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3.3 HAZARDOUS MATERIALS AND WASTES

3.3.1 Introduction

Hazardous materials addressed in this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) (hereafter referred to as "EIS/OEIS") are broadly defined as substances that pose a substantial hazard to human health or the environment by virtue of their chemical or biological properties. The purpose of evaluating hazardous materials and hazardous wastes is to determine whether they pose a direct hazard to individuals or the environment; whether fresh or marine surface waters, soils, or groundwater would be contaminated; and whether waste generation would exceed regional capacity of hazardous waste management facilities.

In general, the degree of hazard posed by these materials is related to their quantity, concentration, bioavailability, or physical state. Hazardous materials are often used in small amounts in high-technology weapons, ordnance, and targets because they are strong, lightweight, reliable, long-lasting, or low cost. Hazardous materials are also required for maintenance and operation of equipment used by the Navy in training activities. These materials include petroleum products, coolants, paints, adhesives, solvents, corrosion inhibitors, cleaning compounds, photographic materials and chemicals, and batteries.

A hazardous waste may be a solid, liquid, semisolid, or contained gaseous material that alone or in combination may (1) cause, or significantly contribute to, an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or (2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous wastes are managed under the Resource Conservation and Recovery Act (RCRA), 42 United States Code (U.S.C.) § 6901 et seq.

For purposes of air, sea, or land transportation, the United States (U.S.) Department of Transportation defines a hazardous material as a substance or material that is capable of posing an unreasonable risk to health, safety, and property when transported in commerce. These materials include hazardous substances, hazardous wastes, and marine pollutants.

3.3.2 Regulatory Framework

Hazardous materials and wastes are regulated by several Federal laws and regulations. The relevant laws include RCRA, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Toxic Substances Control Act (TSCA), the Hazardous Materials Transport Act, the Emergency Planning and Community Right-to-Know Act (EPCRA), and the Oil Pollution Act of 1990 (OPA). Together, the regulations adopted to implement these laws govern the storage, use, and transportation of hazardous materials and wastes from their origin to their ultimate disposal. The recovery and cleanup of environmental contamination resulting from accidental releases of these materials also are addressed in the regulations. State of California laws and regulations generally implement Federal requirements, but broaden their application or impose additional regulatory requirements in some areas.

3.3.2.1 Federal Laws and Regulations

3.3.2.1.1 Resource Conservation and Recovery Act

Hazardous wastes are defined by the Solid Waste Disposal Act, as amended by RCRA, which was further amended by the Hazardous and Solid Waste Amendments. RCRA specifically defines a hazardous waste as a solid waste (or combination of wastes) that, due to its quantity, concentration, or physical, chemical, or infectious characteristics, can cause or significantly contribute to an increase in mortality. RCRA further defines a hazardous waste as one that can increase serious, irreversible, or incapacitating reversible illness or pose a hazard to human health or the environment when improperly treated, stored, disposed of, or otherwise managed. A solid waste is a hazardous waste if it is not excluded from regulation as a hazardous waste or if it exhibits any ignitable, corrosive, reactive, or toxic characteristics (40 Code of Federal Regulations [C.F.R.] Part 261).

In 1997, USEPA published its Final Military Munitions Rule (MMR) (40 C.F.R. § 266.200-.206). The MMR identifies when conventional and chemical military munitions become hazardous wastes under RCRA, and provides for their safe storage and transport. Under the MMR, military munitions include, but are not limited to, the following items:

- Confined gaseous, liquid, and solid propellants
- Explosives
- Pyrotechnics
- Chemical and riot agents
- Smoke canisters

The MMR defines training; Research, Development, Test, and Evaluation (RDT&E); and clearance of Unexploded Ordnance (UXO) and munitions fragments on active or inactive ranges as normal uses of the product. When military munitions are used for their intended purpose, they are not considered to be a solid waste for regulatory purposes. Under the MMR, wholly inert items and nonmunitions training materials are not defined as military munitions. These materials are not excluded from regulation as hazardous wastes under RCRA.

Under RCRA, hazardous materials are considered solid wastes, and thus fall under the definition of hazardous wastes, if they are used in a manner constituting disposal rather than for their intended purpose. Military munitions become subject to RCRA when transported off-range for storage, reclamation, treatment, disposal; if buried or land filled on- or off-range; or if they land off-range and are not immediately rendered safe or retrieved. Transportation, storage, and disposal of these items are governed by RCRA.

3.3.2.1.2 Comprehensive Environmental Response, Compensation, and Liability Act

Under CERCLA, as amended by the Superfund Amendments and Reauthorization Act, a hazardous substance is defined as any substance that, due to its quantity, concentration, or physical and chemical characteristics, poses a potential hazard to human health and safety or to the environment. CERCLA has established national policies and procedures to identify and clean up sites contaminated by hazardous substances.

3.3.2.1.3 Toxic Substances Control Act

TSCA (15 U.S.C. 2601 et. seq.) requires that, prior to manufacturing a new substance which is to become an article of commerce, a facility must file a Pre-Manufacture Notice with the U.S. Environmental Protection Agency (USEPA) characterizing the toxicity of the substance. TSCA also regulates the disposal of polychlorinated biphenyls (PCBs).

3.3.2.1.4 Emergency Planning and a Community Right-to-Know Act

EPCRA requires Federal, state, and local governments and industry to report on their use of hazardous and toxic chemicals. Access to this information contributes to improvements in chemical safety and protection of local communities.

3.3.2.1.5 Oil Pollution Act of 1990

OPA requires oil storage facilities and vessels to submit plans to the Federal government describing how they will respond to large, unplanned releases. In 2002, the Oil Pollution

Prevention regulations were amended by the Oil Pollution Prevention and Response; Non-Transportation-Related Onshore and Offshore Facilities; Final Rule (40 C.F.R. Part 112). This Rule requires Spill Prevention, Control, and Countermeasure (SPCC) Plans and Facility Response Plans. These plans outline the requirements to plan for and respond to oil and hazardous substance releases. Oil and hazardous releases would be reported and remediated in accordance with current Navy policy.

3.3.2.2 State Laws and Regulations

The Navy complies with applicable state regulations under Executive Order (EO) 12088, Federal Compliance with Pollution Control Standards; Department of Defense Directive 4165.60, Solid Waste Management; and Navy guidelines for hazardous materials and wastes management.

At the state of California (State) level, the agency with general authority over hazardous materials and wastes is the California Environmental Protection Agency (Cal-EPA). Within Cal-EPA, the Department of Toxic Substances Control (DTSC) is responsible for the use, storage, transport, and disposal of hazardous materials. Cal-EPA delegates much of its responsibility for hazardous materials management, however, to local governments under the Certified Unified Program Agency (CUPA) program.

State law requires communities to form CUPAs to manage the acquisition, maintenance, and control of hazardous materials in their jurisdictions. In Southern California, CUPAs have typically formed on a county-by-county basis. Navy ships operating in the SOCAL OPAREAs typically dock in San Diego, while San Clemente Island (SCI) is within Los Angeles County. In San Diego County, the CUPA is the San Diego Department of Environmental Health (DEH) , which is responsible for hazardous materials and hazardous wastes regulation. In Los Angeles County, the County Fire Department is the CUPA. State hazardous materials and hazardous wastes laws are summarized below.

