatened marine animals in the world, with 28 percent of species at risk of extinction and approximately half of the 346 species of seabirds that depend on ocean habitats experiencing population declines (International Union for Conservation of Nature, 2012).

Birds are susceptible to multiple stressors, and the susceptibility of many species may be enhanced by additive or synergistic effects of multiple stressors. Section 3.9.5 (Environmental Consequences) includes an extensive discussion of the existing stressors to bird populations in the Study Area, and all activities listed in Table 4.2-1 and stressors described in Table 4.2-2 contribute one or more of these stressors. Other activities in the Study Area that could have direct impacts on birds include wind energy development (strike mortality and forage displacement); noise, light, and water pollution (direct impacts from major spills, indirect impacts from habitat loss and degradation, and marine debris); commercial fishing (loss of food source, strike, and entanglement); climate change (altered prey distributions); coastal land development (disturbance; collisions; and loss of breeding, nesting, or foraging habitat); and operation of ports and terminals or military testing and training areas (disturbance). Commercial fisheries are considered the most serious threat to the world's seabirds (International Union for Conservation of Nature, 2012). Most of the birds in the Study Area are relatively long-lived and wide-ranging seabirds, making it likely that individuals would be exposed to multiple activities and stressors over the course of their lifespans.

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

The analysis in Section 3.9.5 (Environmental Consequences) indicates that birds could potentially be impacted by in-air acoustic stressors (weapons/ordnance firing, aircraft and vessel noise), explosives

(shock wave, sound, fragments), energy stressors (electromagnetic devices, lasers, microwave technology), physical disturbance and strikes (aircraft, aerial targets, vessels and in-water devices, military expended materials), ingestion (military expended materials), and secondary stressors (impacts on habitat and prey). Some stressors, including explosions, physical strikes, and ingestion of military expended materials, could result in injury and mortality. In general, however, the potential for testing or training activities to result in bird injury or mortality is considered low to discountable, depending on the specific testing or training activity being considered. The vast majority of impacts are expected to be nonlethal; the most likely responses to testing and training activities are short-term behavioral or physiological, such as alert response, startle response, cessation of feeding, fleeing the immediate area, and a temporary increase in heart rate. Recovery from the impacts of most stressor exposures that elicit such short-term behavioral or physiological responses would occur quickly. To minimize the risk of potential impacts, the Navy has established mitigation measures for birds (Chapter 5, Standard Operating Procedures and Mitigation).

Impacts that elicit behavioral or physiological impacts can combine with other stressors experienced elsewhere and result in decreased fitness of marine birds as they use and fly through the Study Area. However, most of the proposed activities would be 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 testing or training activities is low. Likewise, for most stressors associated with the Proposed Action, impacts would be short term and localized, and physiological recovery would occur quickly for any individuals experiencing a stress response. It is unlikely that testing and training activities would influence nesting because most activities (apart from launches at San Nicolas Island Building 807 Launch Complex and NBVC Point Mugu launch areas such as Alpha, Bravo, Charlie, and Nike-Zeus pads and Building PM-55) take place over water and away from nesting habitats on land. Additionally, multiple measures are in place to reduce the potential for impacts on nesting birds due to pre-testing activity surveys, monitoring, and avoidance of nest locations.

4.4.9.3.1 Cumulative Impacts on Birds

Although other past, present, and reasonably foreseeable future actions individually and collectively cause disturbance and mortality of birds across the ocean landscape, the Proposed Action is not expected to substantially contribute to diminishing marine bird abundance, induce widespread behavioral or physiological stress, or interfere with recovery from other stressors. It is anticipated that the incremental contribution of the Proposed Action, when added to the impacts of all other past and present actions, would not result in measurable additional impacts on marine birds in the Study Area or beyond. Several potential future actions have the potential for impacts on marine birds, however, these projects will undergo the environmental review process prior to construction or implementation. The Proposed Action may affect individual marine birds if they are present in time and space during testing and training activities; however, no long-term or population-level impacts are anticipated to occur from the Proposed Action.

4.4.10 Cultural Resources

4.4.10.1 Region of Influence

As noted, prehistoric archaeological sites are distributed throughout SNI, though they consist primarily of middens, which contain an abundance of fish, marine mammal, and shellfish remains and tools used to prepare the marine resources for consumption. Other prehistoric sites on SNI include habitation sites, lithic reduction areas, rock art, isolated hearths, and human burials. During consultation for another

undertaking on SNI, the Pechanga Tribe provided information to the Navy identifying two additional cultural resources with the potential of being historic properties. The two potential historic properties identified by Pechanga are a Traditional Cultural Property and an historic district. The Pechanga assert that each archaeological site on the island is a contributing element to the overall historic district.

