# 3.3 Water Resources

# 3.3 WATER RESOURCES

## 3.3.1 Affected Environment

For purposes of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS), the Region of Influence (ROI) for water resources consists of the Gulf of Alaska (GOA) Temporary Maritime Activities Area (TMAA). Areas inland from the coastline, including United States (U.S.) Air Force (Air Force) air ranges and U.S. Army (Army) training lands, are addressed in the *Alaska Military Operations Areas EIS* (USAF 1995), *Improvements to Military Training Routes in Alaska Environmental Assessment* (USAF 2007), *Alaska Army Lands Withdrawal Renewal Final Legislative EIS* (Army 1999) and the *Transformation of U.S. Army Alaska FEIS* (Army 2004).

In general, water resources include the following components:

- Water bodies, including lakes, ponds, rivers, groundwater, the ocean, and transitional areas such as wetlands and estuaries;
- Water processes, including ocean currents, seasonal changes in precipitation and resulting runoff, percolation from surface to aquifers, and biological, physical, and chemical changes that occur as water moves through the hydrologic cycle;
- Water uses, including drinking, recreation, commerce such as transportation and fishing, and plant and animal habitat;
- Water quality, including the chemical and physical composition of groundwater and fresh and marine surface waters, as affected by natural conditions and human activities; and
- The topography of the ocean bottom (bathymetry) that influences currents and sediment movement.

### 3.3.1.1 Ocean Water Resources

Alaska's water resources, including the GOA, are generally in pristine condition because of the low intensity of use in this remote area (U.S. Environmental Protection Agency [USEPA] 2004). Marine water resources in the study area are affected by ocean currents, climate and weather patterns, and bathymetry. Ocean currents influence conditions in the study area by altering surface water temperatures, transporting and depositing sediments, and concentrating or diluting the resources on which marine life depends. Similarly, prevailing winds change with the season and alter the movement of surface waters. During spring and summer, southerly winds push surface waters away from the coast and bring cold, nutrient-rich waters from deeper areas, a process known as upwelling. These processes sustain active fisheries for a variety of fish and marine invertebrates, influence weather patterns and the hydrologic cycle of much of the western United States, and play a vital role in the economy of many coastal communities.

**Pacific Ocean**

The TMAA is located in the Northeast Pacific Ocean off the mountainous coast of southern Alaska. The temporary boundaries of TMAA form a roughly rectangular area oriented from northwest to southeast, approximately 300 nautical miles (nm) (556 kilometers [km]) long by 150 nm (278 km) wide, situated south of Prince William Sound and Kenai Peninsula and east of Kodiak Island. Covering approximately 42,146 square nautical miles ($nm^2$) (145,482 square kilometers [$km^2$])of ocean, the TMAA spans both coastal and deepwater habitats ranging from approximately 426 feet (ft) (130 meters [m]) to over 12,000 ft (3,660 m) in depth. The GOA forms a large, semicircular bight opening southward into the North Pacific Ocean. The GOA is characterized by a broad and deep continental shelf containing numerous troughs, seamounts, and ridges. The region receives high amounts of freshwater input, experiences numerous storms, and exhibits highly variable environmental conditions (Department of Navy [DoN] 2006).

#### Continental Shelf

The GOA shoreline is bordered by a deep continental shelf subject to persistent coastal downwelling. The GOA continental margin is extremely irregular, having been shaped by glacial forces, plate tectonics, and ocean currents. Bottom depths along the shelf range from 490 ft to 660 ft (150 to 200 m). The continental shelf encompasses approximately $1.1 \times 10^5$ $nm^2$ ($3.7 \times 10^5$ $km^2$) of ocean floor. The width of the continental shelf varies from 3 to 110 nm (5 to 200 km) at different points along the GOA (DoN 2006).

#### Seamounts

Seamounts are isolated underwater mountains rising 3,000 to 10,000 ft (900 to 3,000 m) above the surrounding ocean bottom. Seamounts are found in all oceans, but are most numerous in the Pacific Ocean, which has over 2,000. The significant seamounts in the TMAA are the Dall, Pratt, Giacomini, Ely, Quinn, and Surveyor Seamounts (Figure 3.3-1). These seamounts, except for Dall Seamount, are part of the Kodiak-Bowie Seamount chain, which is a chain of extinct volcanoes that formed over the Bowie Hotspot as the tectonic plate shifted. Seamounts provide a unique habitat for both deep-sea and shallow-water organisms because of their large ranges of depth, hard substrate, steep vertical gradients, convoluted surfaces, variable currents, clear oceanic waters, and geographic isolation. Upwelling often occurs around seamounts because currents push cold water from the depths up the slopes of the seamounts, bringing fresh nutrients to the surface.

#### Submarine Canyons

Submarine canyons have steep walls, winding valleys, narrow V-shaped cross-sections, steps, and considerable irregularity along the sea floor. Many troughs and canyons in the GOA transect the continental shelf (DoN 2006). They are the flooded remains of terrestrial canyons cut by large rivers fed by glacial meltwater. The floors of submarine canyons are primarily mud, with isolated sandy patches. Currents flowing through submarine canyons transport sediment from the coast to the deep ocean, forming sediment fans where they open to the abyssal plain.

The major troughs within the TMAA, Stevenson and Amatuli, are located on the eastern edge of Kodiak Island. These troughs are broad, U-shaped valleys that extend from near the shoreline to the shelf break. All of the troughs are relatively straight, running in a northwest to southeast orientation, and are often located between two broad submarine banks. The troughs along Kodiak Island range in depth from 490 ft to 980 ft (150 m to 300 m). The slope of the ocean floor in these troughs is gradual, rarely exceeding two degrees (DoN 2006).

The Aleutian Trench runs along the shelf margin in the Gulf of Alaska and is one of the deepest portions of the eastern North Pacific. It stretches from the southern coastline of Alaska to waters of the northeastern coast of Siberia. The trench is approximately 2,000 nm (3,700 km), with an average width of 27 nm (50 km) and a maximum depth of 25,300 ft (7,700 m) (DoN 2006). The Aleutian Trench is a tectonic subduction zone, where the Pacific Plate is subducted under the North American Plate.

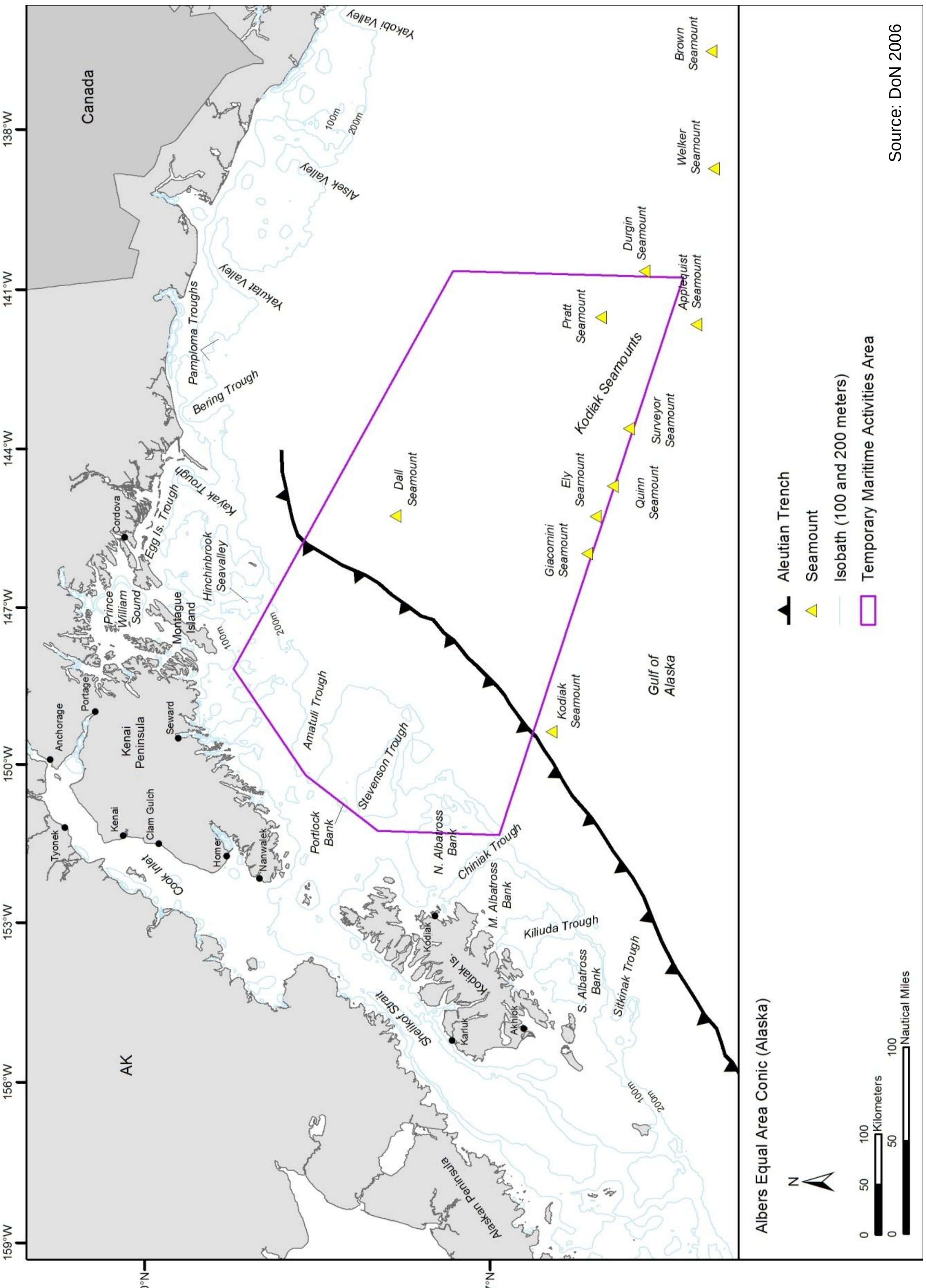


**Figure 3.3-1: Major Geological Features of the TMAA and Vicinity**

### Abyssal Plain

The abyssal plain is a relatively flat area of the deep ocean floor beyond the foot of the continental slope. Depths vary from 9,800 to 16,000 ft (3,000 to 5,000 m) (DoN 2006). The abyssal plain is relatively flat and featureless because fine-grained sediments, mostly silt and clay, have filled in the originally uneven surface of oceanic crust. Most of this sediment is deposited by currents that have been channeled from the continental margins along submarine canyons. The remainder of the sediment is dust blown out to sea from land and the remains of small marine plants and animals that sink from the upper layer of the ocean, known as pelagic sediment.

### Climate

The GOA remains ice-free for the entire year, with the warmest sea surface temperatures in August and the coldest sea surface temperatures in February and March. Portions of bays and inlets may be covered by ice or may have floating glacial ice during the coldest months.

### El Niño

El Niño Southern Oscillation (El Niño) events affect the GOA; these events can initiate large shifts in global climate, atmospheric circulation, and oceanographic processes. El Niño conditions typically last 6 to 18 months, but can persist for longer periods. El Niño events cause global changes over time scales of months to years. El Niño is caused by the interannual changes in sea level pressures between the eastern and western hemispheres of the tropical Pacific Ocean. The trade winds weaken in the central and western Pacific Ocean, and cause the normal east-to-west surface water transport to decrease. The result is a rise in the sea surface temperature across the mid- to eastern Pacific Ocean (DoN 2006).

### La Niña

La Niña is the opposite phase of El Niño in the Southern Oscillation cycle, and is usually associated with the opposite climatic effects. La Niña is characterized by strong trade winds that push the warm surface waters back across to the western Pacific Ocean. Under these conditions, along with increased upwelling along the eastern Pacific Ocean coastline, the thermocline in the eastern Pacific Ocean becomes shallower (DoN 2006). (The thermocline is that portion of the water column between a relatively warm surface zone and a colder deep-water zone, in a thermally stratified [layered] body of water, where the temperature decreases rapidly with increasing depth).

### Arctic Oscillation

The Arctic Oscillation (AO), which affects the GOA, varies based on atmospheric changes in the polar region and mid-latitudes. It varies between negative and positive phases on a decadal scale. The negative phase generally consists of higher-than-normal pressure over the polar region, while the positive phase consists of intense low pressure (USEPA 2004). The low-pressure system results in stormy weather, with high winds and increased precipitation, as well as elevated sea levels and warmer water temperatures. Under these conditions, the wind-induced cross-shelf transport and the Alaska Coastal Current (ACC) increase (DoN 2006).