Table 3.3-1: State of California Laws

Law / Regulation	Description
Hazardous Materials Release Response Plans and Inventory Act	Requires facilities using hazardous materials to prepare Hazardous Materials Business Plans (Title19, California Code of Regulations [CCR] Section 2620 et seq.)
Hazardous Waste Control Act	Regulates the generation, transportation, storage, treatment, and disposal of hazardous materials (Title 22, CCR Section 66260 et seq.)
Safe Drinking Water and Toxic Enforcement Act	Regulates the discharge of contaminants to groundwater (California Government Code, Chapter 7)
Emergency Services Act	Similar to the Federal Emergency Planning and Community Right-to-Know Act (Title 27, CCR)

3.3.3 Affected Environment

3.3.3.1 Southern California Operating Areas

The condition of the Affected Environment includes past and present impacts from natural and man-made pollutants and hazardous materials. As described more fully in Section 3.4, below, open ocean areas are typically considered to be relatively free of hazardous materials and hazardous wastes. Hazardous materials are transported on the ocean, however, as cargoes and as fuel, lubricants, and cleaning and maintenance materials for marine vessels and aircraft. Ships are basically industrial facilities that generate small to moderate amounts of hazardous wastes during maintenance and operations; these materials typically are stored onboard and off-loaded at the next port. Infrequently, large hazardous materials leaks and spills, especially of petroleum products, have fouled the marine environment and adversely affected marine life. No quantitative information is available on the overall types and quantities of hazardous materials present in the SOCAL OPAREAs at a given time, nor on their distribution among the various categories of vessels.

Navy vessels present in the SOCAL OPAREAs represent a small fraction of the overall commercial and recreational boat traffic and, correspondingly, account for only a small fraction of the hazardous materials present in the open ocean areas of the Southern California Bight (SCB). As described above, Navy training activities in open ocean areas involve the use of fuel, lubricants, explosives, propellants, batteries, oxidizers, and other hazardous substances. The Navy makes every effort to minimize its use of hazardous materials during training, and recovers and reuses unexpended training materials to the maximum extent practicable.

Most of the hazardous materials released and hazardous wastes generated in the SOCAL OPAREAs by the Navy result from ship operations. Shipboard hazardous wastes are containerized and stored onboard, off-loaded while in port, and disposed of in accordance with state and Federal laws and Navy regulations. Gunnery exercises expend large quantities of rounds, most of which are not high explosive. Missile firings introduce small amounts of spent rocket motor fuel into the ocean. Target drones and unmanned aerial vehicles could release small amounts of fuel, lubricants, and battery chemicals into the marine environment, but normally are recovered unless they are hit by a missile. Hazardous training materials left unrecovered in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

3.3.3.1.1 Current Mitigation Measures

Shipboard Management of Hazardous Materials

Environmental compliance policies and procedures applicable to operations ashore are defined in the Chief of Naval Operations' Instructions (OPNAVISNT 5090.1C), along with environmental compliance polices and procedures applicable to shipboard operations afloat. These agency instructions reinforce the Clean Water Act's (CWA) prohibition against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nautical miles (nm) (371 kilometers [km]). These instructions include stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements. Navy ships are required to conduct activities at sea in a manner that minimizes or eliminates any adverse impacts on the marine environment. The Consolidated Hazardous Material Reutilization and Inventory Management Program (CHRIMP) Manual also provides information on management of hazardous materials for both afloat and ashore. These documents provide a comprehensive compilation of procedures and requirements that are mandated by law, directive, or regulation. These documents have a compliance orientation to ensure safe and efficient control, use, transport, and disposal of hazardous waste. Any hazardous waste generated onboard ships will be stored in approved containers. The waste will be offloaded for proper disposal within 5 working days of arrival at a U.S. Navy port.

There are primarily two documents that provide guidelines on managing hazardous wastes in the SOCAL OPAREAs:

- Commander, Navy Region Southwest (CNRSW) Waste Management Plan and associated guidance documents. This plan covers Naval Base Coronado, Naval Base San Diego, and Naval Base Point Loma.
- CNRSW Explosive Hazardous Waste Management Plan. This plan covers all bases under CNRSW Area of Responsibility.

Storage

Navy ships are not allowed to discharge overboard untreated, used, or excess hazardous materials generated aboard ship within 200 nm (370 km) of the coast. Ships must retain used and excess hazardous materials onboard for shore disposal.

Recycling

Recycling is the reuse or reclamation of previously used materials that would become wastes and require disposal if not recycled. An aggressive recycling program is an important part of the Navy's Pollution Prevention Program. The Navy has an active Pollution Prevention Program that applies to all aspects of its activities. It is Navy policy to conduct its facility management and acquisition programs so as to reduce to the maximum extent possible the quantity of toxic chemicals entering the environment. Pollution prevention is not pollution control, but a comprehensive set of practices that reduce the volumes of wastes to be treated or transferred to the environment. The fundamental tenet of the Navy's Pollution Prevention Program is the reduction of hazardous materials and wastes at their source. This results in less hazardous waste for all waste streams. Pollution prevention practices include:

- Raw material substitution,
- Product reformulation,
- Process redesign or modification,
- Improved operation and maintenance, and
- Aggressive recycling programs.

Many of the activities are research and development in the weapons systems acquisition process, and these activities must be compliant with the overall Department of Defense (DoD) guidance on pollution prevention during weapons acquisition. DoD Instruction 5000.2-R mandates specific weapons acquisition policies and procedures. Pollution prevention requirements are covered by these regulations and are directive in nature to the military services. EO 12856, EO 13101, and Chapter 4 of OPNAVINST 5090.1C also cover pollution prevention requirements. The regulation's major pollution prevention requirements are as follows:

> In designing, manufacturing, testing, operation, maintaining, and disposing of systems, all forms of pollution shall be prevented or reduced at the source whenever feasible. Pollution that cannot be prevented shall be recycled. Pollution that cannot be prevented or recycled shall be treated in an environmentally safe manner. Disposal or other releases to the environment shall be employed only as the last resort.

3.3.3.2 San Clemente Island

3.3.3.2.1 Hazardous Materials

Various hazardous materials, oils, and hydraulic fuels are used to support aircraft, target, and vehicle maintenance performed on SCI. Only the minimum amount of a hazardous material is obtained for a task to prevent disposing excess material as hazardous waste. Petroleum products such as diesel fuel and gasoline are delivered by regularly scheduled barge from Naval Air Station North Island (NASNI) to the boat ramp area in Wilson Cove, as discussed above. Hazardous materials used on SCI are ordered through NASNI and shipped to the island via barge or aircraft.

Other than fuel (e.g., gasoline, diesel fuel, aviation fuel, propane), materials reported for SCI in the NASNI EPCRA reports (hazardous chemicals present on site greater than 10,000 pounds (lb) (4,536 kilograms [kg]), or 500 lb (227 kg) (or 55 gal. [208 liters [L]]) for an extremely hazardous substance) include fire-fighting foam, cement, and ethylene glycol. Approximately 15,000 gal. (56,800 L) of fire-fighting foam is stored on the island, and approximately 100 gal. (379 L) are used each year.

Ordnance for training and research projects is stored at the Mills Circle Ordnance facility, just south of VC-3. The facility has seven ammunition storage sites (magazines). All ordnance is ground transported from Red Label areas (ordnance loading pad) at the southern end of the airfield and VC-3, and Wilson Cove to the magazines. From the magazines, ordnance is transported by vehicle to approved ready-service lockers at the user's site for temporary storage.

Hazardous materials are transported through the SOCAL OPAREAs to SCI. Transport of hazardous materials over the oceans is regulated by the Federal Department of Transportation in 49 CFR. The International Maritime Dangerous Goods Code applies to ocean vessel shipments. To the extent possible, materials and equipment are prepared and tested before being shipped, to reduce the need to transport hazardous materials. However, fuel and gasoline must be transported from San Diego to SCI by barge. The largest volumes of hazardous material transported to SCI are aviation jet fuel (JP-5) and unleaded gasoline. In Fiscal Year (FY) 2004, SCI received 643,900 gal. (2.44 million L) of JP-5, 678,000 gal. (2.57 million L) of diesel, 28,500 gal. (108,000 L) of unleaded fuel, and 126,000 gal. (477,000 L) of propane.