4.4.10.2 Impacts of Other Actions

Continued use of the Land Impact Site has the potential to affect terrestrial archaeological sites in and in proximity to it. Portions of CA-SNI-168 within the Land Impact Site were mitigated by a data recovery program that was conducted in compliance with federal standards (U.S. Department of the Navy, 1998) and included consultation with the appropriate tribes (e.g., Pauma Band of Luiseño Indians, Pechanga Band of Luiseño Indians, Rincon Band of Luiseño Indians, Santa Ynez Band of Chumash Indians). Potential impacts on any remaining cultural materials at these sites could occur and result in loss of integrity, damage, physical alteration, and destruction. Sites outside the Area of Potential Effect (APE) would not be expected to be impacted by missile debris. No effects would occur to these resources.

Protection procedures for sites CA-SNI-168 and CA-SNI-169 were detailed in the 1998 Environmental Assessment for the Standoff Land-Attack Missile site (U.S. Department of the Navy, 1998). In addition, monitoring and corrective clean-up actions following a test also would minimize effects to archaeological sites in proximity to the APE. Standard Operating Procedures for Inadvertent Discovery of Cultural Resources, National Historic Preservation Act, and Native American Graves Protection and Repatriation Act compliance procedures, described in Chapter 5 (Standard Operating Procedures and Mitigation), and in the Integrated Cultural Resources Management Plan for SNI (U.S. Department of the Navy, 2019), were developed to address and minimize potential effects to terrestrial cultural resources on SNI, including those in and in proximity to the Land Impact Site APE (i.e., SNI-168 & SNI-169).

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

As discussed in Section 3.10 (Cultural Resources), potential impacts on cultural resources are limited to missile and target debris falling onto land or into the ocean and affecting shipwrecks and submerged archaeological resources, and to sonic booms. The proposed action would not result in disturbance of known underwater archaeological sites or shipwrecks. At NBVC Point Mugu, there would be no adverse effect to Building PM-55, which is considered to be an exceptionally significant Cold War-era resource and was determined eligible for listing on the National Register of Historic Places, since the actions would be consistent with actions that already occur there regularly. Implementation of the proposed action or the action alternatives would not adversely impact cultural resources.

4.4.10.3.1 Cumulative Impacts on Cultural Resources

The Navy's cultural resource management program at NBVC Point Mugu and SNI assures that potentially significant cultural resources are protected and are not subject to incremental degradation. Further, the Integrated Cultural Resources Management Plan for each location provides procedures for long-term protection and management of cultural resources. Therefore, the proposed action, in conjunction with other past, present, and foreseeable activities, would not result in cumulative impacts on cultural resources.

4.4.11 Socioeconomic Resources

4.4.11.1 Region of Influence

The analysis in Section 3.11 (Socioeconomic Resources) indicates that the Proposed Action is not expected to result in long-term impacts on socioeconomic resources in the Study Area, including

transportation and shipping (both commercial and military), commercial and recreational fishing, subsistence fishing, and tourism.

4.4.11.2 Impacts of Other Actions

Secondary or indirect cumulative impacts on socioeconomic resources are dependent on the availability of other marine resources (e.g., target fish species). Population-level impacts on fishes, marine mammals, and invertebrates, which are the primary resources indirectly affecting socioeconomics in the Study Area, are not anticipated. No cumulative impacts on commercial transportation and shipping are anticipated because commercial vessels and aircraft are primarily transiting through the Study Area along well-established navigable routes or air traffic corridors that are avoided by Navy vessels and aircraft conducting testing and training activities.

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

Temporary and short-duration (hours) impacts may occur from limits on accessibility to marine areas used by the public (e.g., for fishing and tourism); however, most limitations on accessibility are temporary and would be lifted upon completion of testing and training activities. If in the general vicinity of a testing or training activity, the public may intermittently hear airborne noise from transiting ships or aircraft overflights. These occurrences would be of short duration (seconds to minutes) and infrequent; other than transiting vessels and aircraft, most Navy testing or training that generates airborne noise occurs farther from shore than most recreational and tourism activities. Similarly, impacts on socioeconomic resources from physical disturbances and strikes are unlikely, given that most testing and training activities that pose a risk of a physical disturbance or strike (e.g., activities using munitions or military expended materials) occur farther from shore than most fishing or tourism activities. The Navy's standard operating procedures also require that an area is clear of non-participating vessels and aircraft before an activity using munitions or expended materials occurs. The Navy issues a notice to mariners (NTM) and a notice to airmen (NOTAM) 24 hours in advance to allow vessels and aircraft to choose alternative routes and relocate activities to minimize interactions and impacts from Navy activities.

4.4.11.3.1 Cumulative Impacts on Socioeconomics

Temporary limitations on accessibility to marine areas and the infrequent exposure to airborne noise would not result in a direct loss of income, revenue or employment, resource availability, or quality of experience. Short-term impacts, should they occur, would not contribute incrementally to cumulative impacts on the socioeconomic resources in the Study Area. Therefore, further analysis of cumulative impacts on socioeconomic resources is not warranted.

