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3.3 HAZARDOUS MATERIALS

Hazardous materials addressed in this document are broadly defined as substances that pose a substantial hazard to human health or the environment by virtue of their chemical or biological properties. Hazardous materials may be solid, liquid, semi-solid, or gaseous materials that alone or in combination may: 1) cause or contribute to an increase in mortality or illness; or 2) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed. In general, the degree of hazard posed by these materials is related to their quantity, concentration, bioavailability, or physical state. Hazardous materials are regulated under a variety of federal and state laws (see "Regulatory Framework" in section 3.3.2.1).

In this section the phrase "hazardous materials" refers collectively to objects or individual components and constituents of objects that may be hazardous (e.g., missile warheads and fuel). Hazardous materials are often used in small amounts in high technology weapons, ordnance, and targets because they are strong, lightweight, reliable, long lasting, or low cost (e.g., heavy metals). Hazardous materials also are required for maintenance and operation of Navy vessels, aircraft, and equipment used during training. Except where specifically discussed, the term "hazardous materials" does not include "hazardous waste," a term specific to federal and state law (e.g., Resource Conservation and Recovery Act; see Section 3.3.2.1, Regulatory Framework). Table 3.3-1 below presents training activities and associated expended training materials that involve hazardous materials.

Nonhazardous expended material is defined as parts of a device that are made of nonreactive materials, including parts made of non-toxic metals (e.g., steel, iron, aluminum); polymers (e.g., nylon, vinyl, and various other plastics); as well as rubber, glass, fiber, and concrete. Sources of these materials include bombs, shells, and targets. While these items represent persistent seabed litter, their resistance to degradation and their chemical composition mean that they do not chemically contaminate the surrounding environment by leaching heavy metals or organic compounds (CFMETR 2005). Although these materials are not subject to further analysis in this section, they may cause other concerns that are discussed in other sections, such as benthic communities (Section 3.6), sea turtles (Section 3.8), or marine mammals (Section 3.9).

3.3.1 Affected Environment

In the Northwest Training Range Complex (NWTRC) Study Area, hazardous materials would be used in:

- the Pacific Northwest Operations Area (PACNW OPAREA), including specific offshore areas such as Warning Area W-237;
- inshore areas in Puget Sound where underwater detonation training occurs; and
- on-land areas designated for land-based explosives training. Please see the discussion and figures in Chapter 2 for more information.

Open ocean areas are typically considered relatively pristine with regard to hazardous materials. However, those materials are often present in varying amounts in the marine water and sediments, or on land from prior ocean dumping or land disposal, prior military activity (e.g., bombing ranges during World War II), prior commercial activity (e.g., paper mills), as a result of large spills, and as a result of ongoing activities. However, no information is available on the types and quantities of hazardous materials present in the Study Area at a given time or their distribution among the various categories of vessels and aircraft.

Table 3.3-1: Number of Activities or Expended Training Items – All Alternatives

Warfare Area and Location(s)	Platform	Training Items	Heavy Metals	Chemicals	Explosives	No Action Alternative	Alternative 1	% Change	Alternative 2	% Change
Air Combat Maneuvers (ACM) All MOAs/ATCAAs, W-237	EA-6B, F/A-18, F/16, EA-18G (future), and support aircraft	b/ c/								
Air-to-Air Missile Exercise [a/] **(A-A MEX)** W-237	EA/18G	Tactical air launched decoy (TALD, not recovered)	✓			0	11	—	22	—
		LUU-2B/B flare (not recovered)		✓		0	6	—	11	—
		AIM-7 Sparrow missile	✓	✓	✓	0	6	—	13	—
		AIM-9 Sidewinder missile	✓	✓	✓	0	5	—	9	—
		AIM-120 AMRAAM missile	✓	✓	✓	0	4	—	7	—
Surface-to-Air Gunnery Exercise [a/] **(S-A GUNEX)** W-237, PACNW OPAREA	DDG, FFG, AOE	Naval 5-inch 54 BLP gun shells		✓	✓	136	151	11.0	303	122.8
		20 mm cannon shells (CIWS)	✓			7,200	8,000	11.1	16,000	122.2
		7.62 mm shells				1,224	1,360	11.1	2,720	122.2
		TDU-34 towed target				72	80	11.1	160	122.2
Surface-to-Air Missile Exercise [a/] **(SAMEX)** W-237, PACNW OPAREA	P-3C, Learjet or C-130 (supporting), CVN	NATO Seasparrow missile	✓	✓	✓	0	0	—	8	—
		BQM-74E target	✓	✓		0	0	—	16	—
Surface-to-Surface Gunnery Exercise [a/] **(S-S GUNEX)** W-237, PACNW OPAREA	CVN, DDG (and Canadian DDH), FFH (and Canadian FFH), AOE	5-inch/54 caliber inert				1,716	2,351	37.0	3,463	101.8
		57 mm shells				630	700	11.1	1,260	100.0
		76 mm shells				560	800	11.1	1,120	100.0
		25 mm cannon shells				15,750	17,500	11.1	31,500	100.0
		.50 caliber rounds				58,500	65,000	11.1	117,000	100.0
		High speed maneuverable surface target (HSMST)		✓		0	5	—	9	—
		Trimaran target				0	11	—	20	—