3.3.3.2.2 Current Mitigation Measures

Hazardous Wastes Management

RCRA (see Section 3.3.2.1.1) requires cradle-to-grave management of designated hazardous wastes, and the procedures in OPNAVINST5090.1C reflect that requirement. There are several 90-day RCRA waste accumulation areas on SCI. Hazardous waste is containerized, transported to the pier, and shipped back to NASNI by barge. Upon arrival at San Diego, the waste is transported by NASNI's hazardous waste contractor to an approved Treatment, Storage, or Disposal (TSD) facility. In the baseline year, about 374,063 lb. (170,000 kg) of hazardous wastes were shipped to NASNI from SCI. Most of the hazardous wastes were paint, waste oil, fuel, batteries, and grease. The types and amounts of hazardous waste now generated are assumed, for this analysis, to be similar to those generated in the baseline year.

Small Arms Range Management

Small arms ammunition may contain heavy metals, such as lead, antimony, and copper, that could be hazardous to biological organisms if released into the environment at substantial concentrations. The Navy currently employs basic Best Management Practices (BMPs) on its small arms ranges, such as the removal of spent lead projectiles and fragments from impact berms. These practices reduce the amounts of potentially hazardous substances that are released into the environment.

Otto Fuel Management

Otto fuel is used to power recoverable torpedoes used in training exercises. At the conclusion of a training activity, when a torpedo is recovered, residual amounts of Otto fuel are recovered and reclaimed in accordance with current Naval Sea Systems Command (NAVSEA) procedures. This practice reduces the quantities of such wastes generated by training activities in SOCAL Range Complex (Range Complex).

Installation Restoration Program

The Installation Restoration Program (IRP) was established by the Navy to evaluate and clean up sites where past practices have resulted in contamination of soils, groundwater, or other media by hazardous substances. Seventeen Installation Restoration sites on SCI have been identified. These sites are generally not located in training areas, and will not be affected by the Proposed Action. Therefore, no further discussion of the IRP sites in this EIS/OEIS is warranted.

The Navy's general instructions (e.g., OPNAVINST 5090.1C) and training activity planning and review processes serve to ensure that hazardous materials and hazardous wastes are stored and handled appropriately. The *Consolidated Hazardous Material Reutilization and Inventory Management Program (CHRIMP) Manual*; Commander, Navy Region Southwest (CNRSW) *Hazardous Waste Management Plan*; and associated guidance documents, and CNRSW *Explosive and Hazardous Waste Management Plan* provide additional guidance for users.

Range Sustainability Environmental Program Assessment

The Range Sustainability Environmental Program Assessment (RSEPA) is a component of the Navy's Tactical Training Theater Assessment and Planning Program. RSEPA is a range compliance management process intended to ensure long-term sustainability of the range using a phased approach. Its purposes are to ensure compliance with applicable regulations and to assess the potential for off-site migration of munitions and their constituents.

The first phase of the RSEPA process is the Range Condition Assessment (RCA), which is to be conducted every 5 years. This is a qualitative and quantitative assessment of facility compliance with environmental regulations and evaluation of the status of munitions constituents on the site. If the RCA determines that further analysis is warranted, a Comprehensive Range Evaluation (CRE) is conducted to determine if an off-range release of munitions has occurred, or if there is a significant risk of such an occurrence. The third phase of the RSEPA process, the Sustainable Range Oversight During Off-Range CERCLA Response (SRO) is intended to ensure the sustainability of range operations during a CERCLA response.

In 2003, the Navy conducted an RCA of SCI. The RCA included Pre-site Visit Information Collection, On-site Visit Information Collection and Review, and preparation of a final report. Operational range site models were developed for Special Warfare Training Areas (SWATs) 1 and 2, Missile Impact Range (MIR), and Shore Bombardment Area (SHOBA). Potential releases of munitions constituents from high-order detonations, low-order detonations, and duds (items that failed to function) were estimated, based on recorded munitions use at SCI in FY 2001 and 2002, and maximum soil concentrations of these constituents were estimated**.** The conclusions of the RCA were that (a) further steps were not required to maintain compliance with Federal environmental regulations, and (b) further analysis was not required to assess the risks of off-range releases of munitions or their constituents.

The vertical and horizontal migration of some munitions constituents in SHOBA were modeled for the RCA, based upon their estimated maximum soil concentrations. This predictive analysis indicated that some constituents could migrate as much as 0.16 feet (ft) (0.05 meters [m]) below the ground surface in detectable concentrations, and that perchlorate (the most mobile of the compounds that were modeled) could migrate vertically as far as the groundwater table (5.4 ft [1.6 m] below the ground surface). Perchlorate could migrate horizontally in groundwater for a distance of up to 300 m (984 ft) beyond the boundary of the Impact Area over 400 years at a concentration of up to 0.6 micrograms per liter (μg/L). This concentration is below current laboratory detection limits and no known human or ecological receptors would be exposed to the groundwater.

The potential transport of munitions constituents via overland flow in storm water runoff also was modeled. This analysis determined that trinitrotoluene (TNT) concentrations at the SHOBA shoreline could be up to 4.3 milligrams per liter (mg/L) and that perchlorate concentrations could be up to 0.001 μg/L. The concentrations of these constituents would be further diluted by the seawater into which the storm water runoff would flow.

3.3.4 Environmental Consequences

3.3.4.1 Approach to Analysis

3.3.4.1.1 Hazardous Materials

The use of hazardous materials is an inherent part of the training and RDT&E activities that occur in the SOCAL Range Complex. The energetic materials used to fire projectiles, detonate explosive materials, and provide fuel and power for airborne, surface, and undersea training items all contain hazardous constituents. Ordnance casings and accessory materials also may contain hazardous constituents. Once these items are expended and their energetic materials are used up, the hazardous constituents remain in the residues and structural components.

Hazardous constituents such as lead may be used to increase the strength of materials, lighten weight, reduce the incidence of failure, lower life-cycle costs, or prolong the life of the ordnance. Hazardous features of these training items are understood by their users, and safe handling and pollution prevention measures are a routine part of systems programs to minimize and manage their effects. The components that contain hazardous constituents include propellants, batteries, flares and smoke, telemetry, igniters, jet fuel, diesel fuel, hydraulic fluid, and explosives.

Military munitions also may pose a physical hazard, both from fully charged and primed high explosive ammunition prior to use and from expended, but unexploded ordnance (UXO). For this reason, military munitions are considered to be hazardous materials in and of themselves as long as they contain unreacted energetic materials. Munitions constituents are found in torpedoes, targets, sonobuoys, munitions and demolition materials, and RDT&E ordnance (primarily missiles and targets). This EIS/OEIS addresses the types, amounts, and distribution of munitions constituents and wastes that affect the SOCAL OPAREAs.

Quantities of munitions and other expendable training materials estimated for this analysis are based on the items and per-event quantities provided in the Operations Data Book (DoN 2007) and the numbers of annual training events described in Chapter 2, Description of Proposed Action and Alternatives. The types and quantities of hazardous constituents in these training materials, as well as failure rates and other characteristics of the materials, are as reported in Navy documents or other published sources; these sources are cited in the text below as appropriate. The following subsections provide additional information and assumptions about hazardous training materials, their constituents, and combustion byproducts and residues that were considered in the impact analysis.

Explosives

Explosives in modern military ordnance are generally solid-cast explosive fills formed by melting the constituents and pouring them into steel or aluminum casings. Trinitrotoluene (TNT) is a nitroaromatic compound that has been used by the U.S. Navy as an explosive since 1912. TNT manufacturing in the U.S. has ceased, and it’s use in military munitions is being phased out. Most new U.S. military formulations contain plastic-bonded explosives (PBX) that use plastic or other polymer binders to increase their stability (Janes 2005, 2006). Royal Demolition Explosive (RDX) / High Melting Explosive (HMX) blends have generally replaced TNT in plastic-bonded formulations.

Explosives become an environmental concern when expended ordnance fails to function as designed, and explosive compounds in the UXO are released into the environment. A complete failure to function (dud) typically leaves an ordnance item intact or lightly damaged from impacting the surface. A low-order detonation consumes some of the energetic materials and ruptures the casing, but leaves a portion of the explosive filler and other materials (e.g., propellant, spotting charge) in its original form. UXO may be found lying on the ground or may be buried up to 4 ft deep in the soil.