### Ocean Currents

The general ocean circulation in the GOA is dominated by the counter-clockwise Alaska Gyre, centered at approximately 52º to 53º north (N) and 145º to 155º west (W). The Gyre includes the Alaska Current (AC), the Alaskan Stream (AS), and the North Pacific Current (NPC). Nearshore flow is dominated by the ACC (DoN 2006).

### North Pacific Current

The NPC, also called the West Wind Drift, flows along the southern boundary of the GOA at a velocity of 2 to 6 inches per second (in/sec) (5 to 15 centimeters per second [cm/sec]). The NPC originates in northern Japan, and flows eastward toward North America. The NPC diverges off of the western coast of North America; the northward flow becomes the AC, while the southward flow becomes the California Current. Along the Aleutian Islands, some water from the AS re-circulates into the NPC (DoN 2006).

### Alaska Current

The AC is a northward-flowing, warm-water current offshore of the continental shelf. The AC is broad, 54 to 220 nm (100 to 400 km) wide, and highly variable. It is the dominant transport system of surface waters in the GOA. The AC flows adjacent to the coast of North America at velocities between 30 and 100 cm/sec (DoN 2006). The AC frequently meanders and eddies along the shelf break, most frequently in the fall. Eddies propagate shoreward as the AC proceeds north, with troughs or trenches from the shelf break creating clockwise eddies toward shore (DoN 1993). These eddies cause a variety of ocean currents near the edge of the continental shelf. The AC flows northward along the coast of Alaska to the head of the GOA, where the current follows the curve of the shoreline and forms the AS. Shifts in regional climate also can play a role in the AC. For example, during an El Niño event, the AC destabilizes, increasing the variability in flow volume and direction (DoN 2006).

The AC originates in the western Pacific Ocean, and marine pollution and floating refuse from Asia, from open ocean dumping and from accidents at sea, can be swept northward and westward around the shelf edge in the GOA. Trash from the international fishing industry operating 200 miles offshore is commonly found on beaches in the region (DoN 2006).

### Alaska Coastal Current

The ACC is the primary element of shelf circulation in the GOA. This current originates along the continental shelf of British Columbia. In some years, however, the ACC may start as far south as the Columbia River. The ACC flows west throughout the year along the inner third of the continental shelf, which is approximately 19 nm (35 km) from shore. It is fed by winds, runoff from glaciers, snowmelt, rainfall, and freshwater discharge. The width, speed, and depth of the ACC vary with location along the coast. Late fall and early winter are periods of maximum transport because of accumulated freshwater discharge and strong winds. ACC velocities may exceed 39 in/sec (100 cm/sec) during this period. Minimum transport occurs in the early summer, prior to the spring melt, when local wind stress is weak. The ACC provides a sizeable and ecologically important transition zone between the nearshore and oceanic communities (DoN 2006).

### Alaskan Stream

The AS, which forms at the head of the GOA, is the extension of the AC, and flows westward along the Alaska Peninsula. The AS is narrow (185 nm [100 km]) and swift (18 to 48 in/sec [45 to 123 cm/sec]), affecting the upper 1,600 ft (500 m) of the water column. Periods of low pressure during the AO affect the velocity of the AS; velocities increase northeast of Kodiak Island and decrease southwest of the island (DoN 2006).

### Ocean Water Parameters

Ocean water parameters of interest include temperature, salinity, dissolved oxygen, nutrients, and alkalinity (pH). These parameters influence the rates of chemical and biological processes and the mobility of various substances, such as dissolved metals.

### Temperature

The GOA can be generally characterized by two surface temperature regimes throughout the year. Relatively warm surface water occurs over the continental shelf, while colder water is found farther offshore beyond the shelf break. Surface temperatures within the AC vary by approximately 20 degrees Fahrenheit (°F) (10 degrees Celsius [°C]) throughout the year. On the inner shelf, mean monthly sea surface temperatures (SSTs) range from approximately 38°F (3.5°C) in March to 57°F (14°C) in August. Across the shelf, changes in SSTs are generally small (approximately 4°F [2°C]). The overall difference in annual temperature diminishes with depth, with the annual range being only 2°F (1°C) at depths greater than 490 ft (150 m). During winter, intense circulation over the GOA produces easterly coastal winds and downwelling, which results in a well-mixed water column over the continental shelf. Stratification develops during summer because of decreased winds, increased freshwater discharge, and increased solar radiation (DoN 2006).

Anomalous warmer SSTs in the GOA often are associated with El Niño events. El Niño events do not always result in an immediate shift in SSTs in the North Pacific Ocean; SST anomalies were detected in the region one year after the onsets of the 1976, 1982, 1986, and 1992 El Niño events. During positive AOs, the GOA experiences above-average SSTs. Negative AOs result in below-average SSTs (DoN 2006).

### Salinity

The North Pacific Ocean is less saline than the North Atlantic Ocean. Fresh water entering the North Pacific Ocean inhibits the development of deep water masses, which affects oceanic heat transport. The annual average fresh water influx is approximately $8.1 \times 10^5$ cubic feet per second ($ft^3/sec$) (23,000 cubic meters per second [$m^3/sec$]). This runoff enters the marine environment through many small drainage systems. The discharges peak in early fall and decrease rapidly during winter, when precipitation is stored as snow. A secondary runoff peak occurs in spring and summer from snowmelt in the region. This discharge, approximately 20 percent greater than the mean annual Mississippi River discharge, accounts for nearly 40 percent of the freshwater flows into the GOA. The phasing and magnitude of these freshwater flows are important, because salinity primarily affects horizontal and vertical density gradients in the northern GOA. Seasonal variability in the upper layers of the offshore Alaska Gyre reflects the effects of wind-induced mixing and heat exchange with the atmosphere (DoN 2006).

The vertical salinity structure of the GOA and Alaska Gyre consists of a seasonally varying upper layer extending from the surface to approximately 330 ft (100 m) depth, a halocline (a strong, vertical salinity gradient) that extends from 330 ft to 660 ft (100 m to 200 m) depth, where the salinity increases from 33 to 34 practical salinity units (psu), and a deep layer extending to approximately 3,300 ft (1,000 m), where the salinity increases slowly to 34.4 psu. Beneath the deep layer, the salinity increases gradually to a maximum value of approximately 34.7 psu at the ocean bottom. The halocline is a permanent feature of the subarctic North Pacific Ocean. It is formed by the high rates of precipitation and runoff, in conjunction with large-scale circulation processes of the North Pacific Ocean. The strong density gradient of the halocline limits vertical exchange between the saline and nutrient-rich deep water and the upper layer (DoN 2006).

During the winter, salinities in the upper layer of ocean water range from 32.5 to 32.8 psu. The upper layer in the northern GOA is less saline and colder than the upper layer in the southern GOA. During spring, the upper layer gradually becomes less saline and warms because wind speeds decrease and solar heating increases. Salinities reach a minimum of approximately 25 psu in August. Decreasing wind speeds allow intrusion of high salinity waters from the oceanic regions of the GOA onto the shelf. The summer mixed layer includes a weak secondary halocline, a vertical salinity gradient, centered at approximately 98 ft (30 m) depth. As atmospheric cooling and wind-mixing increase in fall, the seasonal water density gradient erodes rapidly and the physical properties of the upper layer revert to winter conditions (DoN 2006).

#### Dissolved Oxygen, Nutrients, and pH

The major chemical parameters of marine water quality include dissolved oxygen, nutrient concentrations, and pH. The major ions present in seawater include sodium, chloride, potassium, calcium, magnesium, and sulfate.

Surface waters are usually saturated or supersaturated with dissolved oxygen as a result of photosynthetic activity and wave mixing. Below the surface, dissolved oxygen generally remains between 0.4 and 0.6 milliliter per liter (mL/L). Anaerobic (no oxygen) conditions are found in bottom sediments and at the water-sediment interface in deep ocean basins (Dailey et al. 1993).

Nutrients are chemicals or elements necessary to produce organic matter. In marine systems, basic nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. The nitrate concentration of nearshore water varies from 0.1 to 10.0 micrograms per liter (µg/L). The lowest concentrations typically occur in summer. At a depth of 33 ft (10 m), the concentration of phosphate ranges from 0.25 to 1.25 µg/L, while the concentration of silicate ranges from 2.0 to 15 µg/L (Dailey et al. 1993).The marine environment has relatively stable pH (between 7.5 and 8.5) because of the presence of dissolved elements, particularly carbon and hydrogen. Most of the carbon in the sea is present as dissolved inorganic carbon that originates from the complex interaction of dissolved carbon dioxide ($CO_2$) and water. This $CO_2$-carbonate equilibrium system is the major buffering system in seawater, meaning that it keeps pH stable.

### Existing Ocean Water Quality

There is little information on open ocean water quality, but some studies suggest that deep water is generally of higher quality than surface waters. Water quality in the marine environment is determined by complex interactions between physical, chemical, and biological processes. Physical processes include regional currents and tidal flows, seasonal weather patterns and temperature, sediment characteristics, and unique local conditions.

Chemical processes involve salinity, pH, dissolved minerals, oxygen, nutrient levels, and pollutants. Biological processes involve the influence of living things on the physical and chemical environment, such as the uptake, conversion, and excretion of materials during growth, reproduction, and decomposition. These processes operate and interact continuously, creating a dynamic system. Changes in these conditions alter the viability of habitat at certain locations and water depths to various organisms. For instance, excessive nutrients (eutrophication) can lead to algal blooms, subsequent die-offs, and declines in dissolved oxygen (hypoxia) to the point where fish can no longer survive.

Contaminants found in marine environments include suspended solids, sediment, nutrients and organic materials, metals, synthetic organic compounds such as pesticides and plastics, and pathogens. The sources of these contaminants include commercial and recreational vessels, oil spills, industrial and municipal discharges (point source pollution), legal and illegal ocean dumping, poorly or untreated sewage, and runoff from urban and agricultural areas (nonpoint source pollution). Conduits for contamination include streams, rivers, and air currents that carry materials from inland areas to the sea. Alaska coastal resources are generally considered to be pristine because of the low population density and the distance of most of its coastline from major urban and industrial areas (USEPA 2004).

Potential pollutants should be viewed in the context of their "bioavailability," that is, the capacity of material to be taken up by living organisms through physical contact or ingestion. Factors that influence bioavailability include the ocean water parameters noted previously (i.e., temperature, salinity, dissolved oxygen, nutrients, and pH). In sediments, bioavailability is influenced by particle size, organic carbon content, the presence of iron oxyhydroxides and iron sulphides, and the presence of other metals.

### Ocean Sediment Parameters

A variety of ocean floor sediment compositions are found within the GOA. Sediment types include gravely sand, silty mud, muddy to sandy gravel, and hard rock. The northeastern GOA continental shelf is mainly composed of clay silts from the Copper River or glacial deposition. The western area has steep slopes and visible scouring. There are many banks and reefs with primarily coarse or rocky bottoms, while basins and other depressions may accumulate bottom sediments (U.S. Department of Commerce, National Oceanic and Atmospheric Administration [USDC, NOAA] 2005).

The mountains surrounding the GOA are geologically young, and provide plentiful sources of sediment to the marine environment. Glacial scouring of the underlying bedrock also provides an abundance of fine-grained sediments to the Gulf of Alaska shelf and basin. The Bering and Malaspina glaciers are major sources of glacial sediments in the Gulf of Alaska. The Alsek and Copper Rivers in the northern GOA, and the Knik, Matanuska, and Susitna Rivers that feed Cook Inlet all contribute sediment as well (DoN 2006). The majority of rivers along the Pacific Coast drain small, steep watersheds that produce large amounts of sand-sized sediment. Submarine canyons are major conduits for sediment transport to the open ocean. The remainder of the sediment is composed of dust blown out to sea from land, and the remains of small marine plants and animals that sink from the upper layer of the ocean. The Continental Rise in the eastern GOA is an accumulation of sediments from the continental shelf; these fine sediments are generally transported west.

#### Existing Ocean Sediment Quality

Several factors influence the extent and severity of sediment contamination in aquatic systems. Fine-grained (less than 0.63 micrometer [μm]), organic-rich sediments bind some toxicants, such as heavy metals, so strongly that their threat to organisms is greatly reduced. Conversely, these fine-grained sediments are also easily resuspended and transported to distant locations. Thus, silty sediments high in total organic carbon are potential sources of contamination. But such statements do not apply equally to all potential pollutants. Metals such as lead and large organic molecules such as polycyclic aromatic hydrocarbons and polychlorinated biphenyls tend to remain in sediments. More soluble chemicals tend to remain as ions in the pore water surrounding the sediments (Canadian Forces Maritime Experimental and Test Ranges [CFMETR] 2005). At this time, there are no data on sediment quality within the TMAA.