4.4.12 Recreation

The analysis in Section 3.12 (Recreation) indicates that the Proposed Actions would not result in long-term impacts on recreation in the PMSR, including recreational boating, recreational fishing, diving, kayaking, and bird and whale watching. Minimal temporary and short-term impacts may occur from limits on accessibility to marine areas used by the public; however, accessibility restrictions would be lifted upon completion of testing and training activities and conditions would return to normal within hours of being initiated. The Navy issues an NTM and a NOTAM 24 hours in advance to allow vessels and aircraft to choose alternative routes and relocate activities to minimize interactions and impacts from Navy activities. The public may intermittently hear noise from transiting ships or aircraft overflights if they are in the general vicinity of a testing or training activity, but these occurrences would be infrequent, and other than transiting, most Navy testing and training activities occur farther from shore than most recreational activities. Temporary limitations on accessibility to marine areas and the

infrequent exposure to noise would not result in a direct loss of resource availability or quality of recreating experience. Short-term impacts, should they occur, would not contribute incrementally to cumulative recreational impacts. Therefore, further analysis of cumulative impacts on recreation resources is not warranted.

4.4.13 Sea and Air Space

The analysis in Section 3.13 (Sea and Air Space) indicates that the Proposed Action would not result in long-term impacts on commercial transportation resources in the Study Area, including commercial transportation and shipping, and commercial and private aviation.

Both military and non-military (e.g., commercial and recreational) entities have been sharing use of the airspace comprising, and the ocean surface underlying the Sea Range for more than 60 years. Both entities have established an operational coexistence consistent with federal, state, and local plans and policies and compatible with each interest's varying objectives. Temporary and short-duration (hours) impacts may occur from limits on accessibility to marine areas used by the public; however, most limitations on accessibility are temporary and would be lifted upon completion of testing and training activities. The Navy issues an NTM and a NOTAM 24 hours in advance to allow vessels and aircraft to choose alternative routes and relocate activities to minimize interactions and impacts from Navy activities.

Navy vessels account for only about 9 percent of the vessel traffic on the PMSR. The PMSR is open to commercial and private vessel traffic and is widely used by non-Navy vessels. Most Navy testing and training, aside from target launches from NBVC Point Mugu, occurs farther from shore than most commercial and recreational vessel activity. Similarly, air traffic is fully managed by the FAA to minimize impacts on commercial and recreational transit of the PMSR. The Navy's standard operating procedures for testing and training require that an area is clear of non-participating vessels and aircraft before an activity using potentially hazardous systems and munitions occurs.

Testing and training activities on the PMSR are not conducted until non-participant vessels and aircraft are clear of the area in accordance the established range clearance procedures previously described. Given the advance notice system, commercial and private sea and airspace use of the PMSR impacts from testing and training activities are less than significant.

4.4.14 Public Health and Safety

All testing and training activities would be accomplished by technically qualified personnel and would be conducted in accordance with applicable Navy, other federal, and state safety standards and requirements. The Navy issues an NTM and a NOTAM 24 hours in advance to allow vessels and aircraft to choose alternative routes and relocate activities to minimize interactions and impacts from Navy activities. The analysis presented in Section 3.14 (Public Health and Safety) indicates that the Proposed Action is not expected to result in impacts on public health and safety and thus would not contribute incrementally to or combine with other impacts on health and safety within the PMSR. Therefore, further analysis of cumulative impacts on public health and safety is not warranted.

4.5 Summary of Cumulative Impacts

The Proposed Action would contribute incremental effects on the ocean ecosystem, which is already experiencing and absorbing a multitude of stressors to a variety of receptors. In general, it is not anticipated that the implementation of the Proposed Action would have a meaningful contribution to the ongoing stress or cause significant collapse of any particular marine resource, but it would

contribute minute impacts on resources that are already experiencing various degrees of interference and degradation. It is intended that the mitigation measures described in Chapter 5 (Standard Operating Procedures and Mitigation) will further reduce the potential impacts of the Proposed Action in such a way that they are avoided to the maximum extent practical and to ensure that impacts do not become cumulatively significant to any marine resource.

Marine mammals and sea turtles are the primary resources of concern for cumulative impacts analysis; however, the incremental contributions of the Proposed Action are not anticipated to meaningfully contribute to the decline of these populations or affect the stabilization and recovery thereof. The Navy proposes to implement standard operating procedures that reduce the likelihood of overlap of Navy stressors in time and space with non-Navy stressors, and mitigation measures as described in Chapter 5 (Standard Operating Procedures and Mitigation) reduce the risk of direct impacts of the Proposed Action to individual animals. The aggregate impacts of past, present, and other reasonably foreseeable future actions (Tables 4.2-1 and 4.2-2) have resulted in significant impacts on some marine mammal and all sea turtle species in the Study Area. However, the decline of these species is chiefly attributable to other stressors in the environment, including the synergistic effect of bycatch, entanglement, vessel traffic, ocean pollution, recreation and tourism, coastal zone development, and climate change. The analysis presented in this Chapter 4 (Cumulative Impacts) and Chapter 3 (Affected Environment and Environmental Consequences) indicates that the incremental contribution of the Proposed Action to cumulative impacts on air quality, sediments and water quality, marine habitats, marine vegetation, marine invertebrates, marine fishes, marine birds, cultural, recreation, socioeconomic resources, sea and airspace, and public health and safety would not significantly contribute to cumulative stress on those resources.

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