Munitions constituents of concern include nitroaromatics—principally TNT, its degradation products, and related compounds; and cyclonitramines, including RDX, HMX, and their degradation products. TNT degrades to dinitrotoluene (DNT) and subsequent degradation products from exposure to sunlight (photolysis) or bacteria (biodegradation). RDX also is subject to photolysis and biodegradation once exposed to the environment. As a group, military-grade explosives have low water solubility (see Table 3.3-2), and are relatively immobile in water. The degradation and dissolution of these materials may be further slowed by the physical structure and composition of blended explosives, which contain multiple chemical compounds, often with additional binding agents (see Table 3.3-3).

Table 3.3-2: Water Solubility and Degradation Products of Common Explosives

Compound	Water Solubility (milligrams per liter at 20°C)
Salt (sodium chloride) [for comparison]	357,000
Ammonium perchlorate	249,000
Picric acid	12,820
Nitrobenzene	1,900
Dinitrobenzene	500
Trinitrobenzene	335
Dinitrotoluene (DNT)	160-161
Trinitrotouene (TNT)	130
Tetryl	51
Pentaerythritoltetranitrate (PETN)	43
RDX	38
HMX	7
White phosphorus	4

Source: DoN 2007

Table 3.3-3: Explosive Components of Munitions

Name	Composition	Use
Composition A	91% RDX	Grenades, projectiles
Composition B	60% RDX, 39% TNT	Projectiles, grenades, shells, bombs
Composition C-4	91% RDX, 9% plasticizer	Demolition explosive
Explosive D	picric acid, ammonium picrate	Bombs, projectiles
Octol	70-75% HMX, 25-30% TNT	Shaped and bursting charges
TNT	NA	Projectiles, shells
Tritonal	80% TNT, 20% aluminum	Bombs, projectiles
H6	80% Comp B, 20% aluminum	Bombs, projectiles

Source: USEPA 2006
Note: NA = Not Applicable

Other Munitions Constituents

Other munitions constituents of concern include pyrotechnic (illumination and smoke) compounds, propellants, primers, and metals (e.g., iron, manganese, copper, lead, zinc, antimony, mercury) released from both initiation primers and ordnance casing corrosion. Nitrocellulose, nitroglycerin, perchlorate, nitroguanidine, and pentaerythritoltetranitrate (PETN) are commonly used in artillery, mortar, and rocket propellants. Common primers include lead azide, lead styphnate, and mercury fulminate. PETN is a major component of detonation cord and blasting caps. Phosphorus, potassium perchlorate, and metal nitrates are common ingredients of pyrotechnics, flares, and smokes. In particular, the heavy metals tend to accumulate in surface soils because of their generally low solubility and their elemental nature; they may oxidize or otherwise react with natural substances, but do not break down in the manner of organic compounds.

Explosives Byproducts

The explosive byproducts generated when ordnance does function as designed (high-order detonation), or experiences a low-order detonation, also generate constituents of concern. The major explosive byproducts of organic nitrated compounds such as TNT and RDX include water, carbon dioxide, carbon monoxide, and nitrogen (Brinkley and Wilson 1943, John 1941 and 1943; Renner and Short, 1980; Cook and Spillman, 2000). High-order detonations result in almost complete conversion of explosives (99.997 percent or more [USACE 2003]) into such inorganic compounds, whereas low-order detonations result in incomplete conversion (i.e., a mixture of the original explosive and its byproducts). For example, Table 3.3-4 lists the calculated chemical byproducts of high-order underwater detonation of TNT, RDX, and related materials.

Table 3.3-4: Chemical Byproducts of Underwater Detonations

Byproduct	Percent by Weight, by Explosive Compound		
	TNT	RDX	Composition B
Nitrogen	18.2	37.0	29.3
Carbon dioxide	27.0	24.9	34.3
Water	5.0	16.4	8.4
Carbon monoxide	31.3	18.4	17.5
Carbon (elemental)	10.6	-	2.3
Ethane	5.2	1.6	5.4
Hydrogen	0.2	0.3	0.1
Propane	1.6	0.2	1.8
Ammonia	0.3	0.9	0.6
Methane	0.2	0.2	0.2
Hydrogen cyanide	<0.0	<0.0	<0.0
Methyl alcohol	<0.0	<0.0	-
Formaldehyde	<0.0	<0.0	<0.0
Other compounds	<0.0	<0.0	<0.0

Note: <0.0 = not detected above the applicable detection limit.
Source: Renner and Short 1980

High-order detonations spread micron-sized and submicron-sized particles over hundreds of square meters. Most of these materials are deposited on the soil surface, and remain there. Sampling of vertical soil profiles at military training ranges has shown that concentrations of munitions constituents drop off rapidly with depth (USEPA 2006). Field studies indicate that explosives residues include 0.003 percent or less of the original quantity of material, although the amounts of explosives residues vary among different types of ordnance (see Table 3.3-5).

Table 3.3-5: Per-Round Results of Live-Fire Detonation Tests

Munition	Plume Area (m^2)	Residue (milligrams)				Total (%)
		RDX	HMX	TNT	Total	
60-mm mortar	214	0.076	ND	ND	0.076	2.0×10^{-5}
81-mm mortar	230	8.3	ND	1.1	9.4	1.0×10^{-3}
120-mm mortar	450	17.0	1.3	2.8	21.0	7.0×10^{-4}
105-mm howitzer	530	0.095	ND	0.17	0.27	1.3 x 10-^{5}
155-mm howitzer	938	0.3	ND	0.009	0.31	4.4 x 10-^{6}

Note: ND = Not Detectable

Source: USACE 2007

For purposes of cleaning up contaminated properties, the USEPA has identified maximum soil concentrations for explosives, propellants, and metals that are consistent with various types of land use (USEPA, 2004). While not directly applicable to military ranges, these Preliminary Remediation Goals (PRGs) are widely used, and provide a reasonable basis for determining the potential risk to the public and the environment from hazardous constituents deposited on the soils at military ranges. For purposes of evaluation, the most sensitive PRGs—those recommended for residential uses—are shown in Table 3.3-6.

Table 3.3-6: USEPA Preliminary Remediation Goals for Contaminated Soils

Hazardous Constituent	Preliminary Remediation Goal, Residential (ppm)
Barium	5,400
Cadmium	37
Chromium III	100,000
Copper and copper compounds	3,100
HMX	3.100
Lead	400
Mercury and mercury compounds	23
Nickel and nickel compounds	1,600
Perchlorate	7.8
RDX	4.4
TNT	16

Note: ppm = parts per million
Source: USEPA 2004

Soil sampling at military ranges indicates that concentrations of explosives residues, while often detectable, generally are not present at concentrations that pose acute or chronic hazards. At Fort Greely, Alaska, the following soil concentrations of explosives were found (USACE 2001a):

- On the TOW missile range, RDX was detected at 0.002 to 0.17 parts per million (ppm).
- On the 40-mm grenade range, RDX was detected at 0.01 to 1.7 ppm.
- The median concentration in soil was 0.021 ppm for RDX and 0.004 ppm for TNT.

At Fort Lewis, soil sampling of the artillery range determined that concentrations of explosives residues often were below the laboratory's detection limit, and soils at the hand grenade range had a median RDX concentration of 1.56 ppm (USACE 2001b). Soils sampled on the hand grenade range at Fort Richardson had a median RDX concentration of 0.029 ppm (USACE, 2001). Such concentrations of these organic compounds are below the USEPA's most restrictive PRGs, and thus pose no risk to human health or the terrestrial environment.

Unlike organic explosive and propellant compounds, inorganic metallic residues do not break down and are relatively immobile. Soil samples collected near anti-tank targets at Fort Ord contained elevated concentrations of lead and copper (USACE, 2004). Similarly, soil samples collected on the 40-millimeter (mm) grenade range at Fort Greely, Alaska contained elevated concentrations of lead and copper. Other than cadmium and mercury, however, the PRGs for toxic metals are an order of magnitude or greater than those for TNT and RDX. Studies to date suggest that, while concentrations of metals may be high in areas of concentrated use, such as around fixed targets, metals concentrations on military ranges generally are within acceptable limits.