### 3.3.1.2 Current Requirements and Practices

At sea, Navy vessels are required to operate in a manner that minimizes or eliminates any adverse impacts on the marine environment. Environmental compliance policies and procedures applicable to shipboard operations afloat are defined in Chief of Naval Operations Instruction (OPNAVINST) 5090.1C, Chapter 3, "Pollution Prevention," and Chapter 19, "Environmental Compliance Afloat" (DoN 2007a); Department of Defense (DoD) Instruction 5000.2-R (§C5.2.3.5.10.8, "Pollution Prevention"). In addition, provisions in Executive Order (EO) 12856, *Federal Compliance With Right-To-Know Laws and Pollution Prevention Requirements*, and EO 13101, *Greening the Government through Waste Prevention, Recycling, and Federal Acquisition* reinforce the prohibition in the Clean Water Act (CWA) against discharge of harmful quantities of hazardous substances into or upon U.S. waters out to 200 nm (371 km), and mandate stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements. Table 3.3-1 provides information on Navy Standard Operating Procedures and Best Management Practices for shipboard management, storage, and discharge of hazardous materials and wastes, and on other pollution protection measures intended to protect water quality. Onshore policies and procedures related to spills of oil and hazardous wastes are detailed in OPNAVINST 5090.1C, Chapter 12. (DoN 2007a).

Shipboard waste-handling procedures governing the discharge of nonhazardous waste streams have been established for commercial and Navy vessels. These categories of wastes include solids (garbage) and liquids such as “black water” (sewage), “gray water” (water from deck drains, showers, dishwashers, laundries, etc.), and oily wastes (oil-water mixtures). Table 3.3-1 summarizes the waste stream discharge restrictions for Navy vessels at sea.

**Table 3.3-1: Waste Discharge Restrictions for Navy Vessels**

| Zone (nm from shore) | Type of Waste | |
|---|---|---|
| | **Black Water (Sewage)** | **Gray Water** |
| U.S. Waters (0-3 nm) | No discharge. | If vessel is equipped to collect gray water, pump out when in port. If no collection capability exists, direct discharge permitted. |
| U.S. Contiguous Zone (3-12 nm) | Direct discharge permitted. | Direct discharge permitted. |
| >12 nm from shore | Direct discharge permitted. | Direct discharge permitted. |
| **Zone** | **Oily Waste** | |
| U.S. Waters (0-3 nm) | Discharge allowed if waste has no visible sheen. If equipped with Oil Content Monitor (OCM), discharge < 15 parts per million (ppm) oil. | |
| U.S. Contiguous Zone (3-12 nm) | Same as 0-3 nm. | |
| >12 nm from shore | If equipped with OCM, discharge < 15 ppm oil. Vessels with oil/water separator but no OCM must process all bilge water through the oil-water separator. | |
| **Zone** | **Garbage (Plastic)** | **Garbage (Non-plastic)** |
| U.S. Waters (0-3 nm) | No discharge. | No discharge. |
| U.S. Contiguous Zone (3-12 nm) | No discharge. | Pulped or comminuted food and pulped paper and cardboard waste may be discharged >3nm |
| 12-25 nm from shore | No discharge. | Bagged shredded glass and metal waste may be discharged >12nm[1] |
| > 25 nm from shore | No discharge | Direct discharge permitted[2] |

Note: (1) Submarines may discharge compacted, sinkable garbage between 12 nm and 25 nm provided that the depth of water is greater than 1,000 fathoms.
(2) Surface ships shall use pulpers and shredders for all discharges of food products, paper, cardboard, glass and metal wastes
Source: DoN 2007a

In 1990, Congress enacted the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Title I of Public Law 101-646; 16 United States Code [U.S.C.] §§4701, et seq.), which established a federal program to prevent the introduction and to control the spread of unintentionally introduced aquatic nuisance species and gave the U.S Coast Guard jurisdiction over ballast water management. In 1996, the

National Invasive Species Act amended the Nonindigenous Aquatic Nuisance Prevention and Control Act to create a national ballast management program modeled after the Great Lakes program wherein all ships entering U.S. waters (after operating outside the U.S. Exclusive Economic Zone) are directed to undertake high seas (i.e., mid-ocean) ballast exchange or alternative measures pre-approved by the Coast Guard as equally or more effective. When the National Invasive Species Act amended the Nonindigenous Aquatic Nuisance Prevention and Control Act in 1996, 16 U.S.C. 4713 was added, which indicated that the DoD was to establish its own ballast water management program for seagoing vessels of the Department of Defense. Additionally, the Clean Water Act was amended in 1996 to allow for the Secretary of the Defense and Administrator of the USEPA to work in consultation with the U.S. Coast Guard and interested states to determine discharges incidental to the normal operation of a vessel of the Armed Forces for which it is reasonable and practicable to require use of a marine pollution control device.

On May 10, 1999, USEPA and DoD published the final rule establishing regulations for undertaking to establish the Uniform National Discharge Standards for Vessels of the Armed Forced. This rule completed the first phase of a three-phase process to set the Uniform National Discharge standards. This Phase I rule determined the type of vessel discharges that require control by marine pollution control devices and those that do not, based on anticipated environmental effects of the discharge as well as factors listed in the Clean Water Act. A total of 25 vessel discharges that could cause an adverse impact on the environment requiring control standards have been identified under Phase I of the program (Federal Register 64[89], 25126-25138). Dirty ballast was one of the types of incidental discharges identified to require a marine pollution control device in Phase I. Phase II involves developing performance standards and control procedures for those discharges. The Navy and USEPA have agreed to promulgate Phase II standards in batches. The batch rulemaking approach allows the Navy and USEPA to conduct technical analyses and develop discharge standards in batches (approximately five discharges per batch) rather than conducting analyses and developing standards for all 25 discharges at one time. To date, this Phase II process is still ongoing.

Therefore, since Navy ships operate worldwide, the Navy has chosen to adopt the intent of the U.S. Coast Guard standards with respect to ballast water management even though U.S. Coast Guard regulations exempt vessels of the Armed Forces that are subject to the Uniform National Discharge Standards from the ballast water guidelines. Under Navy policy, if it is necessary for a surface ship to load ballast water in an area that is either potentially polluted or within three nm from the shore, the ship will pump the ballast water out when outside 12 nm (22 km) from shore and twice fill the tanks with clean sea water and pump prior to the next entry within 12 nm (22 km) from shore. It is also Navy policy to not exchange ballast water during local operations (within the same locale) or when returning within 12 nm (22 km) in the same locale as the ballast water was initially loaded. Surface ships maintain records of all ballast water exchanges. In addition, surface ships routinely wash down anchors, chains, and appendages to prevent on board collection of sediment, mud, and silt. Where possible, following anchor retrieval, surface ships wash down chain lockers outside 12 nm (22 km) from land to flush out sediment, mud, or silt.

### 3.3.2 Environmental Consequences

The ROI for water resources includes the GOA TMAA (Section 3.3.1). Navy training activities within Air Force inland Special Use Airspace and Army inland training lands were evaluated under previous National Environmental Policy Act (NEPA) documentation (USAF 1995, USAF 2007, Army 1999, Army 2004). These documents are incorporated by reference. Environmental effects in the open ocean beyond the U.S. territorial seas (outside of 12 nm [22 km]) are analyzed in this EIS/OEIS pursuant to EO 12114.

#### 3.3.2.1 Previous Analyses

Impacts related to water resources were previously evaluated in Section 3.1 of the *Alaska Military Operations Area EIS* (USAF 1995); Section 3.0 of the *Improvements to Military Training Routes in Alaska Environmental Assessment* (USAF 2007); Sections 3.8, 3.9, 4.8, and 4.9 of the *Alaska Army Lands Withdrawal Renewal Final Legislative EIS* (Army 1999); and Sections 3.5, 3.6, 4.5, and 4.6 of the *Transformation of U.S. Army Alaska FEIS* (Army 2004).

#### 3.3.2.2 Regulatory Framework

Marine ecosystems in the study area developed around, and are sustained by, the chemical, physical, and biological processes and the seasonal patterns in each environment. The health of these systems, as well as human use of the water resources in the study area, is monitored and protected by international, federal, State, and local laws and regulations. The following subsections describe the legal and regulatory framework applicable to military training activities in the GOA. International, federal, and State regulations on solid waste and hazardous materials are described in Section 3.2, Expended Materials.

**International**

MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978, is the primary international marine environmental convention. MARPOL 73/78 is designed to minimize pollution from ships. It contains six major annexes or sections: I-Oil, II-Noxious Liquid Substances in Bulk, III-Harmful Substances Carried by Sea in Packaged Form, IV-Sewage from Ships, V-Garbage from Ships, and VI-Air Pollution from Ships. Discharges from ships are restricted within specified distances from shore. On the open seas, natural bacterial action is considered adequate for dealing with raw sewage. The U.S. is not party to Annex IV-Sewage from Ships (USEPA 2009); however, the Navy regulates discharges from vessels under OPNAVINST 5090.1C (Table 3.3-1).

**Federal**

The principal federal law protecting water quality is the Federal Water Pollution Control Act, more commonly known as the CWA (33 U.S.C. 1251 et seq.), which is enforced by the USEPA. In addition, NOAA oversees coastal and marine water resources under CWA, the Coastal Zone Management Act (CZMA), the Marine Plastic Pollution Research and Control Act (MPPRCA), and the Oil Pollution Act (OPA). NOAA also is responsible for managing and protecting coastal and marine habitats through its National Marine Fisheries Service (NMFS).

**Clean Water Act**

The goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters, including coastal and marine waters. The USEPA establishes National Ambient Water Quality Criteria (USEPA 2006) for priority and non-priority pollutants. These criteria for aquatic life and human health include both seawater and freshwater concentrations. These criteria are published for enforcement through Section 304(a) of the CWA. Various CWA sections govern point sources and nonpoint sources of pollution. Oil and hazardous substances are regulated by CWA §311 out to the boundary of the contiguous zone.

**Coastal Zone Management Act**

The federal CZMA (16 U.S.C. 1451, et seq.) is a voluntary state-federal partnership that encourages states to adopt programs that meet federal goals of protecting and restoring coastal zone (CZ) resources, including protecting coastal waters from nonpoint source pollution (16 U.S.C. 1455[b]). The program is administered by NOAA. The CZMA requires participating coastal states to develop management programs that demonstrate how they will carry out their obligations and responsibilities in managing their coastal areas. Upon federal approval of a state's coastal zone management program, the state benefits by becoming eligible for federal CZ grants. Activities that occur in the CZ or affect CZ resources are regulated by the adjoining state after federal approval of its coastal zone management plan. The state also gains review authority over certain federal activities in the CZ, and the consistency of those activities with the CZ management plan.

#### Marine Plastic Pollution Research and Control Act

The MPPRCA of 1987 (33 U.S.C. §§ 1901 et seq.) regulates the discharge of garbage, primarily plastics, into the ocean. Under this federal statute, the discharge of any plastic materials (including synthetic ropes, fishing nets, plastic bags, and biodegradable plastics) into the ocean is prohibited. The discharge of other materials, such as floating dunnage (cargo packing materials), food waste, paper, rags, glass, metal, and crockery, is also regulated by the MPPRCA. Ships are permitted to discharge these types of refuse depending on their distance from shore. It is illegal to dump most garbage within 3 nm of shore. From 3 to 12 nm (5.6 to 22 km), it is illegal to dump plastic or any garbage greater than one inch (in) in size. It is illegal to dump dunnage and plastics within 12 to 25 nm (22 to 46 km) of shore. An additional component of the MPPRCA requires that all ocean-going, U.S.-flagged vessels greater than 40 ft (12.2 m) in length or manned, fixed, or floating platforms subject to U.S. jurisdiction keep records of garbage discharges and disposals.

#### Oil Pollution Act

The OPA (33 U.S.C. §§ 2701 et seq.), passed in 1990, increased the protection of our nation's oceans by amending the CWA and including new policies relating to oil spill prevention and cleanup methods. The OPA provides regulations for the prevention of the discharge of oil into the ocean waters out to the limits of the contiguous zone (out to 25 nm). Any party that is responsible for a vessel, offshore facility, or deepwater port that could cause an oil spill must maintain proof of financial responsibility for potential damage and removal costs. OPA identifies the parties that are liable in a variety of oil spill circumstances and what damage and removal costs must be paid. The President has the authority to use the Oil Spill Liability Trust Fund to cover these costs when necessary. Any cost for which the fund is used must be in accordance with the National Contingency Plan, which is an oil and hazardous substance pollution prevention plan established by the CWA. Federal, state, Indian tribe, and foreign trustees must assess the natural resource damages that occur from oil spills in their trusteeships, and develop plans to restore the damaged natural resources. The Act also establishes an Interagency Coordinating Committee on Oil Pollution Research to research and develop plans for natural resource restoration and oil spill prevention.