Table 3.3-1: Number of Activities or Expended Training Items – All Alternatives (cont'd)

Warfare Area and Location(s)	Platform	Training Item	Heavy Metals	Chemicals	Explosives	No Action Alternative	Alternative 1	% Change	Alternative 2	% Change
S-S GUNEX (cont'd)		SPAR target				0	17	—	31	—
		Killer Tomato (FAST) target				60	67	11.7	120	100.0
Air-to-Surface Bombing Exercise (BOMB A-S) W-237, PACNW OPAREA	P-3 P-8 (future)	MK-82 live HE bomb (500 lb, 192 NEW*)		✓	✓	8	10	25.0	10	25.0
		BDU-45 (inert)				88	110	25.0	110	25.0
		MK-58 marine marker		✓		8	10	25.8	10	25.0
Sink Exercise (SINKEX) W-237, PACNW OPAREA	E-2, FA-18, P-3, SH-60B P-8 (future)	MK-82 live bomb (500 lb, 192 NEW)		✓	✓	4	8	100.0	8	100.0
		MK-83 live bomb (1,000 lb, 416 NEW)		✓	✓	4	8	100.0	8	100.0
		MK-84 live bomb (2,000 lb, 945 NEW)		✓	✓	4	8	100.0	8	100.0
		AGM-88 HARM missile	✓	✓	✓	2	4	100.0	4	100.0
		AGM-114 Hellfire missile	✓	✓	✓	1	2	100.0	2	100.0
		AGM-65 Maverick missile	✓	✓	✓	3	6	100.0	6	100.0
	CG, DDG, FFG, SSN (support)	AGM-84 Harpoon missile	✓	✓	✓	3	6	100.0	6	100.0
		SLAM ER missile	✓	✓	✓	1	2	100.0	2	100.0
		5-inch/62 mm shells				500	1,000	100.0	1,000	100.0
		76 mm shells				200	400	100.0	400	100.0
		MK-48 ADCAP torpedo	✓	✓	✓	1	2	100.0	2	100.0
		Decommissioned vessel				1	2	100.0	2	100.0

Table 3.3-1: Number of Activities or Expended Training Items – All Alternatives (cont'd)

Warfare Area and Location(s)	Platform	Training Item	Heavy Metals	Chemicals	Explosives	No Action Alternative	Alternative 1	% Change	Alternative 2	% Change
Antisubmarine Warfare Tracking Exercise (ASW TRACKEX – MPA) W-237, PACNW OPAREA	P-3 P-8 (future)	MK-39 EMATT (expendable mobile ASW training target)	✓	✓	✓	25	26	4.0	26	4.0
		SSQ-36 BT passive sonobuoy	✓	✓	✓	288	295	2.4	302	4.9
		SSQ-53 DIFAR passive sonobuoy	✓	✓	✓	7,283	7,503	3.0	7,661	5.2
		SSQ-62 DICASS active sonobuoy	✓	✓	✓	844	865	2.5	886	5.0
		SSQ-77 VLAD passive sonobuoy	✓	✓	✓	593	623	5.1	653	10.1
		MK-58 marine marker		✓		200	205	2.5	210	5.0
ASW Tracking Exercise – EER W-237, PACNW OPAREA	P-3C, P-8 MMA	SSQ-110A source explosive sonobuoy	✓	✓	✓	124	136	9.7	149	20.2
		SSQ-77 passive sonobuoy	✓	✓	✓	201	221	10.0	241	19.9
Surface Ship ASW	DDG, FFG	c/								
Submarine ASW TRACKEX PACNW OPAREA	SSBN, SSGN	MK-39 EMATT (not recovered)		✓		96	100	4.2	100	4.2
Electronic Combat (EC) Exercise W-237A, Darrington Area	P-3, EP-3, EA-6B, EA-18G (future) CVN, DDG, FFG, AOE, SSGN, SSBN	b/ c/								
Mine Countermeasure Training EOD Crescent Harbor, EOD Indian Island, and EOD Floral Point		< 2.5 lb charge NEW		✓	✓	3	0	0	0	0
		2.5 lb charge NEW		✓	✓	51	4	-92	4	-92
		5.0 lb charge NEW		✓	✓	1	0	-100	0	-100
		20.0 lb charge NEW		✓	✓	5	0	-100	0	-100