Munitions constituents are deposited on the surface of the ocean during training and testing in amounts similar to those identified on land ranges. Laboratory studies have determined that TNT exhibits toxicity in the marine environment at concentrations of 0.9 to 11.5 mg/L, while RDX generally showed more limited toxicity. In marine sediments, TNT exhibits toxicity at concentrations of 159 to 320 ppm (i.e., about 40 percent to 80 percent of USEPA's residential PRG). RDX exhibits no sediment toxicity at the concentrations tested (Lotufo and Ludy, 2005; Rosen and Lotufo, 2005; Rosen and Lotufo 2007a, 2007b). In a series of tests mimicking a natural environment, Ek et al (2006) determined that, under environmental conditions typical of in-water UXO, no substantial toxicity or bioaccumulation of TNT munitions occurred. In general, munitions constituents in the marine environment appear to pose little risk to the environment.

Unexploded Ordnance and Low-Order Detonations

UXO is ordnance that fails to function as designed. This ordnance may remain capable of detonation, posing a physical risk to individuals in its vicinity. On land ranges controlled by the Navy, this risk is limited to military personnel who are trained in UXO avoidance. Explosive Ordnance Disposal (EOD) personnel periodically remove UXO from the range, or conduct a blow-in-place (BIP) operation to render it safe. UXO poses a risk to the public when ordnance lands off-range and is not immediately recovered, or when Navy training activities occur in areas accessible to the public.

The failure rate, or percentage of ordnance that fails to properly function, varies widely by ordnance type and by the circumstances under which the ordnance is used. Quality control (QC) testing of U.S. Army ordnance identified failure rates by ordnance type (see Table 3.3-7). These rates were determined under controlled conditions, however; average failure rates under field conditions were estimated to be about 10 percent. The authors of the QC tests report stated that they had observed failure rates of up to 25 percent and low-order detonation rates of up to 5 percent for mortars (USACE, 2007). These higher observed failure rates take into account operator error, missing the target, and other field conditions not present during the QC tests.

UXO and low-order detonations also account for much of the explosives residues on military ranges. Ordnance that does not detonate may break open upon impact or the casings may be compromised later by corrosion, releasing raw explosives into the environment. In low-order detonations, as much as 40 percent of the explosive material may remain, compared with about 0.003 percent for high-order detonations. For assessing impacts on the environment, an overall failure rate of 5 percent and an overall low-order detonation rate of 0.2 percent are assumed.

Table 3.3-7: Failure and Low-Order Detonation Rates of Military Munitions

MUNITION	FAILURE RATE (%)	LOW-ORDER RATE (%)
Gun/artillery	4.68	0.16
Hand grenade	1.78	NA
High explosive munitions	3.37	0.09
Howitzer	3.75	NA
Mortars	2.91	0.08
Rocket	3.84	NA
Submunition	8.23	NA

Sources: Rand Corporation 2005; USACE 2007
Note: NA = Not Applicable

3.3.4.1.2 Hazardous Wastes

The Navy has a process for managing hazardous materials and waste. Hazardous materials management in the SOCAL OPAREAs is the responsibility of the Naval Base Coronado (NBC) program. No hazardous waste is disposed at SCI. Hazardous materials used on SCI for maintenance activities are ordered through NASNI. After materials are used, they are accumulated and managed based on their properties and the hazardous wastes (e.g., paints, adhesives, solvents, aerosols, batteries, and cleaning compounds) are shipped back to NASNI for processing. Expended ordnance materials are left on the range, until accumulations of expended materials need to be cleared to prevent interference with continued operations.

3.3.4.2 No Action Alternative

3.3.4.2.1 SOCAL Operating Areas

Hazardous Materials

Expended training materials containing hazardous constituents that will be deposited in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

Hazardous Wastes

Used hazardous materials and chemical byproducts generated at sea are not considered to be hazardous wastes until off-loaded in port. Under the No Action Alternative, the accumulation of used hazardous materials aboard ship will remain at baseline levels. Used and excess hazardous wastes will continue to be managed in compliance with OPNAVINST 5090.1C. The No Action Alternative will not affect hazardous materials management practices aboard ship.

The anticipated amounts of hazardous wastes generated are well within the capacity of the Navy's ashore hazardous waste management system. The anticipated amounts also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.4.2.2 San Clemente Island

Hazardous Materials

Shore Bombardment Area

The major sources of hazardous materials on SCI are explosives and ordnance. Almost all of the ordnance used on SCI is expended in SHOBA, except for small arms and demolition training. Ordnance use in SHOBA can be broadly characterized for analytical purposes as:

- Missiles, rockets, and aerial targets;
- Artillery, naval gunfire, mortar rounds, and cannon rounds;
- Bombs; and

- Flares and smoke charges.

Missiles, Rockets, and Aerial Targets

Approximately 330 guided munitions, missiles, rockets, and aerial targets are used in Expeditionary Firing Exercises (EFEXs), Strike Warfare (STW), and other land training activities. In addition, as part of the EFEX, one BGM-71E TOW missile will be used under the No Action Alternative. The missile uses a solid propellant rocket motor for propulsion, and has a warhead containing approximately 7 lb (3.1 kg) of explosives.

Artillery, Naval Gunfire, Mortar Rounds, and Cannon Rounds

Under the No Action Alternative, artillery shells, naval gun shells, mortar rounds, and 30-mm guns are used in training exercises. Most of the energetic materials are converted to gases when the item functions. Less than 25 percent of the original weight of the ordnance remains as solids and water. Total numbers of these training items are provided by warfare area in Table 3.3-9 below.

Bombs

Wholly inert and high explosive bombs are dropped in Impact Area II, the only target area where MK-80 Series bombs can be dropped. The solid emission products from high explosive bombs are mostly aluminum oxide and carbon, and the liquid emission product from detonation is water. Minor constituents include barium, magnesium, phosphorus, and lead. Only barium and lead are constituents of concern. About 2,220 bombs are used annually on SCI. An estimated 111 of these bombs will fail to function as designed, although most of them will be nonexplosive practice bombs with only a spotting charge.

Flare and Smoke Charges

Approximately 300 flares and smoke charges per year are used in Direct Action exercises as signaling devices or illumination devices. Electronic Combat (EC), Land Demolition, and Combat Search and Rescue (CSAR) also use flares and smoke charges. Major constituents of these items are water, potassium, sodium, and calcium. Minor constituents include magnesium and lead. Of these constituents, only lead is considered to be hazardous.

Amphibious Warfare

Amphibious training events vary from small boat raids to larger activities with amphibious assault vehicles or landing craft. As shown below in Table 3.3-9, these activities require the annual use of about 4,500 naval shells, 886 cannon and mortar rounds, 14,100 small arms projectiles, 151 missiles and rockets, and 344 bombs. Highly explosive ordnance is not expended in Over-the-Beach (OTB) amphibious assaults. No highly explosive ordnance is used, so no hazardous materials are expended in this exercise. No battalion landings occur under the No Action Alternative.

Naval Special Warfare

These training activities use demolition explosives, both on land and underwater, small arms firing on static ranges; land navigation training; and platoon-sized activities using high explosive ordnance in authorized areas. Under the No Action Alternative, about 2.6 million rounds of cannon and small arms projectiles are expended each year on SCI during NSW activities, including about 896 grenades (see Table 3.3-9). This ammunition deposits approximately 24 tons (about 22 metric tons) of solid and liquid detonation products on SCI. Of this amount, about 9 tons (8 metric tons) is lead. Other constituents include aluminum, barium, antimony, and magnesium. An estimated 90 percent of these materials are deposited on land, while an estimated 10 percent are deposited in the nearshore waters of SCI.