#### Marine Protection, Research, and Sanctuaries Act

The Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972, also known as the Ocean Dumping Act, regulates materials dumped into ocean waters that could endanger human health, welfare, and amenities, and the marine environment, ecological systems, and economic possibilities. The Ocean Dumping Act regulates the disposal of any material in the U.S. territorial seas or contiguous zones, as well as the marine disposal anywhere of waste and other material that originated in U.S. territory or was transported on U.S.-registered vessels or aircraft.

The Navy currently holds a General Permit for Sinking Exercise (SINKEX) activities from the USEPA under the MPRSA(40 CFR §229.2, Transport of Target Vessels). This MPRSA permit allows the Navy to transport vessels in ocean waters for the purpose of sinking the vessel. Pursuant to the MPRSA permit, vessel sinkings must be conducted in water at least 6,000 ft (1,830 m) deep and at least 50 nm (93 km) from land. Regulations require that measures be taken to ensure that the vessel sinks to the bottom rapidly and permanently, and does not pose a hazard to marine navigation. In addition, the MPRSA permit requires the appropriate measures be taken to remove, to the maximum extent practicable, all materials that may degrade the marine environment. This includes, but is not limited to, emptying all fuel tanks and fuel lines to the lowest point practicable and removal of trash, floatable materials, and mercury or fluorocarbon containing materials capable of contributing to chemical pollution. The August 1999 SINKEX Letter of Agreement between USEPA and the Navy created additional measures to the MPRSA permit, which are described in Section 3.2, Expended Materials, for removal of materials that may degrade the marine environment.

#### State and Local

Navy training in the TMAA occurs more than 12 nm (22 km) from shore, which is beyond the State of Alaska's regulatory jurisdiction. Therefore, State and local regulations on water quality do not apply to Navy training in the TMAA. The following section is provided only for informational purposes.

##### Water Quality and Pollution Standards

State regulation of water quality is enforced by the Alaska Department of Environmental Conservation (ADEC). The ADEC establishes water quality standards, which may not be consistent with USEPA standards, for enforcement through the Water Quality Standards program. State standards focus on specific water constituents that affect water quality in Alaska. These standards are used to enforce the CWA, but are not effective until approval by USEPA. Protected classes of water bodies are identified in 18 Alaska Administrative Code 70.020, where marine water supply, recreation, propagation of aquatic life and wildlife, and harvest and consumption of raw mollusks and other raw wildlife are all considered under the Water Quality Standards program. The marine water quality standards address fecal coliform bacteria, dissolved gases, petroleum hydrocarbons, oil, grease, and other constituents.

##### Sediment Management Standards

Alaska does not have a sediment quality management program. Due to the extensive shoreline, very little sediment testing is conducted on a regional scale. The State has begun researching cost-effective methods for testing sediment quality, but no actions have been taken. No State standards have been developed.

##### Coastal Zone Management

The Alaskan Legislature enacted the Alaska Coastal Management Act in 1977 (Chapter 84 State Legislature of Alaska 1977), which established the Alaska Coastal Management Plan (ACMP). The CZ extends from 3 nm (5.6 km) offshore to inland areas necessary to control the shoreline, and where land uses would have a substantial effect on coastal resources. The ACMP addresses a variety of issues, including the sustainability of fisheries, impacts of mining, transportation needs and impacts, and other areas of concern within the CZ. The Alaska Department of Natural Resources is the primary authority for the ACMP. Twenty-eight of Alaska's 33 coastal districts are revising their plans to be consistent with the new enforceable policies, updated in 2003 and 2005. The ACMP is described and its applicability to Navy training in the TMAA is discussed in Section 1, Purpose and Need of the Proposed Action.

### 3.3.2.3 Approach to Analysis

#### Data Sources

A systematic review of relevant literature was conducted to complete this analysis of water resources in the study area, including journals, DoD reports and operational manuals, natural resource management plans and other technical reports published by government agencies, prior environmental documents for facilities and activities in the study area, and work conducted by private businesses and consulting firms.

#### Assessment Methods

For each alternative, this document characterizes and quantifies the total amount of training materials, both hazardous and nonhazardous, that are expended annually during Navy training in the TMAA. This analysis does not include materials expended during Navy training in the inland lands of the GOA because those activities are covered by Army and Air Force documents identified in Section 3.3.2.1. Hazardous material weights and leaching rates are based on assumptions identified in Section 3.2.1.1 for each expended training material.

This analysis assumes that expended training materials are deposited on 20 percent of the available training area (TMAA) (DoN 2009). The TMAA consists of an ocean area of approximately 42,146 $nm^2$ (145,482 $km^2$). Deposition of expended materials over 20 percent of the training area would affect an area of approximately 8,430 $nm^2$ (29,100 $km^2$). This is a conservative assumption that is based on Navy personnel experience, which indicates that the distribution of training exercises within ocean training areas is not uniform.

Aircraft overflights occur under all of the alternatives. Aircraft overflights between the TMAA and the Alaska inland training areas would not involve expenditures of training materials. Therefore, aircraft overflights in the GOA will not be addressed further in this section.

#### 3.3.2.4 No Action Alternative

This section analyzes the circumstances under which water quality in the TMAA could be affected by expended materials during training under the No Action Alternative. The No Action Alternative is the baseline for Navy training in the TMAA. Under the No Action Alternative, training exercises are conducted once per year for a short period (up to 14 days). Potential impacts on water quality will result from expended training materials in the marine environment. Expended materials that contain hazardous constituents may affect water quality because hazardous materials can be released during use (i.e. combustion byproducts), directly deposited into the marine environment (i.e. residual explosive material), or leach from expended materials after deposition. Expended training materials may contain several sources of hazardous chemicals, such as missiles that contain heavy metals, propellant, batteries, and explosives. The following section addresses substances of concern, the training materials in which they are found, and their potential impacts on water quality. Detailed analyses of expended and hazardous materials, their possible pathways for insertion into the marine environment, and their environmental fates are provided in Section 3.2, Expended Materials.

This analysis assumes that 99 percent of expended training materials are deposited on 20 percent of the available training area (DoN 2009). This is a conservative assumption that is based on Navy personnel experience, which indicates that the distribution of training activities within sea training areas is not uniform. The TMAA is an ocean area of approximately 42,146 $nm^2$ (145,482 $km^2$). Twenty percent of the TMAA is approximately 8,430 $nm^2$ (29,100 $km^2$).

Aircraft overflights occur under all of the alternatives. Aircraft transiting between the TMAA and Alaska inland training areas would not expend any training materials. Therefore, aircraft overflights associated with Navy training in the GOA will not be further addressed in this section.

**Heavy Metals**

Heavy metals are present in vessels, manned and unmanned aircraft, bombs, shells, missiles, bullets, sonobuoys, batteries, and electronic components, and as anticorrosion compounds coating exterior surfaces (e.g., missiles, vessels). Heavy metals that may be present in expended materials include lead, antimony, brass, copper, nickel, chromium, and cadmium. The USEPA recommends application of a 24-hour acute limit and 4-day chronic limit. Neither limit can be exceeded more than once every 3 years, on the average. Water quality criteria for several pollutants expected to result from expended materials during Navy training are provided in Table 3.3-2.

### Fuels and Propellants

Hazardous chemicals include fuels and other propellants, and combustion byproducts of those fuels and propellants (Section 3.2, Expended Materials). These materials are present in or may be generated by the use of aircraft, vessels, and self-propelled machines such as Expendable Mobile Anti-Submarine Warfare (ASW) Training Targets (EMATTs) and unmanned aerial vehicles.

**Table 3.3-2: Threshold Values for Safe Exposure to Selected Metals**

| Metal | Criteria (µg/L) | |
|---|---|---|
| | Acute (24-hr exposure) | Chronic (4-day mean exposure) |
| Lead | 210 | 8.1 |
| Silver | 1.9 | n/a |
| Copper | 4.8 | 3.1 |
| Cadmium | 40 | 8.8 |
| Nickel | 74 | 8.2 |
| Silver | 1.9 | n/a |
| Lithium[1] | 6,000 | n/a |

n/a = no chronic value is available; µg/L = micrograms per liter; hr = hour
(1) No USEPA criteria available; values shown are based on literature (Kszos et al. 2003)
Source: USEPA 2006

### Explosives

Explosives are contained in live bombs, missiles, and one type of sonobuoy. Most new military explosives are mixtures of plastic or other polymer binders and Royal Demolition Explosive (RDX, cyclotrimethylene trinitramine) or High Melting Explosive (cyclotetramethylene tetranitramine). Pentaerythritol tetranitrate is used in blasting caps, detonation cord, and similar initiators of explosions. Explosives that fail to function as designed (duds) or are low-order detonations result in residual explosives. Dud and low-order detonation rates are discussed in Section 3.2, Expended Materials.

### Non-Hazardous Expended Materials

Non-hazardous expended materials include the parts of a device that are made of nontoxic metals (e.g., steel, iron, aluminum) or polymers (e.g., nylon, rubber, vinyl, and various other plastics); as well as glass and concrete. These materials are used in inert bombs, inert shells, and targets. While these items represent persistent seabed litter, they do not chemically contaminate the environment by leaching heavy metals or organic compounds because of their strong resistance to degradation and their chemical composition. Most of these objects will settle to the bottom. There they will lodge in deep sediments and eventually be covered by sediment. The expended materials may become coated by corrosion (e.g., rust on metal surfaces) or encrusted by marine organisms (e.g., coral), slowing chemical leaching. Therefore, these materials are not subject to further analysis.

### Other Factors Influencing Marine Water and Sediment Quality

The open ocean and nearshore environments are complex and dynamic systems of physical, chemical, and biological components. These components continually influence each other, and are also influenced by other factors. This complexity can make accurately identifying the source of a particular material or predicting the ultimate fate of specific materials expended during training a challenge. For example:

- Many contaminants are conveyed into marine systems by the wind or by surface runoff, such as from rivers.

- Once training materials are deposited, natural physical, chemical, and biological processes can re-suspend, transport, and redeposit these materials in areas far removed from their original source.
- The properties of seawater, such as temperature, salinity, pH, dissolved oxygen concentration, and hardness, affect the mobility and the toxicity of contaminants. The presence of other substances in seawater, such as extremely small particles (< 0.63 µm), bicarbonates, sulfides, phosphates, and other metals, also affect the mobility and the toxicity of contaminants.

**Materials Expended During Training in the TMAA – No Action Alternative**

Table 3.3-3 summarizes the number of items, the weight of expended materials, and the weight of hazardous materials that will be deposited on the ocean floor in the TMAA.

**Table 3.3-3: Training Materials Expended Per Year – No Action Alternative**

| Type of Training Material | Number of Items | Weight of Material (lb) | | Hazardous Content (%) |
|---|---|---|---|---|
| | | Expended Materials | Hazardous Materials | |
| Bombs | 120 | 54,000 | 395 | 0.73 |
| Missiles | 22 | 6,770 | 56.4 | 0.83 |
| Targets and pyrotechnics | 252 | 3,610 | 27.2 | 0.75 |
| Naval gun shells | 10,564 | 10,700 | 1,320 | 12.3 |
| Small arms rounds | 5,000 | 180 | 1.80 | 1.00 |
| Sonobuoys | 24 | 936 | 70.8 | 7.56 |
| **Total** | **15,982** | **76,200** | **1,870** | **2.45** |

Note: Weights of expended and hazardous materials are estimates, and are rounded to three significant digits.

**Bombs**

Approximately 120 bombs per year will be expended in the TMAA under the No Action Alternative, resulting in approximately 54,000 pounds (lb) (24,300 kilograms [kg]) of expended materials. Assuming a distribution of expended materials over 20 percent of the TMAA, the deposition rate of expended bombs will be approximately 6.4 lb of material per $nm^2$ (0.83 kg per $km^2$) per year. Bombs used during training exercises will deposit approximately 395 lb (180 kg) per year of hazardous materials (residual explosives and heavy metals). This rate will increase the amounts of hazardous materials deposited in the TMAA by less than 0.05 lb per $nm^2$ (less than 0.01 kg per $km^2$) per year. The majority of bombs (60 percent) will be inert. They will settle to the ocean bottom, and become encrusted by chemical processes and marine organisms. Inert bombs may contain explosive spotting charges. The amounts will be small, however, and will be consumed upon contact with land or water. Therefore, inert bombs will present no hazard to ocean water resources. Live bombs will have no measurable impact on ocean water resources because most of their hazardous constituents will be consumed upon detonation and a low percentage (approximately 3.37 percent [Rand 2005]) would be duds.