Table 3.3-1: Number of Activities or Expended Training Items – All Alternatives (cont'd)

Warfare Area and Location(s)	Platform	Training Item	Heavy Metals	Chemicals	Explosives	No Action Alternative	Alternative 1	% Change	Alternative 2	% Change
Land Demolitions DTR Bangor, DTR Seaplane Base	Pickup Trucks (support)	C-4 – 1.25 lb block		✓	✓	1,570	1,693	7.8	1,693	7.8
		Igniters		✓	✓	170	183	7.6	183	7.6
		MK-142 firing device		✓	✓	97	104	7.2	104	7.2
		Hand grenades		✓	✓	170	183	7.6	183	7.6
		MK-174 CTG cal .50 impulse		✓	✓	901	971	7.7	971	7.7
		DetaSheet 2.0 lb (M024)		✓	✓	255	276	8.2	276	8.2
		DetaSheet C-2 (0.083 in.)		✓	✓	850	917	7.9	917	7.9
		C-4 – 2.0 lb block		✓	✓	255	275	7.8	275	7.8
		Blasting cap, electric (M130)		✓	✓	1,870	2,017	7.9	2,017	7.9
		Detonation cord (M456)		✓	✓	34,000 ft	36,667 ft	7.8	36,667 ft	7.8
		Timed blasting fuse (M670)		✓	✓	17,340 ft	18,700 ft	7.8	18,700 ft	7.8
		Timed blasting fuse Igniter (M766)		✓	✓	340	367	7.9	367	7.9
		Blasting cap, non electric (M131)		✓	✓	1,020	1,100	7.8	1,100	7.8
		Red smoke (G950)		✓		238	256	7.6	256	7.6
		Green smoke (G940)		✓		97	104	7.2	104	7.2
		Violet smoke (G955)		✓		204	220	7.8	220	7.8

Table 3.3-1: Number of Activities or Expended Training Items – All Alternatives (cont'd)

Warfare Area and Location(s)	Platform	Training Item	Heavy Metals	Chemicals	Explosives	No Action Alternative	Alternative 1	% Change	Alternative 2	% Change
Insertion and Extraction Seaplane Base, OLF Coupeville, Crescent Harbor	C-130, H-60	b/								
HARMEX (non-firing) Okanogan, Olympic, and Roosevelt MOAs	EA-6B, E/A-18 (future)	CATM-88 missile (not released); a/				2,724	3,000	10.1	3,000	10.1
NSW Training Indian Island, Seaplane Base Survival Area	SEAL delivery vehicle, RHIB	c/								
Intelligence, Surveillance, and Reconnaissance (ISR) W-237, PACNW OPAREA	P-3C	SSQ-53 DIFAR passive sonobuoy	✓	✓	✓	980	1,043	6.4	1,043	6.4
UAV Activities R-6701, W-237, PACNW OPAREA	Scan Eagle, Global Hawk (future BAMS)	b/ c/				12	112	0.0	112	0.0

* NEW – "net explosive weight"

a/ Proposed range enhancements, including surface target services, would result in increased air-to-air missile exercises, surface-to-air gunnery, surface-to-air missile exercises, and surface-to-surface gunnery exercises in the NWTRC.

b/ Aircraft activities. Under the No Action Alternative, a total of 7,568 sorties (flights) would be flown by fixed-wing aircraft (98 percent), helicopters (one percent), and unmanned aerial vehicles (one percent). Compared to the No Action Alternative, sorties would increase 21 percent (to 9,204) under Alternative 1, and 55 percent under Alternative 2 (to 11,786). The relative proportion among the aircraft types remains largely the same. Existing Navy directives manage the storage, use, and proper disposal of materials that may be harmful to the environment.

c/ Naval vessel activities. Under the No Action Alternative, naval vessels would be underway and conducting exercises for 6,940 hours each year. Compared to the No Action Alternative, this would increase four percent (7,228 hours) under Alternative 1, and it would increase ten percent under Alternative 2. Vessels, aircraft, and other military equipment used in these activities carry and use hazardous materials for routine operation and maintenance. Existing Navy directives manage the storage, use, and proper disposal of materials that may be harmful to the environments. Please see the discussion of current requirements and practices below, as well as Table 3.4-1, Water Resources, for summary of water discharge restrictions for Navy vessels.