Under the No Action Alternative, approximately 79,700 lb (36,200 kg) of energetic materials is used by NSW for its explosives training. If these energetic materials consist of RDX (the primary ingredient of C-4), for example, then the major detonation products will include carbon dioxide (21,900 lb or 9,960 kg), carbon solids (5,360 lb or 2,430 kg), water (16,800 lb or 7,650 kg), and nitrogen (27,100 lb or 12,300 kg), all of which are common nontoxic substances. None of these materials are hazardous or toxic. Explosive support devices such as cable cutters, fuse cutters, time fuses, detonation cord, blasting caps, and claymore mines are included in this total.

Other Island Operations

Island noncombat operations include four Explosive Ordnance Disposal (EOD) events. EOD activities involve the explosive destruction of munitions, but the areas where these activities occur are very isolated (usually on VC-3). Detonation products from this small number of activities are very small, and the materials produced are similar to the emission products discussed under NSW, above, for explosives training.

Activities at NALF are generally restricted to military aviation and contract flights to bring personnel to SCI and return them to the mainland. The hazardous materials used and produced during airfield operations will be handled by the hazardous materials handling and processing procedures in place.

Research, Development, Test, and Evaluation

SCI and its surrounding waters accommodate a variety of RDT&E activities. Most are benign activities that use little or no hazardous materials. The RDT&E events that have the most hazardous constituents are the testing of missiles and a few other systems. These tests include Standard Missiles, Joint Stand-Off Weapons (JSOW), Unmanned Area Vehicle (UAVs), and sonobuoys. The constituents of sonobuoys and torpedoes are addressed in Section 3.4, Water Resources.

The components that contain hazardous constituents in missile flight tests include propellants, batteries, telemetry, igniters, jet fuel, hydraulic fluid, and explosives. For the No Action Alternative, three JSOWs and four Land Attack Standard Missiles (LASMs) were analyzed. The total amount of hazardous material remaining after the missile shots is shown in Table 3.3-8.

Table 3.3-8: Estimated Missile Impact Constituents

Missile		Amount, lb (kg)				
Type	Number	Propellant, Residual	Batteries	Igniters, Wiring, etc.	Explosives	Total
JSOW	3	1.7 (0.8)	NA	NA	59 (27)	61 (28)
LASM	5	751 (341)	6 (3)	0.5 (0.2)	70 (32)	828 (376)

Source: DoN 1996, DoN 1998, DoN 2002

Note: NA = Not Applicable

Hazardous Wastes

Under the No Action Alternative, the on-island accumulation and storage, ocean transport, and ashore treatment or disposal of hazardous wastes will remain at baseline levels. Hazardous wastes will continue to be managed in compliance with OPNAVINST 5090.1C. The Navy's hazardous waste disposal practices also comply with Federal, state, and local laws. The volume of wastes is well within the capacity of the Navy's hazardous waste management system, and commercial waste transporters and treatment and disposal facilities.

Summary

Hazardous Materials

Table 3.3-9 summarizes the training materials expended on SCI under the No Action Alternative. Most of these materials will be deposited in SHOBA. Based on the analysis presented above, most of the constituents and degradation products of the training materials expended on SCI are nonhazardous. However, several thousand pounds of hazardous metals, including lead, copper, and antimony, will be deposited on SCI ranges annually by Navy training activities. Periodic range clearances by EOD personnel reduce the likelihood of areas of high contaminant concentrations developing on land ranges.

The expended ordnance is likely to be concentrated at certain points within the range, such as around fixed targets, so some areas of concentrated soil contamination could develop over time. Sediment transport processes will tend to move surface soils downslope over time; conveying metals and other insoluble constituents into nearby marine areas. An estimated 70 percent of eroded soils on SCI eventually are transported to the ocean (DoN 2006).

Explosives and propellants decompose gradually due to sunlight and bacterial activity, and their water-soluble degradation products migrate vertically and horizontally in the soil. Where UXO or low-order detonations result in large deposits of these materials, a local area of high contamination concentrations could result, but soil concentrations of these hazardous constituents are not expected to approach actionable levels as a result of residues from normal high-order detonations. Periodic range clearances by EOD personnel reduce the likelihood of contaminant concentrations developing on land ranges.

Relatively insoluble inorganic constituents, such as lead and other metals, will tend to accumulate in surface soils, while soluble materials—such as nitrate, sulfate, and chlorate compounds—will tend to migrate vertically and horizontally. The gradual buildup of hazardous substances may eventually reach actionable concentrations (see Table 3.3-6) in heavily used locations. Overall, however, the concentrations of these substances will not rise to a level of concern.

Hazardous Wastes

The anticipated amounts of hazardous wastes are well within the capacity of the Navy's hazardous waste management system. The anticipated amounts also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.4.3 Alternative 1

3.3.4.3.1 SOCAL Operating Areas

Hazardous Materials

Unrecovered training materials containing hazardous constituents that would be deposited in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

Hazardous Wastes

The amount of hazardous waste generated by SOCAL OPAREAs activities under Alternative 1 would increase in rough proportion to the increase in training activities. Used hazardous materials would be off-loaded from Navy ships upon reaching port, probably in San Diego, at which time these materials would become hazardous wastes. All hazardous wastes would continue to be managed in compliance with OPNAVISNT 5090.1C.

The anticipated increases in hazardous wastes generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

Table 3.3-9: Estimated Expenditures of Training Materials on SCI, No Action Alternative

Activity Area	Expenditures, Annual					
	Gun Shell	Cannon / Mortar Shell	Small Arms	Flare / Smoke	Missiles / Rockets	Bomb
Amphibious Warfare	4,500	886	14,100	0	151	344
Naval Special Warfare	0	234	2,550,000	397	0	0
Strike Warfare	0	0	5,600	14	173	1,870
Space and Naval Warfare	195	0	0	0	7	0
Total (number/year)	**4,700**	**1,120**	**2,570,000**	**411**	**331**	**2,210**
Total (weight in tons)	136	14	25	0.16	14	159
Estimated UXO (number/yr)	235	56	NA	21	17	110
Estimated Low-Order (number/yr)	9	2	NA	1	1	4

Note: numbers of items are estimates,. lb = pounds; yr = year.

Source: U.S. Navy, 2007

3.3.4.3.2 San Clemente Island

Hazardous Materials

Shore Bombardment Area

Missiles, Rockets, and Aerial Targets

The missiles and aerial targets used in SHOBA consist of NSW Stinger training against Ballistic Aerial Target Systems (BATS). The hazardous materials found in these systems are primarily from the propellants used in the target and missile, and the warhead in the missile.

For the NSW training, BATS contain between 12 lb (5.4 kg) and 30 lb (13.6 kg) of propellant, which is expended during the launch of the target. The Stinger missile has approximately 11.4 lb (5.2 kg) of propellant and a warhead of approximately 6.6 lb (3 kg) of explosives. The propellants and explosives are used up in the exercise, creating primarily air emissions of carbon dioxide, water, and nitrogen. Under Alternative 1, 51 Stingers would be used against up to 24 BATS.

Approximately 175 rockets (25 more than under the No Action Alternative) would be used in EFEXs. In addition, as part of the EFEX, one BGM-71E TOW missile would be used under Alternative 1. The missile uses a solid propellant rocket motor for propulsion, and has a warhead containing approximately 7 lb (3.1 kg) of explosives.

Artillery, Naval Gunfire, Mortar Rounds, and Cannon Rounds

Under Alternative 1, artillery and naval gun shells (about 5,100/year) and cannon and mortar rounds (about 1,840/year) would be used in training exercises on SCI. The majority of the energetic materials in these items would be converted to inorganic gaseous products and water. Less than 25 percent of the original weight of the ordnance would remain as solids and water. Less than 1 percent of these materials would consist of toxic metals such as lead. Total numbers of these training items are provided by warfare area in Table 3.3-11 below.