**Missiles**

Table 3.3-4 describes the types of explosives and propellants for selected types of missiles used in the TMAA under the No Action Alternative.

In general, the single largest hazardous constituent of missiles is solid propellant, such as solid double-base propellant, aluminum and ammonia propellant grain, and arcite propellant grain. The solid propellant is primarily composed of rubber (polybutadiene) mixed with ammonium perchlorate. Hazardous constituents, such as Plastic Bonded Explosive (PBX) high-explosive (HE) components, PBX-106 explosive, and PBX (AF)-108 explosive, are also used in igniters, explosive bolts, batteries (potassium hydroxide and lithium chloride), and warheads. Testing has demonstrated that water penetrates only 0.06 in (0.15 cm) into solid propellants during the first 24 hours of immersion, and that fragments will very slowly release ammonium and perchlorate ions (DoN 2007a). These ions will be rapidly diluted and disperse in the surrounding water such that local concentrations will be extremely low.

**Table 3.3-4: Explosives and Propellants in Selected Missiles – No Action Alternative**

| Type of Missile | Number Expended | Type of Propellant |
|---|---|---|
| AIM-7 Sparrow | 6 | Propellant is dual-thrust, solid-fuel rocket motor (Hercules MK-58); warhead is an 88-lb (40 kg) WDU-27/B blast-fragmentation device. |
| AIM-9 Sidewinder | 8 | Propulsion system contains up to 44 lb (20 kg) of solid double-base propellant; warhead contains approximately 10 lb (4.5 kg) of PBX HE. |
| AIM-120 AMRAAM | 6 | Propellant is solid-fuel rocket motor (ATK WPU-6B booster and sustainer with RS hydroxyl-terminated polybutadiene (solid propellant fuel); warhead contains 40 lb (18 kg) of HE. |
| RIM-67A Standard Missile-1 | 2 | Propellant is a two-stage, solid-fuel rocket (MK-30 sustainer motor and a Hercules MK 12 booster); warhead contains 137 lb (62 kg) of HE. |

Source: Global Security 2008a

Another concern is when ordnance does not function correctly—it either does not detonate ("dud") or does not detonate completely (low-order detonation), and some of the explosive remains. As with propellants, these materials can release small amounts of hazardous materials into the water as they degrade and decompose. Table 3.3-5 provides a list of these items.

**Table 3.3-5: Ordnance Constituents of Concern**

| Training Ordnance | Constituent of Concern |
|---|---|
| Pyrotechnics, Tracers, and Spotting charges | Barium chromate and Potassium perchlorate |
| Oxidizers | Lead oxide |
| Delay Elements | Barium chromate, Potassium perchlorate, and Lead chromate |
| Propellants | Ammonium perchlorate |
| Fuses | Potassium perchlorate |
| Detonators | Fulminate of mercury and Potassium perchlorate |
| Primers | Lead azide |

Source: United States Army Corps of Engineers 2007

Twenty-two missiles will be used annually under the No Action Alternative, and no missiles will be recovered after training exercises. The total weight of missiles expended will be 6,770 lb (3,050 kg) each year. If deposited on 20 percent of the training area, this will be a deposition rate of 0.8 lb per $nm^2$ (0.1 kg per $km^2$) per year. Approximately 56.4 lb (25.6 kg) of expended missile material (approximately 38 lb [17 kg] of residual explosives and 18 lb [8.1 kg] of residual propellant) would be considered hazardous. Residual explosives and solid propellants will slowly leach hazardous substances, but would not result in concentrations considered to be harmful. Missile casings are relatively inert, and will corrode in the marine environment. Corrosion and benthic organisms will encrust the missile body, further slowing degradation. Thus, expended training materials will not impact water resources.

### Targets and Pyrotechnics

Table 3.3-6 summarizes the types and numbers of targets and pyrotechnics that will be used in the TMAA under the No Action Alternative. About 276 targets and pyrotechnics will be used annually during training exercises, and 252 (91 percent) will not be recovered after training use. Twenty marine markers and 12 LUU-2B/B illuminating flares will be used, and will be mostly consumed as heat and smoke during use. Approximately 27 lb (12 kg) of residual pyrotechnic material will be expended in the TMAA per year during Navy training. Pyrotechnics make up 97 percent of the unrecovered targets and pyrotechnics.

**Table 3.3-6: Types and Numbers of Targets and Pyrotechnics – No Action Alternative**

| Type of Target or Pyrotechnic | Number of Items |
|---|---|
| **Targets** | |
| TDU-34 towed target | 2 |
| Tactical Air-Launched Decoy (TALD)* | 8 |
| BQM-74E unmanned aircraft | 2 |
| Killer Tomato surface target | 10 |
| SPAR | 10 |
| **Pyrotechnics** | |
| LUU-2B/B* | 12 |
| MK-58 Marine Marker* | 20 |
| Chaff* | 212 |
| **Total number used** | **276** |
| **Total not recovered** | **252** |
| **Total Expended Weight (lb)** | **3,610** |

*Not recovered

Under the No Action Alternative, 540 lb (245 kg) of chaff will be used per year. All components of the aluminum coating are present in seawater in trace amounts, except magnesium, which is present at 0.1 percent. The stearic acid coating is biodegradable and nontoxic. The potential for chaff to have a long-term adverse impact on water quality is very unlikely, and chemicals leached from the chaff will also be diluted by the surrounding seawater, thus reducing the potential for concentrations to build up to levels that can affect sediment quality and benthic habitats. Further analysis of chaff and its environmental effects is provided in Section 3.2, Expended Materials.

Even though chaff dipoles contain aluminum and other trace metals that can ultimately be leached from the chaff, the amount of chaff needed to raise environmental concentrations of these metals above background levels far exceeds the number than can be realistically deposited in a given area of land or body of water. Chaff is generally resistant to chemical weathering, and likely remains in the environment for long periods. Chaff is much like aluminosilicate minerals, so its influence on the physical environment will be small, and likely limited to settling with bottom geology. Ocean waters are in constant contact with crustal materials, so there is little reason to believe that small amounts of chaff would affect either water or sediment composition (Hullar et al. 1999).

### Naval Gun Shells

Under the No Action Alternative, 10,564 gun shells will be expended each year. Assuming a distribution of expended materials over 20 percent of the TMAA, the deposition rate of expended naval gun shells will be approximately 1.26 items per $nm^2$ (0.36 items per $km^2$) per year. Navy training in the TMAA will deposit an estimated 1,320 lb (600 kg) of hazardous material from shells (heavy metals) in the TMAA.

Expended training materials from naval gun shells are relatively inert. Expended materials may contain heavy metals, but effects on water and sediment quality will be limited to a small area around the expended round. Expended materials will settle to the sea bottom, where they will become encrusted by chemical processes and marine organisms. Metals will leach slowly, and will not pose a hazard to ocean water resources because leached constituents will be rapidly dispersed by ocean currents.

### Small Arms Rounds

Five thousand small arms rounds will be expended per year under the No Action Alternative, which will result in approximately 180 lb of expended material. Assuming a distribution of expended materials over 20 percent of the TMAA, small arms expended materials will result in a deposition rate of 0.6 item per $nm^2$ (0.17 item per $km^2$) per year. The weight of expended small arms rounds will be minimal (180 lb [81kg]), with about 2 lb (less than one kg) of hazardous material (heavy metals) from Navy training exercises in the TMAA. This deposition will have minimal impacts on ocean water resources because its density is low and the materials are relatively inert.

### Sonobuoys

The No Action Alternative will use SSQ-36 Bathythermograph (BT) sonobuoys, which monitor water temperature. Sonobuoys consist of two main sections: a surface unit that contains the seawater battery and a metal subsurface unit. Sonobuoy components of concern for water resources are the seawater batteries, lithium batteries, battery electrodes, metal housing, lead solder, copper wire, and lead used for ballast. Sonobuoys also expend inert materials, such as parachutes and nylon wire.

#### *Batteries*

Each sonobuoy contains a seawater battery, housed in the upper, floating portion, which supplies power to the sonobuoy. These seawater batteries contain about 300 grams of lead, in addition to battery electrodes composed of lead chloride, cuprous thiocyanide, or silver chloride. In cases where the upper portion of the sonobuoy is lost to the seabed, the lead batteries are also lost. Silver chloride, lithium, or lithium iron disulfide thermal batteries are used to power subsurface units. The lithium-sulfur batteries used typically contain lithium sulfur dioxide and lithium bromide, but may also contain lithium carbon monofluoroxide, lithium manganese dioxide, sulfur dioxide, and acenitrile (a cyanide compound). During battery operation, the lithium reacts with the sulfur dioxide to form lithium dithionite. Lithium iron disulfide thermal batteries are used in Directional Command Activated Sonobuoy System (DICASS) sonobuoys. An important component of the thermal battery is a hermetically sealed casing of welded stainless steel 0.03- to 0.1-in thick that is resistant to the battery electrolytes (Klassen 2005).

The evaluation of the potential effects associated with seawater batteries includes comparing the expected concentrations of potentially toxic battery constituents with USEPA water quality criteria established for the protection of aquatic life or with conservative toxicity thresholds available from the literature. Chemical reactions of sonobuoy batteries proceed almost to completion once the cell is activated, and only a small amount of reactants remain when the battery life ends. These residual materials will slowly dissolve and become diluted by ongoing ocean and tidal currents. Given the mobility of the most soluble battery constituent, lead chloride, there is a low potential for substantial accumulations of contaminants in sediments. As the outside metal case corrodes, it becomes encrusted by seawater processes and marine organisms, thus slowing the rate of further corrosion. Many of the components of concern are coated with plastic to reduce corrosion, providing an effective barrier to water exchange. In instances where seawater causes the body of the sonobuoy to corrode, that corrosion will take at least 40 years (Klassen 2005).

Lithium always occurs as a stable mineral or salt, such as lithium chloride or lithium bromide (Ksozos 2003). Lithium is naturally present in freshwater, soil, and sediment. A study demonstrated that sodium ions in saltwater mitigate the toxicity of lithium to sensitive aquatic species. (Fathead minnows

[*Pimephales promelas*] and water fleas [*Ceriodaphnia dubia*] were unaffected by lithium concentrations as high as 6 milligrams per liter [mg/L] in the presence of tolerated concentrations of sodium). In the marine environment, therefore, where sodium concentrations are at least an order of magnitude higher than tolerance limits for the tested freshwater species, lithium would be essentially nontoxic. Because of these factors, lithium batteries would not adversely affect marine water quality. One estimate concluded that 99 percent of the lithium in a battery would be released to the environment over 55 years. The release will result in a dissolved lithium concentration of 83 mg/L in the immediate area of the breach in the sonobuoy housing. At a distance of 5.5 mm from the breach, the concentration of lithium will be about 15 mg/L, or 10 percent of typical seawater lithium values (150 ppm); thus it would be difficult to distinguish the additional concentration due to the lithium leakage from the background concentration (Klassen 2005).

Two studies involved on-site or laboratory studies of batteries expended from U.S. Coast Guard aid-to-navigation sites (USEPA 2001, Borener and Maughan 1998). Sediment samples were taken adjacent to and near the navigation sites, and were analyzed for all metal constituents in the batteries. Results indicated that metals were either below or consistent with background levels or compared favorably with NOAA sediment screening levels, “reportable quantities” under the Comprehensive Environmental Response, Compensation, and Liability Act §103(a), or USEPA toxicity procedures.

A study by the Navy (DoN 1993) examined the impact of materials released by activated seawater batteries in sonobuoys that freely dissolve in the water column (e.g., lead, silver, and copper ions), as well as nickel-plated steel housing, lead solder, copper wire, and lead shot used for sonobuoy ballast. The study concluded that constituents released by saltwater batteries, as well as the decomposition of other sonobuoy components, did not exceed state or federal standards, and that the reaction products are short-lived in seawater. A detailed description of this study is provided in Section 3.2, Expended Materials.