One study by Hoffsomer et al. (1972) analyzed seawater and ocean floor sediments and fauna at known ocean dumping sites for military ordnance. The sites were located 85 miles west of Cape Flattery, Washington, and 12 miles south-southeast of Charleston, South Carolina. Using a gas chromatograph, samples were tested for the explosives TNT (trinitrotoluene), RDX (Royal Demolition Explosive, cyclotrimethylene trinitramine), tetryl (nitramine), and the explosive oxidizing agent ammonium perchlorate. None of these materials were detected in any of the samples.

Navy vessels in the NWTRC Study Area represent a small fraction of the total watercraft and aircraft traffic entering and leaving Washington, Oregon, and northern California. Hazardous materials are present on all ocean-going vessels as cargoes, fuel, lubricants, and cleaning and maintenance materials, and as weapons and training materials on military vessels and aircraft.

3.3.1.1 Hazardous Materials

Table 3.3-1 provides the types and amounts of training items under each alternative that may present issues related to hazardous materials. These materials can be broadly categorized as heavy metals, chemicals, and explosives.

Heavy Metals

Some metals are necessary for biological organisms to function properly, such as iron, zinc, copper, and manganese in humans. Heavy metals commonly noted for concern include lead, cadmium, mercury, and chromium, but zinc, copper, and manganese may also be noted when exposure levels are too high. In the Study Area, heavy metals are present in vessels, manned and unmanned aircraft, bombs, shells, missiles, sonobuoys, batteries, electronic components, and as anti-corrosion compounds coating exterior metal surfaces. Most of these materials are inert, dense, and will settle to the bottom where they will lodge in deep sediments, eventually be covered by sediment, encrusted by chemical processes (e.g., rust), or covered by marine organisms (e.g., coral).

Chemicals

Hazardous chemicals include fuels and other propellants, and combustion byproducts of those fuels and propellants. These materials are present or may become present from the use of aircraft, vessels, and self-propelled machines such as torpedoes, high speed maneuverable surface targets (HSMSTs), expendable mobile anti-submarine warfare training target (EMATTs), and unmanned aerial vehicles. The batteries within these machines may also contain hazardous chemicals, as do smoke canisters and other markers. Toxic components of fuel oils include aromatic hydrocarbons such as benzene, toluene, xylene, and polycyclic aromatic hydrocarbons (PAHs) such as naphthalene, acenaphthene, and fluoranthene. Examples of shipboard materials necessary for normal activities and maintenance include lubricants and hydraulic fluids, paint, solvents, corrosion inhibitors, adhesives, coolants, and cleaning compounds. Like commercial and recreational watercraft, boat engines discharge petroleum products in their wet exhaust.

Explosives

Explosives are contained in live bombs, missiles, torpedoes, and sonobuoys, and are used in explosives training. Constituents of concern in explosives include nitroaromatics (e.g., TNT) and cyclonitramines, including RDX (Royal Demolition Explosive, cyclotrimethylene trinitramine) and HMX (High Melting Explosive, cyclotetramethylene tetranitramine) that are mixed with plastics or other polymer binders (Janes 2005, 2006). PETN (pentaerythritol tetranitrate) is used in blasting caps, detonation cord, and similar initiators of explosions. Under normal use, 99.997 percent of the explosive is converted to inorganic compounds (Table 3.3-2; USACE 2003, Renner and Short 1980).

Table 3.3-2: Chemical Byproducts of Underwater Detonations

Detonation Byproduct	Percent by Weight by Explosive Compound		
	TNT	RDX	Composition B*
nitrogen	18.2	37.0	29.3
carbon dioxide	27.0	24.9	34.3
water	5.0	16.4	8.4
carbon monoxide	31.3	18.4	17.5
carbon (elemental)	10.6	0	2.3
ethane	5.2	1.6	5.4
hydrogen	0.2	0.3	0.1
propane	1.6	0.2	1.8
ammonia	0.3	0.9	0.6
methane	0.2	0.2	0.2
hydrogen cyanide	<0.0	<0.0	<0.0
methyl alcohol	<0.0	<0.0	0
formaldehyde	<0.0	<0.0	<0.0
other compounds	<0.0	<0.0	<0.0

* 59.5% RDX, 39.5% TNT, 1% wax.