Bombs

Wholly inert and high explosive bombs are dropped primarily in Impact Area II (high explosive bombs are dropped in Impact Area IIA), the only target area where MK-80 Series bombs can be dropped. Of the approximately 2,500 bombs to be dropped (10 percent more than under the No Action Alternative), around 40 percent would be nonexplosive practice bombs, 47 percent would be 500-lb (227-kg) bombs (MK-82 or equivalent), and 13 percent would be 1,000-lb (334-kg) bombs (MK-83 or equivalent). The main solid products would be aluminum oxide and carbon, and the main liquid product from detonation is water. In addition, other nonexplosive practice bombs such as BDU-48, BDU-45, LGTR, and MK-76s would be dropped on the range.

Flares and Smoke Charges

A small number of flares and smoke charges (313/year versus 300/year under the No Action Alternative) would be used in Direct Action training. Flares and smoke charges also would be used in Electronic Combat (42) and Land Demolition (175). The main solid and liquid products are water and potassium. Approximately 9 percent of these wastes would consist of lead oxide.

Amphibious Warfare

Amphibious warfare activities vary from small boat raids to larger events with several Amphibious Assault Vehicles (AAVs) or Landing Craft Air Cushions (LCACs). High explosive ordnance is not expended in the OTB portion of the amphibious assaults. No high explosive ordnance is used, so no hazardous materials are used in this exercise. The ordnance used after the landing is captured in the SHOBA analysis above.

Naval Special Warfare

These training activities involve the use of demolition explosives, both on land and underwater, small arms firing on static ranges, land navigation training, and platoon-sized activities using high explosive ordnance in authorized areas.

Under Alternative 1, about 5.1 million rounds of small arms ammunition would be used annually for NSW training, including about 1,790 grenades. Use of this ammunition would deposit approximately 29 tons (T) (27 metric tons [MT]) of solid and liquid detonation products on SCI. Of this amount, the lead in the ammunition would be about 12 T (11 MT). Other constituents include aluminum, barium, antimony, and magnesium. An estimated 90 percent of these materials are deposited on land, while an estimated 10 percent are deposited in the nearshore waters of SCI.

Under Alternative 1, approximately 105,000 lb (47,700 kg) of energetic materials would be used by NSW for explosives training. The detonation products of most of the explosives, C-4 and TNT, result in approximately 5,920 lb (2,690 kg) of water and 4,100 lb (1,860 kg) of carbon. Explosive support devices such as cable cutters, fuse cutters, time fuses, detonation cord, blasting caps, and claymore mines are included in this total.

Other Island Operations

Noncombat Operations include EOD activities. The EOD activities involve hazardous materials during the explosive destruction of munitions, but the areas in which the activities occur are very isolated (usually on VC-3). The emission products from this limited number of events would be very small.

Activities at NALF are generally restricted to military aviation and contract flights to bring personnel to the island and return them to the mainland. The hazardous materials used and produced during airfield operations would be handled by the hazardous materials handling and processing procedures in place.

Research, Development, Test, and Evaluation

The components that contain munitions constituents in missile flight tests include propellants, batteries, telemetry, igniters, jet fuel, hydraulic fluid, and explosives. Under Alternative 1, five JSOWs, five LASMs, two Tomahawk missiles, five Japanese Missile tests, and one developmental Anti-Ship Missile were analyzed. The total amount of hazardous material (other than the warhead) is shown in Table 3.3-10.

Table 3.3-10: Estimated Missile Impact Constituents

Missile		Amount, lb (kg)				
Type	Number	Propellant, Residual	Batteries	Igniters, Wiring, etc.	Explosives	Total
JSOW	5	2.9 (1.3)	NA	NA	98.1 (44.5)	101 (46)
LASM and Japanese Missile	10	1,654 (750)	13 (5.9)	0.9 (0.4)	153 (69.4)	1,821 (826)
Tomahawk	2	6.2 (2.8)	NA	NA	68.6 (31.1)	79.4 (36)
Developmental Anti-Ship Missile	1	3.1 (1.4)	NA	NA	34.4 (15.6)	39.9 (18)

Note: NA = Not Applicable
Source: DoN 1996, DoN 1998, DoN 2002

Hazardous Wastes

Under Alternative 1, the on-island accumulation and storage, ocean transport, and ashore treatment or disposal of hazardous wastes would increase by about 50 percent from baseline conditions. Hazardous wastes would continue to be managed in compliance with OPNAVINST 5090.1C. The volume of wastes would be well within the capacity of the Navy's hazardous waste management system, and commercial waste transporters and treatment and disposal facilities.

Summary

Hazardous Materials

Table 3.3-11 summarizes the training materials expended on SCI under Alternative 1. Most of these materials would be deposited in SHOBA. Based on the analysis presented above, most of the constituents and degradation products of the training materials expended on SCI would be nonhazardous. Several thousand pounds of lead would be deposited on SCI ranges as a result of Navy training activities; this amount would increase by about 10 percent over the No Action Alternative. The environmental fate of the training materials deposited on the land ranges would be as described under the No Action Alternative in Section 3.3.4.2.2.

Hazardous Wastes

The anticipated increases in hazardous waste generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

3.3.4.4 Alternative 2

3.3.4.4.1 SOCAL Operating Areas

Hazardous Materials

Expended training materials containing hazardous constituents that would be deposited in the SOCAL OPAREAs are addressed in Section 3.4, Water Resources.

Hazardous Wastes

The amount of hazardous waste generated by SOCAL OPAREAs activities under Alternative 2 would increase in rough proportion to the increase in training activities. Used hazardous materials would be off-loaded from Navy ships upon reaching port, probably in San Diego, at which time these materials would become hazardous wastes. All hazardous wastes would continue to be managed in compliance with OPNAVISNT 5090.1C.

The anticipated increases in hazardous wastes generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

Table 3.3-11: Estimated Expenditures of Training Materials on SCI, Alternative 1

Activity Area	Expenditures, Annual					
	Gun Shell	Cannon / Mortar Shell	Small Arms	Flare / Smoke	Missiles / Rockets	Bomb
Amphibious Warfare	4,990	1,590	130,000	0	277	401
Naval Special Warfare	0	245	5,050,000	488	0	0
Strike Warfare	0	0	6,270	16	194	2,100
Space and Naval Warfare	81	0	0	0	18	0
Total (number/year)	**5,070**	**1,840**	**5,180,000**	**504**	**489**	**2,500**
Total (weight in tons)	151	15	30	0.18	18	227
Estimated UXO (number/yr)	254	92	NA	25	24	125
Estimated Low-Order (number/yr)	10	4	NA	1	1	5

Notes: Numbers of training items are estimates, and are rounded to 3 significant digits to indicate their relative imprecision. lb = pound, yr = year.

Source: DoN 2007.

3.3.4.4.2 San Clemente Island

Hazardous Materials

Shore Bombardment Area

Missiles, Rockets, and Aerial Targets

The missiles and aerial targets used in SHOBA would consist of NSW Stinger training against BATS. BATS are described under Alternative 1. Under Alternative 2, 59 Stinger missiles would be used against BATS.

Approximately 200 rockets (versus 150 under the No Action Alternative) would be used in EFEXs. In addition, as part of the EFEX, one BGM-71E TOW missile would be used under Alternative 2. The hazardous materials found in these systems are primarily from the propellants used in the target and missile, and the warhead in the missile.

Artillery, Naval Gunfire, and Mortar Rounds

Under Alternative 2, 5,510 artillery and naval gun shells and 800 mortar rounds would be used in training exercises on SCI. The majority of the energetic materials in these items would be converted to inorganic gaseous products and water. Less than 25 percent of the original weight of the ordnance would remain as solids and water. Less than 1 percent of these materials would consist of toxic metals such as lead. Total numbers of these training items are provided by warfare area in Table 3.3-13 below.