The impacts of lead and lithium (among other materials) were studied at the CFMETR near Nanoose Bay, British Columbia, Canada (CFMETR 2005). These materials are common to EMATTs, Acoustic Device Countermeasures, sonobuoys, and torpedoes. The CFMETR study noted that lead is a naturally occurring heavy metal in the environment. Cores taken of marine sediments in the test range show a steady increase in lead concentration from the bottom of the core to a depth of approximately 8 in (20 cm). Sediments found at this depth were deposited during the late 1970s and early 1980s, and their elevated lead concentrations were attributed to deposition of atmospheric lead derived from a gasoline additive. The sediment cores showed a general reduction in lead concentration with decreasing depth, coincident with the phasing out of lead-based additives in gasoline by the mid-1980s. The study also noted that studies at other ranges have shown minimal impacts of lead ballasts because they are usually buried deep in marine sediments where they are not biologically available. The study concluded that there would be no effects from the lead ballasts due to the low probability of mobilization (CFMETR 2005).

Regarding lithium, cores of marine sediments taken in the test range showed fairly consistent lithium concentrations with depth, indicating little change in lithium deposition with time. Compared with ambient lithium concentrations from outside the range, the report concluded that “it is difficult to demonstrate an environmental impact of lithium caused by CFMETR” (CFMETR 2005).

#### *Lead in Sonobuoys*

Sonobuoys contain other metal and nonmetal components, such as metal housing (nickel-plated, steel-coated with polyvinyl chloride plastics to reduce corrosion), batteries, lead solder, copper wire, and lead used for ballast that, over time, can release hazardous constituents into the surrounding water. Most of the other sonobuoy components are either coated with plastic to reduce corrosion or are solid metal. The slow rate at which solid metal components are corroded by seawater translates into slow release rates into the marine environment. Once the metal surfaces corrode, the rate of metal released into the environment decreases. Releases of chemical constituents from all metal and nonmetal sonobuoy components are further reduced by natural encrustation of exposed surfaces. Therefore, corrosive components of the sonobuoy do not substantially degrade marine water quality. Sonobuoy hazardous components are analyzed in Section 3.2, Expended Materials.

Under the No Action Alternative, 24 SSQ-36 BT sonobuoys will be expended each year. These expended materials will weigh approximately 936 lb (421 kg), and will be deposited on the ocean floor at a rate of 0.11 lb per $nm^2$ (0.01 kg per $km^2$) per year. Approximately 71 lb (32 kg) per year of hazardous materials will be deposited by sonobuoy use in the TMAA. This rate of hazardous materials deposition is not expected to affect water resources. The effects of sonobuoy batteries will be as described in this section. Expended sonobuoys may contaminate nearby water and sediment, but ocean and tidal currents will disperse these chemicals quickly. Thus, with the low concentration of expended training materials in the study area, sonobuoy use under the No Action Alternative in GOA will not have substantial effects on water resources.

**Summary – No Action Alternative Effects**

Table 3.3-3 provides a summary of expended materials that will be deposited on the floor of the ocean in the TMAA. Under the No Action Alternative, 15,982 items will be expended each year during training exercises. Assuming a distribution of expended materials over 20 percent of the TMAA, the deposition rate of expended materials will be 1.92 items per $nm^2$ (0.55 items per $km^2$) per year. The weight of all expended materials will be approximately 76,200 lb (34,600 kg) tons per year, at a density of 9.0 lb per $nm^2$ (1.2 kg per $km^2$) of ocean per year. Assuming Navy training under the No Action Alternative would remain consistent over periods of five and 20 years, the Navy will expend approximately 191 tons (45.2 lb per $nm^2$ [5.9 kg per $km^2$]) and 762 tons (181 lb per $nm^2$ [23.8 kg per $km^2$]) of training materials in the TMAA, respectively. Of the expended materials, only a small amount would be considered hazardous (approximately 2.45 percent or 1,870 lb [850 kg]). Given that many of these materials are relatively inert, this level of deposition will have minimal impacts on ocean water resources.

### 3.3.2.5 Alternative 1

Under Alternative 1, there would be an increase in training tempo in the TMAA, which would increase the amount of expended training materials. Alternative 1 would introduce ASW training exercises that would use additional sonobuoys and underwater targets. This section analyzes the possible impacts of water quality from training in the TMAA under Alternative 1. Table 3.3-7 summarizes the expended materials for Navy training under Alternative 1. Table 3.3-8 shows the weight of hazardous materials in each type of training material and the percentage of hazardous materials in the total expended materials weight.

**Table 3.3-7: Training Materials Expended Annually – Alternative 1**

| Type of Training Material | Alternative 1 | | No Action Alternative | | Increase under Alternative 1 (%) | |
|---|---|---|---|---|---|---|
| | Number | Weight (lb) | Number | Weight (lb) | Number | Weight |
| Bombs | 180 | 79,900 | 120 | 54,000 | 50 | 48 |
| Missiles | 33 | 10,200 | 22 | 6,770 | 50 | 50 |
| Targets & pyrotechnics | 322 | 5,610 | 252 | 3,610 | 28 | 55 |
| Naval gun shells | 13,188 | 13,800 | 10,564 | 10,700 | 25 | 28 |
| Small arms rounds | 5,700 | 210 | 5,000 | 180 | 14 | 17 |
| Sonobuoys | 793 | 30,900 | 24 | 936 | 3,200 | 3,200 |
| PUTR | 7 | 2,100 | NA | NA | NA | NA |
| **Total** | **20,223** | **143,000** | **15,982** | **76,200** | **26** | **87** |

Note: Weights of expended materials are estimates, and are rounded to three significant digits; PUTR: Portable Undersea Training Range

**Table 3.3-8: Expended Materials Considered Hazardous – Alternative 1**

| Type of Training Material | Weight of Material (lb)[1] | | Hazardous Content (%) |
|---|---|---|---|
| | Expended Material | Hazardous Material | |
| Bombs | 79,900 | 617 | 0.77 |
| Missiles | 10,200 | 84.5 | 0.83 |
| Targets and pyrotechnics | 5,610 | 190 | 3.39 |
| Naval gun shells | 13,800 | 1,650 | 12.0 |
| Small-caliber rounds | 210 | 2.10 | 1.00 |
| Sonobuoys | 30,900 | 2,340 | 7.57 |
| PUTR | 2,100 | 0 | 0 |
| **Total** | **143,000** | **4,890** | **3.42** |

Note: Weights of expended materials are estimates, and are rounded to three significant digits
(1) Weights of hazardous materials are based upon available information, and may not include hazardous weight of all expended materials.

## Materials Expended During Training – Alternative 1

### Bombs

Under Alternative 1, 180 bombs would be expended each year in the TMAA (a 50-percent increase over the No Action Alternative). Alternative 1 would increase the amount of bombs by 60, of which 36 would be inert. Inert bombs may contain spotting charges, but the small amount of explosives would have negligible impacts on the environment. Navy training in the TMAA would result in approximately 79,900 lb (36,000 kg) of expended bomb material each year Assuming expended materials from bombs would be deposited on 20 percent of the TMAA, their deposition rate would be approximately 9.51 lb per $nm^2$ (2.76 lb per $km^2$) of ocean per year. The amount of hazardous material (unconsumed explosives) would increase from 390 lb per year under the No Action Alternative to 617 lb per year under Alternative 1. This rate of deposition would increase the concentration of hazardous materials on portions of the ocean bottom in the TMAA by approximately 0.07 lb per $nm^2$ (0.01 kg per $km^2$). Expended materials would settle to the sea bottom. Materials would corrode and become encrusted through chemical processes and marine organisms. Chemical leaching rates would decrease and, therefore, pose no hazard to ocean water resources. The additional use of bombs under Alternative 1 would have no measurable adverse impacts because the density of expended bombs on the ocean floor would be low and relatively inert materials would be the majority of the expended material weight.

### Missiles

Under Alternative 1, 33 missiles would be expended per year, an increase of 11 over the No Action Alternative. The weight of expended materials would be 10,200 lb (4,590 kg), with a deposition rate of approximately 1.21 lb per $nm^2$ (0.16 kg per $km^2$) of ocean per year. Hazardous materials would also increase by 50 percent, with 85 lb (38 kg) (57 lb [26 kg] of explosive and 28 lb [13 kg] of propellant) of hazardous materials being deposited per year in the TMAA. As noted under the No Action Alternative, no expended missiles would be recovered. The primary constituents of concern in missiles (i.e., solid propellant) would be expended in the marine environment if the missile failed to function properly. Solid propellants decompose very slowly in the marine environment. Ocean and tidal currents would disperse these materials to undetectable concentrations under Alternative 1. Thus, there would be no substantial impact on water resources.

### Targets and Pyrotechnics

Table 3.3-9 compares the types and numbers of targets and pyrotechnics under Alternative 1 to those under the No Action Alternative.

**Table 3.3-9: Targets and Pyrotechnics Expended Annually – Alternative 1**

| Type of Target or Pyrotechnic | Number of Items | | Increase under Alternative 1 | |
|---|---|---|---|---|
| | Alternative 1 | No Action Alternative | Numerical | Percent |
| **Targets** | | | | |
| TDU-34 towed target | 3 | 2 | 1 | 50 |
| TALD* | 12 | 8 | 4 | 50 |
| BQM-74E unmanned aircraft | 2 | 2 | 0 | 0 |
| Killer Tomato surface target | 12 | 10 | 2 | 20 |
| SPAR | 12 | 10 | 2 | 20 |
| MK-39 EMATT* | 20 | 0 | 20 | 0 |
| **Pyrotechnics** | | | | |
| LUU-2B/B* | 18 | 12 | 6 | 50 |
| MK-58 Marine Marker* | 60 | 20 | 40 | 200 |
| Chaff* | 212 | 212 | 0 | 0 |
| **Total number used** | **351** | **276** | **75** | **27** |
| **Total not recovered** | **322** | **252** | **70** | **28** |
| **Total Expended Weight (lb)** | **5,610** | **3,610** | **2,000** | **55** |

Note: * not recovered

Under Alternative 1, the number of targets and pyrotechnics used in the TMAA would increase by 27 percent (75 items). Targets and pyrotechnics not recovered represent 92 percent of all training materials. The weight of expended targets would increase by 55 percent, but the density of expended materials on the ocean floor would be low because of the large area of the TMAA. A new type of target (MK-39 EMATT) would be used during ASW exercises. The use of EMATTs for ASW exercises would expend 120 lb (56 kg) per year of lithium batteries. Approximately 22 percent of unrecovered items are flares (MK-58 and LUU-2B/B), the bulk of which are consumed as heat and smoke. Annual residual pyrotechnic materials from flares would weigh approximately 66 lb (30 kg). No additional chaff would be used under Alternative 1, and chaff effects would be similar to effects under the No Action Alternative. Given the small amount of hazardous materials and the inert nature of most components, these training materials would not have a measurable impact on ocean water resources.

### Naval Gun Shells

Alternative 1 proposes a 25-percent increase in the number of naval gun shells (13,188 gun shells or 13,800 lb [6,270 kg]) over the No Action Alternative. Assuming that expended materials would be deposited on 20 percent of the TMAA, the deposition rate of expended materials would be approximately 1.57 gun shells or 1.64 lb per nm$^2$ (0.45 gun shell or 0.22 kg per km$^2$) of ocean per year. Approximately 1,650 lb (750 kg) per year of these materials would be hazardous. Naval gun shells are generally inert in the marine environment. Expended shells may contain heavy metals, such as lead, but these metals would be a small percentage of the shell. The shells would settle to the ocean bottom and corrode, becoming encrusted by chemical processes and marine organisms. Any effects would be limited to the immediate area around the expended shell; ocean currents would disperse leached substances quickly. Therefore, expended materials from naval gun shells under Alternative 1 would not affect ocean water resources.

### Small Arms Rounds

Under Alternative 1, 5,700 small-caliber rounds would be expended each year in the TMAA, a 14-percent increase over the No Action Alternative. Assuming that expended training materials would be deposited on 20 percent of the TMAA, expended small arms would have a deposition rate of approximately 0.7 item per nm$^2$ (0.20 item per km$^2$) of ocean per year. Expended training materials would result in 210 lb (95 kg) per year of material being deposited on the ocean floor, of which approximately 2.1 lb (0.9 kg) per year would be considered hazardous. Given the inert nature of the majority of these items, this rate of deposition would not have a substantial impact on ocean water resources.

#### Sonobuoys

Alternative 1 would introduce ASW as a new training mission area to the TMAA. ASW would use sonobuoys to assist aircraft and surface vessels in locating submarines. Table 3.3-10 shows the types and numbers of sonobuoys proposed under Alternative 1.