However, these explosives become a concern when the ordnance does not function correctly, that is, when they do not detonate or do not detonate completely (low-order detonation). In these cases, all or a portion of the explosive remain. Table 3.3-3 provides information on the failure and low-order detonation rates for various ordnance (Rand 2005, USACE 2007). These materials can release small amounts of hazardous materials into the water or soil as they degrade and decompose. Table 3.3-4 provides a list of these materials (DoN 2008c).

Table 3.3-3: Failure and Low-Order Detonation Rates of Military Ordnance

Ordnance	Failure Rate (Percent)	Low-Order Detonation Rate (Percent)
Guns / artillery	4.68	0.16
Hand grenades	1.78	—
High explosive ordnance	3.37	0.09
Rockets	3.84	—
Submunitions	8.23	—

These materials can release small amounts of hazardous materials into the water as they decompose. However, the hazardous constituents decompose slowly, so existing ocean and tidal currents would dissipate these materials to undetectable levels.

Table 3.3-4: Hazardous Material Components of Training Materials

Training Application, Ordnance Element	Hazardous Material Component
Pyrotechnics Tracers Spotting Charges	Barium chromate Potassium perchlorate Chlorides Phosphorus Titanium compounds Depleted uranium
Oxidizers	Lead oxide
Delay Elements	Barium chromate Potassium perchlorate Lead chromate
Propellants	Ammonium perchlorate
Fuses	Potassium perchlorate
Detonators	Fulminate of mercury Potassium perchlorate
Primers	Lead azide

Close-in weapons systems (CIWS) use 20 mm cannon shells composed of both depleted uranium (DU) and tungsten. DU is "depleted" in that is has one-third less of the isotopes of U-234 and U-235, making it nearly 60 percent less radioactive than natural uranium. Each 20mm round weighs 9 ounces (253 grams) of which 2.5 ounces (70 grams) is depleted uranium. The Nuclear Regulatory Commission (NRC) approved the Navy's license application which clearly stated that CIWS DU rounds would be fired at sea and not recovered. Consultations with the NRC and the U.S. Environmental Protection Agency determined that this practice was acceptable because of the absence of environmental risk. The Navy is currently phasing out use of DU rounds because of the superior flight characteristics of tungsten and its performance against missile casings. The Navy's transition to tungsten began in 1989 and most rounds with depleted uranium have been replaced.

Uranium is a naturally occurring, slightly radioactive heavy metal found in many parts of the world. Normal uranium concentration in seawater is three parts per billion. According to Hanson (1974), uranium is soluble in oxygen-rich water, such as those found in the surface of the ocean. However, after firing, DU rounds and fragments would fall into to the ocean bottom. Where DU rounds remain at the seawater-bottom interface, the metal alloy would dissolve slowly over many years. Between mixing through water movement and natural background levels, impacts would not be detectable. Where DU rounds lodge in bottom sediments, the electro-chemical conditions common in such layers tends to change uranium to a form that "has a high affinity for organic material." Although saltwater would corrode DU rounds, Hanson (1974) indicated that the resulting impacts would not be noticeable from normal uranium levels in seawater. Whether at the sediment surface or lodged more deeply, exposure of DU to marine life would be low.

Hanson (1974) indicated that bioaccumulation of uranium up through the food chain did not appear to occur. A recent report investigated the presence of depleted uranium in marine waters off the southern coast of England in an area used for test firing of DU rounds (Toque 2006). Approximately 68,340 pounds (31 metric tonnes) of DU was fired off the southern coast of England between 1982 and 2003.

Sampling was done of intertidal and ocean bottom sediments, as well as seaweed, mussels, and locally-caught lobster and scallops. Results did not indicate the presence of depleted uranium.

Fate of Hazardous Materials

Three things generally happen to materials that come to rest on the ocean floor: 1) they lodge in sediments where there is little or no oxygen (below four inches [10 cm]); 2) they remain on the ocean floor and begin to react with seawater; or 3) they remain on the ocean floor and become encrusted by marine organisms. Rates of deterioration depend on the material and conditions in the immediate marine and benthic environment. Buried deep in ocean sediments, materials tend to decompose at much lower rates than when exposed to seawater (Ankley 1996). With the exception of torpedo guide wires and sonobuoy parts, sediment burial appears to be the fate of most ordnance used in marine warfare (CFMETR 2005).