Bombs

Wholly inert and high explosive bombs are dropped primarily in Impact Area II (high explosive bombs are dropped in Impact Area IIA), the only target area where MK-80 Series bombs can be dropped. Of the approximately 2,760 bombs dropped, around 40 percent would be nonexplosive practice bombs, 47 percent would be 500-lb (227-kg) bombs (MK-82 or equivalent), and 13 percent would be 1,000-lb (334-kg) bombs (MK-83 or equivalent). The primary solid products would be aluminum oxide and carbon, and the primary liquid product from detonation would be water. In addition, other wholly inert bombs such as BDU-48, BDU-45, LGTR, and MK-76s would be dropped on the range.

Flares and Smoke Charges

Approximately 365 flares and smoke charges would be used in NSW Direct Action activities as signaling devices or illumination devices, compared with 300 under the No Action Alternative. In addition, 43 flares and smoke charges would be used for EC and 189 flares and smoke charges would be used for Land Demolition. The primary solid and liquid products would be water and potassium. Approximately 9 percent of these wastes would consist of lead oxide.

Amphibious Warfare

Amphibious warfare activities vary from small boat raids to larger events with numbers of AAVs or LCACs. Marines could be airlifted onto SCI landing zones by helicopter. High explosive ordnance would not be expended in the OTB portion of the amphibious assaults. No high explosive ordnance would be used in these exercises.

Naval Special Warfare

These training activities involve the use of demolition explosives, both on land and underwater, small arms firing on static ranges, land navigation training, and SEAL platoon-sized activities using high explosive ordnance in authorized areas. On-island use of explosives is discussed in the Explosives section of the SHOBA discussion. On-island expenditure of small arms for NSW training is captured above under Small Arms in the SHOBA analysis.

Under Alternative 2, about 6 million rounds of small arms ammunition would be used annually for NSW training, including over 2,140 grenades. Use of this ammunition would deposit approximately 36 tons (33 metric tons) of solid and liquid detonation products on the range. Of this amount, the lead in the ammunition would be more than 14 tons (13 metric tons).

Under Alternative 2, approximately 123,000 lb (55,900 kg) of energetic materials would be used by NSW for explosives training. The products of detonation of the majority of the explosives, C-4 and TNT, resulted in approximately 6,930 lb (3,150 kg) of water and 4,810 lb (2,190 kg) of carbon. Explosive support devices such as cable cutters, fuse cutters, time fuses, detonation cord, blasting caps, and claymore mines are included in this total.

Other Island Operations

Noncombat Operations include EOD activities. The EOD activities involve hazardous materials during the explosive destruction of munitions, but the areas in which the activities occur are very isolated (usually on VC-3). The emission products from this limited number of events would be very small, and the materials produced would be similar to the emission products discussed earlier for that type of ordnance.

Activities at NALF are generally restricted to military aviation and contract flights to bring personnel to the island and return them to the mainland. The hazardous materials used and produced during airfield operations will be handled by the hazardous materials handling and processing procedures in place.

Research, Development, Test, & Evaluation

The components that contain munitions constituents in missile flight tests include propellants, batteries, telemetry, igniters, jet fuel, hydraulic fluid, and explosives. Under Alternative 2, ten JSOWs, ten LASMs, two Tomahawk missiles, five Japanese Missile tests, and one developmental Anti-Ship Missile were analyzed. The total amount of hazardous material is shown in Table 3.3-12.

Table 3.3-12: Estimated Missile Impact Constituents

Missile		Amount, lb (kg)				
Type	Number	Propellant, Residual	Batteries	Igniters, Wiring, etc.	Explosives	Total
JSOW	10	5.7 (2.6)	NA	NA	196 (88.9)	201.7 (91.5)
LASM and Japanese Missile	15	1,203 (546)	10 (4.5)	0.7 (0.3)	111 (50.3)	1324 (601)
Tomahawk	2	30.4 (13.8)	NA	NA	343 (155.6)	79.4 (36)
Developmental Anti-Ship Missile	1	3.1 (1.4)	NA	NA	34.4 (15.6)	39.9 (18.1)

Note: NA = Not Applicable
Source: DoN 1996, DoN 1998, DoN 2002

Hazardous Wastes

Under Alternative 2, the on-island accumulation and storage, ocean transport, and ashore treatment or disposal of hazardous wastes would increase by about 68 percent from baseline conditions. Hazardous wastes would continue to be managed in compliance with OPNAVINST 5090.1C. The volume of wastes would be well within the capacity of the Navy's hazardous waste management system, and commercial waste transporters and treatment and disposal facilities.

Summary

Hazardous Materials

Table 3.3-13 summarizes the training materials expended on SCI under Alternative 2. Most of these materials would be deposited in SHOBA. Based on the analysis presented above, most of the constituents and degradation products of the training materials expended on SCI would be nonhazardous. Several thousand pounds of lead would be deposited on SCI ranges as a result of Navy training activities; this amount would increase by about 50 percent over the No Action Alternative. The environmental fate of the training materials deposited on the land ranges would be as described under the No Action Alternative in Section 3.3.4.2.2.

Hazardous Wastes

The anticipated increases in hazardous waste generation would be well within the capacity of the Navy's hazardous waste management system. The anticipated increases also are well within the existing capacities of hazardous waste transporters and treatment and disposal facilities.

Table 3.3-13: Estimated Expenditures of Training Materials on SCI, Alternative 2

Activity Area	Expenditures, Annual					
	Gun Shell	Cannon / Mortar Shell	Small Arms	Flares / Smokes	Missiles / Rockets	Bombs
Amphibious Warfare	5,400	2,720	244,000	0	369	459
Naval Special Warfare	0	285	6,040,000	554	0	0
Strike Warfare	0	0	6,870	16	212	2,300
Space and Naval Warfare	109	0	0	0	28	
Total (number/year)	**5,510**	**3,010**	**6,290,000**	**570**	**609**	**2,760**
Total (weight in tons)	**164**	**22**	**44**	**0.23**	**22**	**234**
Estimated UXO (number/yr)	**276**	**150**	**NA**	**29**	**30**	**138**
Estimated Low-Order (number/yr)	**11**	**6**	**NA**	**1**	**1**	**6**

Notes: Numbers of training items are estimates, and are rounded to three significant digits to indicate their relative imprecision. lb - pound, yr - year.
Source: DoN 2007.

3.3.5 Mitigation Measures

The Navy's process for managing hazardous waste and materials mitigates the potential for environmental impact (See Sections 3.3.3.1.1 and 3.3.3.2.2).

3.3.6 Unavoidable Adverse Environmental Effects

Under the Proposed Action, hazardous constituents of expended training materials and their degradation products would accumulate in soils at a faster rate. No other unavoidable adverse effects were identified.

3.3.7 Summary of Effects by Alternative

The reasonably foreseeable activities that could add incremental impacts to the past and present impacts from hazardous waste, described in this section, have been addressed by the analyses under the No Action Alternative, Alternative 1, and Alternative 2. Table 3.3-14 presents a summary of these effects and mitigation measures.

Table 3.3-14: Summary of Effects by Alternative

Alternative	NEPA (On-Land and U.S. Territorial Waters)	EO 12114 (Non U.S. Territorial Waters)
No Action Alternative	• SCI on-island use of expendable training materials will deposit tens of thousands of pounds of training materials on the land ranges. Most of the degradation products of these materials are nonhazardous inorganic materials, however, hazardous constituents and metals from ordnance are deposited into soils including lead, nickel, chromium, and copper. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.
Alternative 1	• Impacts on SCI would be similar to those of the No Action Alternative. Overall volume of expended training materials would increase by about 50%. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.
Alternative 2	• Impacts on SCI would be similar to those of the No Action Alternative. Overall volume of expended training materials would increase by about 68%. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.	• No effect from land activities. • The Navy's existing hazardous waste management system is sufficient for handling of wastes generated by the proposed action.
Mitigation Measures	• The Navy's general instructions (e.g., OPNAVINST 5090.1C) and training activity planning and review processes serve to ensure that hazardous materials and hazardous wastes are stored and handled appropriately.	• The Navy's general instructions (e.g., OPNAVINST 5090.1C) and training activity planning and review processes serve to ensure that hazardous materials and hazardous wastes are stored and handled appropriately.