**Table 3.3-10: Sonobuoys Expended Annually – Alternative 1**

| Type of Sonobuoy | Number of Items | | Increase under Alternative 1 (%) |
|---|---|---|---|
| | Alternative 1 | No Action Alternative | |
| SSQ-36 BT (passive) | 60 | 24 | 150 |
| SSQ-53 DIFAR (passive) | 500 | 0 | NA |
| SSQ-62 DICASS (active) | 133 | 0 | NA |
| SSQ-77 VLAD (passive) | 60 | 0 | NA |
| SSQ-110A IEER (explosive) or SSQ-125 AEER (Tonal) | 40 | 0 | NA |
| **Total Number** | **793** | **24** | **3,200** |
| **Total Weight (lb)** | **30,900** | **936** | **3,200** |

Notes: Numbers and weights of training items are estimates, and are rounded to three significant digits; NA = Not applicable; DIFAR: Directional Frequency Analysis and Recording; VLAD: Vertical Line Array Directional Frequency Analysis and Recording; IEER: Improved Extended Echo Ranging Sonobuoy; AEER: Advanced Extended Echo Ranging Sonobuoy.

Under Alternative 1, 793 sonobuoys would be expended each year. Assuming that expended sonobuoys would be deposited on 20 percent of the TMAA, the deposition rate would be approximately 0.1 expended sonobuoy per $nm^2$ (0.03 sonobuoy per $km^2$) of ocean per year. Expended sonobuoys would weigh 30,900 lb (13,900 kg) per year, with a deposition rate (by weight) of approximately 3.7 lb per $nm^2$ (0.47 kg per $km^2$) of ocean per year. Hazardous materials of expended sonobuoys would weigh approximately 2,340 lb (1,050 kg), increasing the concentration of these materials on the ocean floor in the TMAA by approximately 0.28 lb per $nm^2$ (0.04 kg per $km^2$) each year. The expended sonobuoys would be relatively inert in the marine environment, becoming encrusted by corrosion and benthic organisms; these natural processes would decrease leaching rates, and ocean and tidal currents would disperse hazardous constituents as they leached. Hazardous materials would be dispersed over large areas of ocean bottom. Therefore, expended sonobuoys would have a negligible impact on ocean water resources under Alternative 1.

#### Explosive Sonobuoys – Potential Impacts of Detonation Byproducts

One type of sonobuoy, the SSQ-110A IEER sonobuoy used in ASW training under Alternatives 1 and 2, would contain two 4.2-lb explosive charges (Global Security 2008b). The explosives contain 90 percent RDX and small amounts of PBX and hexanistrostilbene, a detonator component. The most toxic byproducts are the hydrogen fluoride compounds ($H_xF_x$), but only a small percentage (0.63 percent) of the $H_xF_x$ byproduct is expected to dissolve in the water prior to reaching the surface. Ocean and tidal currents would rapidly disperse byproducts. Further discussion of the materials produced by sonobuoy detonations is provided in Section 3.2, Expended Materials.

Given this dilution and the large area within which the sonobuoys would be deployed, the adverse impacts of detonation byproducts would be negligible. Leaching chemicals, such as lead and lithium, would result in water and sediment toxicity surrounding each expended sonobuoy. The effect would be limited to the immediate area of the leaching source because mixing and dispersion by ocean currents would quickly dilute chemicals to concentrations below harmful levels. SSQ-110A sonobuoys would make up 5.5 percent of the expended sonobuoys during training exercises. With a deposition rate of 0.1 expended sonobuoy per year per $nm^2$ of ocean, any impact on water resources would be negligible.

**Portable Undersea Training Range**

The PUTR would require the installation of seven anchors. Upon completion of training, these anchors would remain on the ocean floor. Each anchor would weigh approximately 300 lb, which would result in approximately 2,100 lb of expended materials. Anchors would be made of concrete or sand bags, which would be covered by sand or sediment over time. No hazardous materials would be associated with these anchors and, thus, effects on the marine environment would be minimal.

**Summary – Alternative 1 Impacts**

A summary of expended materials under Alternative 1 is provided in Table 3.3-7. Under Alternative 1, 20,223 items would be expended each year, a 26-percent increase over the No Action Alternative. Assuming a distribution of these materials over 20 percent of the TMAA, the deposition rate of expended items would be 2.40 items per $nm^2$ (0.69 items per $km^2$) of ocean per year. Alternative 1 would increase the expended materials weight by 87 percent over the No Action Alternative. Deposition of expended materials in the TMAA would be approximately 143,000 lb (65,000 kg) or approximately 16.9 lb per $nm^2$ (2.23 kg per $km^2$) of ocean per year. Assuming Navy training under Alternative 1 would remain consistent over periods of 5 and 20 years, the Navy would expend approximately 358 tons (84.8 lb per $nm^2$ [11.2 kg per $km^2$]) and 1,430 tons (339 lb per $nm^2$ [44.7 kg per $km^2$]) in the TMAA, respectively. Many of these items are relatively inert, and would settle to the sea floor.

Alternative 1 would result in an increase in expended hazardous materials of about 160 percent (4,890 lb [2,220 kg]), but would only deposit approximately 0.58 lb of hazardous materials per $nm^2$ (0.08 kg per $km^2$) of ocean per year within 20 percent of the TMAA. The metals would corrode, eventually becoming encrusted through chemical processes and marine organisms, and would pose no hazard to ocean water resources. Leaching would decrease as surfaces become encrusted through natural processes. Hazardous materials from explosive constituents would be mostly consumed upon detonation, and would not affect water quality. The remaining hazardous materials have low solubility in water, and would leach hazardous materials at rates below harmful concentrations.

### 3.3.2.6 Alternative 2

Under Alternative 2, Carrier Strike Group exercises would take place two times per year, compared to once per year under the No Action Alternative and Alternative 1. This increase in training tempo would increase the amount of expended training materials. Under Alternative 2, SINKEX would occur in the TMAA. During SINKEX, a decommissioned surface ship is towed to a deep-water location and sunk using a variety of ordnance. A summary of training materials expended annually under Alternative 2 is provided in Table 3.3-11. Table 3.3-12 shows the weights of hazardous materials for each type of training material and the percentage of hazardous materials in the total expended materials weight.

**Materials Expended during Training in the TMAA – Alternative 2**

**Bombs**

Under Alternative 2, 360 bombs would be expended each year in the TMAA (a 200-percent increase over the No Action Alternative). One hundred forty-four of the additional 240 bombs (60 percent) expended under Alternative 2 would be inert. With expended materials deposited on 20 percent of the TMAA, the deposition rate of expended materials would be approximately 0.04 item or 19.0 lb per $nm^2$ (0.01 item or 2.5 kg per $km^2$) of ocean per year.

**Table 3.3-11: Training Materials Expended Annually – Alternative 2**

| Type of Training Material | Alternative 2 | | No Action Alternative | | Increase under Alternative 2 (%) | |
|---|---|---|---|---|---|---|
| | Number | Weight (lb) | Number | Weight (lb) | Number | Weight |
| Bombs | 360 | 160,000 | 120 | 54,000 | 200 | 200 |
| Missiles | 66 | 20,300 | 22 | 6,770 | 200 | 200 |
| Targets & pyrotechnics | 644 | 11,200 | 252 | 3,610 | 160 | 210 |
| Naval gun shells | 26,376 | 27,500 | 10,564 | 10,700 | 150 | 160 |
| Small-caliber rounds | 11,400 | 420 | 5,000 | 180 | 130 | 130 |
| Sonobuoys | 1,587 | 61,900 | 24 | 936 | 6,500 | 6,500 |
| PUTR | 7 | 2,100 | NA | NA | NA | NA |
| SINKEX[1] | 858 | 70,000 | NA | NA | NA | NA |
| **Total** | **41,298** | **352,000** | **15,982** | **76,200** | **160** | **360** |

Notes: Weights of expended materials are estimates, and are rounded to three significant digits, NA = Not applicable; (1) Due to the variability in weight of available ship hulks, the expended weight for SINKEX does not include the ship hulk weight.

**Table 3.3-12: Percent of Expended Material Considered Hazardous – Alternative 2**

| Type of Training Material | Weight of Materials (lb)[1] | | Hazardous Content (%) |
|---|---|---|---|
| | Expended Material | Hazardous Material | |
| Bombs | 160,000 | 1,130 | 0.70 |
| Missiles | 20,300 | 169 | 0.83 |
| Targets and pyrotechnics | 11,200 | 381 | 3.40 |
| Naval gun shells | 27,500 | 3,310 | 1.31 |
| Small-caliber rounds | 420 | 4.20 | 1.00 |
| Sonobuoys | 61,900 | 4,680 | 7.56 |
| PUTR | 2,100 | 0 | 0 |
| SINKEX | 70,000 | 850 | 1.25 |
| **Total** | **352,000** | **10,500** | **2.98** |

Notes: Weights of expended materials are estimates, and are rounded to three significant digits; (1) Weights of hazardous materials are based upon available information, and may not include the hazardous weight of all expended materials; NA = Not applicable

Bombs used under Alternative 2 would deposit approximately 160,000 lb (72,000 kg) of expended material, and 1,130 lb (510 kg) per year of hazardous materials. Alternative 2 would deposit approximately 0.13 lb of hazardous materials per $nm^2$ (0.02 kg per $km^2$) of ocean per year in the TMAA. Inert bombs would contain spotting charges; the small amount of explosives would not have a substantial effect on water quality. Expended materials would settle to the sea bottom and corrode. This would cause the metals to become encrusted by chemical processes and marine organisms and, therefore, pose no hazard to ocean water resources. The use of live bombs would have no measurable adverse impacts on water quality because these items would be dispersed over large areas of ocean and because their hazardous constituents would be mostly consumed upon detonation.

**Missiles**

Under Alternative 2, 66 missiles would be used each year, an increase of 44 over the No Action Alternative. Expended material weight from missiles would increase 200 percent over the No Action

Alternative to 20,300 lb (9,140 kg) tons per year. Distributed over 20 percent of the TMAA, missile use during training would deposit 2.4 lb (1.1. kg) of expended training material per $nm^2$ (0.3 kg per $km^2$) of ocean per year. As noted under the No Action Alternative, missiles used during training would not be recovered. The constituent of concern in missiles (i.e., solid propellant) becomes hazardous to water resources only if missiles fail to function properly, and such materials decompose very slowly in the marine environment. Ocean and tidal currents would disperse these materials to undetectable levels; thus, there would be no substantial impact on water resources under Alternative 2.

### Targets and Pyrotechnics

Table 3.3-13 compares the types and numbers of targets and pyrotechnics for the study area under Alternative 2 compared to the No Action Alternative.

**Table 3.3-13: Targets and Pyrotechnics Expended Annually – Alternative 2**

| Type of Target or Pyrotechnic | Number of Items | | Increase under Alternative 2 | |
|---|---|---|---|---|
| | Alternative 2 | No Action Alternative | Numerical | Percent |
| **Targets** | | | | |
| TDU-34 towed target | 6 | 2 | 4 | 200 |
| TALD* | 24 | 8 | 16 | 200 |
| BQM-74E unmanned aircraft | 4 | 2 | 2 | 100 |
| Killer Tomato surface target | 24 | 10 | 14 | 140 |
| SPAR | 24 | 10 | 14 | 140 |
| MK-39 EMATT* | 40 | 0 | 40 | 0 |
| **Pyrotechnics** | | | | |
| LUU-2B/B* | 36 | 12 | 24 | 200 |
| MK-58 Marine Marker* | 120 | 20 | 100 | 500 |
| Chaff* | 424 | 212 | 212 | 100 |
| **Total number used** | **702** | **276** | **426** | **150** |
| **Total not recovered** | **644** | **252** | **392** | **160** |
| **Total Expended Weight (lb)** | **11,200** | **3,610** | **7,610** | **210** |

Notes: * Not recovered; Percentages are estimates, and are rounded to three significant digits.

Under Alternative 2, the number of targets and pyrotechnics used would increase by 150 percent (426 items) over the No Action Alternative. Items not recovered would represent about 92 percent of all training materials (644 items per year), and 90 percent of these items would be pyrotechnics. Expended targets would deposit 11,200 lb (5,040 kg) per year of expended material on the sea floor, an increase of 210 percent over the No Action Alternative. Most of the expended materials would be relatively inert in the marine environment, with 381 lb (170 kg) per year of expended materials (approximately 130 lb [59 kg] of residual pyrotechnic materials and 250 lb [113 kg] of batteries from EMATTs) considered to be hazardous. This rate of hazardous materials deposition would have minimal effects on the marine environment because of its low density (0.05 lb per $nm^2$ [less than 0.01 kg per $km^2$]) in the TMAA.

Chaff use would increase to 1,080 lb (490 kg) per year under Alternative 2, but would not affect water resources because of the large dispersal area and its inert composition. Expended chaff would have similar effects to those described under the No Action Alternative. Given the number of items and the relatively inert nature of the components, these training materials would not have a measurable impact on ocean water resources.

#### Naval Gun Shells

Alternative 2 proposes a 150-percent increase in naval gun shells over the No Action Alternative. A total of 26,376 gun shells would be expended annually under Alternative 2, resulting in approximately 27,500 lb (12,500 kg) of expended material. Assuming expended materials would be deposited over 20 percent of the TMAA, approximately 3.26 lb of expended material per $nm^2$ (0.43 kg per $km^2$) of ocean would be deposited annually in the TMAA. Approximately 3,310 lb (1,500 kg) per year of this material would be hazardous. This amount of material would have negligible effects on the marine environment because effects would be limited to the immediate area around expended shells. Hazardous materials would not cause harmful concentrations of heavy metals in the surrounding water column because of their low concentration (0.39 lb per $nm^2$ [less than 0.05 kg per $km^2$]) and rapid dispersal of leached hazardous substances by ocean currents. The expended shells would settle to the sea bottom, and would degrade as described under the No Action Alternative. Under Alternative 2, the naval gun shells would have no substantial impact because they consist of relatively inert materials that degrade slowly in the environment.

#### Small Arms Rounds

Under Alternative 2, 11,400 small arms rounds would be used each year, an increase of 130 percent over the No Action Alternative. Alternative 2 would deposit less than 1.4 expended rounds per $nm^2$ (0.39 items per $km^2$) of ocean per year, assuming deposition on 20 percent of the TMAA. The total expended weight of small arms rounds would be 420 lb (190 kg) per year, and approximately 4.2 lb (1.9 kg) per year of hazardous materials. Given the inert nature of the majority of these items, this level of deposition would have a negligible impact on ocean water resources.

#### Sonobuoys

Table 3.3-14 compares the types and numbers of sonobuoys proposed under Alternative 2 compared to the No Action Alternative.

**Table 3.3-14: Sonobuoys Expended Annually – Alternative 2**

| Type of Sonobuoy | Number of Items | | Increase under Alternative 2 (%) |
|---|---|---|---|
| | Alternative 2 | No Action Alternative | |
| SSQ-36 BT | 120 | 24 | 400 |
| SSQ-53 DIFAR (passive) | 1,000 | 0 | NA |
| SSQ-62 DICASS (active) | 267 | 0 | NA |
| SSQ-77 VLAD (passive) | 120 | 0 | NA |
| SSQ-110A IEER (explosive) or SSQ-125 AEER (Tonal) | 80 | 0 | NA |
| **Total Number** | **1,587** | **24** | **6,500** |
| **Total Weight (lb)** | **61,900** | **936** | **6,500** |

Note: Numbers of expended materials are estimates; NA = Not applicable

Under Alternative 2, 1,587 sonobuoys would be used each year during training exercises. Assuming an expended materials deposition area of 20 percent of the TMAA, the deposition rate of expended sonobuoys would be approximately 0.2 sonobuoy per $nm^2$ (0.05 sonobuoys per $km^2$) of ocean per year. Expended materials from sonobuoys would weigh approximately 61,900 lb (27,900 kg) per year, with a deposition rate (by weight) of 7.35 lb per $nm^2$ (0.96 kg per $km^2$) of ocean per year.

About 4,680 lb (2,100 kg) of hazardous materials would be deposited annually on the ocean floor from ASW exercises using sonobuoys, which would deposit approximately 0.56 lb per year of hazardous material per $nm^2$ (0.07 kg per $km^2$) of ocean. Section 3.3.4.1 discusses the potential impact on water resources of sonobuoy batteries and explosive components. Given the conclusions in that section, sonobuoy use under Alternative 2 would only affect water and sediment quality in the immediate vicinity of expended sonobuoys. Ocean currents would quickly disperse leached substances to concentrations below harmful levels. Thus, the proposed increase in sonobuoy use under Alternative 2 would have no measurable impact on water resources.

**Portable Undersea Training Range**

Under Alternative 2, PUTR would require the same number of anchors (seven) to be placed on the ocean floor as under Alternative 1. Anchors would be made of concrete or sand, and would not contain any hazardous materials. Any effects on the marine environment would be the same as under Alternative 1.

**SINKEX**

Alternative 2 would include two SINKEX events (one each summertime training exercise). Table 3.3-15 provides a list of the types and numbers of training materials that could be expended annually during SINKEX.

**Table 3.3-15: Training Materials Expended During a SINKEX**

| Type of Training Material | Number of Items |
|---|---|
| **Missiles** | |
| AGM-65 Maverick | 6 |
| AGM-84 Harpoon | 10 |
| AGM-88 high-speed anti-radiation missile (HARM) | 4 |
| AGM-114 Hellfire | 2 |
| AGM-119 Penguin | 2 |
| Standard Missile-1 | 2 |
| Standard Missile-2 | 2 |
| **Bombs** | |
| MK-82 (inert) | 6 |
| MK-82 (live) | 14 |
| MK-83 | 8 |
| **Naval Gun Shells** | |
| 5-in gun shells | 800 |
| **Torpedoes** | |
| MK-48 ADCAP torpedo | 2 |
| **Targets** | |
| Surface Ship Hulk | 2 |
| **Total** | **858** |
| **Total Expended Weight (lb)** | **70,000**[1] |
| **Total Hazardous Weight (lb)** | **850** |

Notes: Numbers are cumulative for two separate SINKEX events; (1) Due to the variability in weight of available ship hulks, the total expended weight does not include ship hulk weights.

Ordnance use during SINKEX would vary, based on training requirements and training conditions. For example, a MK-48 ADCAP torpedo would only be used at the conclusion of SINKEX if the target vessel was still afloat. This analysis assumes that the greatest number of ordnance would be used during SINKEX under Alternative 2. Therefore, 858 ordnance items per year would be expended during two

SINKEX events under Alternative 2. This would result in approximately 70,000 lb (31,500 kg) per year of expended materials, which would increase the ocean floor density of such materials by approximately 8.3 lb per $nm^2$ (1.0 kg per $km^2$) per year. Most of these materials would be relatively inert, with approximately 850 lb (380 kg) per year of hazardous material (e.g., residual explosives, propellant, and heavy metals such as lead). These materials would be in solid forms, and would leach slowly because of their low solubility. In the past, vessels used for SINKEX had most of the solid PCBs removed, leaving estimates of up to 100 lb of PCBs on board with sinking took place (USEPA 1999). This amount of hazardous materials would not have an effect on the marine environment.

Alternative 2 would expend two surface vessels per year during two SINKEX events. For SINKEX, the vessels used as targets are selected from a list of U.S. Navy-approved vessels that have been cleaned in accordance with USEPA guidelines. By rule, SINKEX would be conducted at least 50 nm (93 km) offshore and in water at least 6,000 feet deep (1,830 m) (40 CFR §229.2). USEPA considers the contaminant levels that would be released during the sinking of a target vessel to be within the standards of the Marine Protection, Research, and Sanctuaries Act (16 USC 1341, et seq.). As with other inert materials, the vessel would become encrusted by chemical processes and biological organisms. Therefore, vessels used as targets would not pose a hazard to ocean water resources.

**Summary of Impacts – Alternative 2 (Preferred Alternative)**

Training materials expended under Alternative 2 are summarized in Table 3.3-11. Under Alternative 2, 41,298 items would be expended each year, a 160-percent increase over the No Action Alternative. This would result in approximately 4.90 items per $nm^2$ (1.42 items per $km^2$). The weight of expended materials would increase 360 percent to 352,000 lb (160,000 kg) per year. Assuming expended materials would be deposited on 20 percent of the TMAA, the deposition rate of expended materials would be approximately 41 lb per $nm^2$ (5.4 kg per $km^2$) of ocean per year. Assuming Navy training under Alternative 2 would remain consistent over periods of five and 20 years, the Navy would expend approximately 880 tons (209 lb per $nm^2$ [27.5 kg per $km^2$]) and 3,520 tons (835 lb per $nm^2$ [110 kg per $km^2$]) of training materials in the TMAA, respectively.

Under Alternative 2, approximately 10,500 lb (4,770 kg) per year of hazardous material would be expended. Assuming deposition of expended materials on 20 percent of the TMAA, the ocean floor density of annually expended hazardous materials would be approximately 1.2 lb per $nm^2$ (0.2 kg per $km^2$). Alternative 2 would also include two decommissioned surface vessels expended during two SINKEX events. Vessels would be cleaned according to USEPA standards, and would be considered relatively inert in the marine environment. Solid PCBs would be removed to the maximum extent practicable, but some vessel materials with PCBs would remain on board when the vessel in sunk (approximately 100 lb per vessel [USEPA 1999]).

Most expended materials would be relatively inert, and hazardous materials would either be consumed upon detonation or would be present in insoluble forms. Most expended materials would be relatively inert and would settle to the sea bottom, becoming encrusted by chemical processes and marine organisms. This would slow chemical leaching below harmful concentrations, and pose no hazard to ocean water resources. Expended materials under Alternative 2 would not substantially impact water resources because the distribution density of hazardous materials would be low and most expended training materials would consist of relatively inert substances that degrade slowly in the marine environment.

### 3.3.3 Mitigation

Impacts on water resources under the alternatives would be below thresholds that could result in long-term degradation of water resources or affect water quality. Possible impacts on water quality during normal operating conditions would continue to be mitigated by measures identified in Section 3.3.1.2. No additional mitigation measures would be implemented because there would be no substantial impact on water quality.

### 3.3.4 Summary of Effects

None of the proposed alternatives would have long-term or substantial impacts on water resources in the TMAA. Short-term effects on water resources would be related to ordnance use and expended materials, and would not be anticipated to be measurable, given the large area over which activities occur and the dynamic nature of the marine environment. Table 3.3-16 summarizes the effects of the No Action Alternative, Alternative 1, and Alternative 2 on water resources under both NEPA and EO 12114.

**Table 3.3-16: Summary of Effects by Alternative**

| Alternative | NEPA (U.S. Territorial Seas, 0 to 12 nm) | EO 12114 (Non-U.S. Territorial Seas, > 12 nm) |
|---|---|---|
| **No Action Alternative** | • Current Navy activities were considered and are consistent with those analyzed in the previous environmental documentation (USAF 1997, USAF 2007, Army 1999, Army 2004). These documents concluded that no significant impacts on water resources would occur.<br>• Aircraft overflights would not involve expenditures of training materials, and thus would not affect water quality. | • With a distribution of expended materials over 20 percent of the TMAA, the deposition rate of expended materials will be 1.92 items per $nm^2$ (0.55 items per $km^2$) per year.<br>• Ordnance constituents and other materials (batteries, fuel, and propellant) from training devices have minimal effect or are below standards.<br>• No long-term degradation of marine water quality. |
| **Alternative 1** | • Under Alternative 1, Navy activities were considered and would be consistent with those analyzed in the previous environmental documentation (USAF 1997, USAF 2007, Army 1999, Army 2004). These documents concluded that no significant impacts on water resources would occur.<br>• Aircraft overflights would not involve expenditures of training materials, and thus would not affect water quality. | • An estimated 26-percent increase in expended training materials would occur, compared to the No Action Alternative. With a distribution of these materials over 20 percent of the TMAA, the deposition rate of expended items would be 2.40 items per $nm^2$ (0.69 items per $km^2$) per year.<br>• Deposition of hazardous materials (i.e., batteries, fuel, and propellant) from expended materials would be minimal (less than ½ lb per $nm^2$).<br>• No long-term degradation of marine water quality would occur. |
| **Alternative 2 (Preferred Alternative)** | • Under Alternative 2, Navy activities were considered and would be consistent with those analyzed in the previous environmental documentation (USAF 1997, USAF 2007, Army 1999, Army 2004). These documents concluded that no significant impacts on water resources would occur.<br>• Aircraft overflights would not involve | • An estimated 160 percent increase in expended training materials would occur, compared to the No Action Alternative. With a distribution of these materials over 20 percent of the TMAA, the deposition rate of expended items would be approximately 4.90 items per $nm^2$ (1.42 items per $km^2$) per year.<br>• Impacts from the increase in expended |

| | | |
|---|---|---|
| | expenditures of training materials, and thus would not affect water quality. | materials would be minimal because most expended materials (97 percent) would be inert in the marine environment.<br>• Assuming deposition over 20% of the TMAA, the amount of hazardous materials from expended materials would be low, approximately 1.2 lb per $nm^2$ per year. |