Metals. When exposed to seawater, metals begin to corrode. This process creates a layer of corroded material around the object. This removes the material from direct exposure to the corrosiveness of seawater, a process that further slows movement of the metals into the adjacent sediments and water column. This is particularly true of aluminum. In a similar fashion, as materials become covered by marine creatures, the direct exposure of the material to seawater decreases and the rate of corrosion decreases. Dispersal of these materials in the water column is controlled by physical mixing and diffusion, both of which tend to vary with time and location. A recent study of similar Canadian military activities in the Strait of Georgia found few chemical or biological impacts as a result of debris released during activities (CFMETR 2005).

Explosives. TNT degrades to dinitrotoluene (DNT) and subsequent degradation products from exposure to sunlight (photolysis) or bacteria (biodegradation). RDX is also subject to photolysis and biodegradation once exposed to the environment. When exposed on the ocean floor, RDX breaks down within a few hours (DoN 2001). Military-grade explosives have low water solubility, meaning that they do not readily dissolve in water and are, therefore, relatively immobile in water (Table 3.3-5). The degradation and dissolution of these materials may be further slowed by the physical structure and composition of blended explosives, which contain multiple chemical compounds and binding agents. Because of these factors, explosives in the marine environment appear to pose little risk to the environment.

Based on the preceding discussion and the location of military activities under the various alternatives, the following habitats may be impacted by hazardous materials: 1) open ocean habitat – surface and subsurface (pelagic) areas; 2) open ocean habitat – bottom dwelling (benthic) communities; and 3) nearshore habitat, including bottom-dwelling algaes (e.g., kelp forests) and seagrass beds Specific impacts to specific resources are detailed in other sections: geology and soils – Section 3.1; water resources – Section 3.4; and marine invertebrates and plants – Section 3.6.

3.3.1.2 Current Requirements and Practices

Discharges of hazardous materials are regulated by a variety of federal and state programs that are explained in more detail below. In addition, the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) prohibits certain discharges of oil, garbage, and other substances from vessels. The MARPOL convention is implemented by national legislation, including the Act to Prevent Pollution from Ships (33 USC 1901, et seq.) and the Federal Water Pollution Control Act ("Clean Water Act"; 33 USC 1321, et seq.). These and other requirements are implemented by the *Navy Environmental and Natural Resources Program Manual* (OPNAVINST 5090.1C, 2007) and related Navy guidance documents that require hazardous materials to be stored and handled appropriately, both on shore and afloat.

Table 3.3-5: Water Solubility of Common Explosives and Degradation Products

Compound	Water Solubility*
salt (sodium chloride) [for comparison]	357,000
ammonium perchlorate	249,000
picric acid	12,820
nitrobenzene	1,900
dinitrobenzene	500
trinitrobenzene	335
dinitrotoluene (DNT)	160-161
trinitrotoluene (TNT)	130
tetryl	51
pentaerythritoltetranitrate (PETN)	43
RDX	38
HMX	7
white phosphorus	4
* Units are milligrams per liter (mg/L) at 20°C	

Source: DoN 2008c

At sea, Navy vessels are required to operate in a manner that minimizes or eliminates any adverse impacts to the marine environment. Environmental compliance policies and procedures applicable to shipboard activities afloat are defined in the *Navy Environmental and Natural Resources Program Manual* (OPNAVINST 5090.1C, 2007), Chapter 4, "Pollution Prevention," and Chapter 22, "Environmental Compliance Afloat"; DoD Instruction 5000.2-R (§C5.2.3.5.10.8, "Pollution Prevention") (DoN 2003). 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 Clean Water Act prohibition against discharge of harmful quantities of hazardous substances into U.S. waters out to 200 nm (371 km), and mandate stringent hazardous waste discharge, storage, dumping, and pollution prevention requirements. Table 3.4-1 in the Water Resources section provides information on Navy current requirements and 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 materials are detailed in OPNAVISNT 5090.1C, Chapter 12. These are discussed in more detail in Chapter 5.

The Navy has also implemented hazardous materials management programs to ensure compliance and to provide guidance on handling and disposing of such materials. Navy instructions include stringent discharge, storage, and pollution prevention measures and require facility managers to reduce, to the extent possible, quantities of toxic substances released into the environment. All Navy vessels and facilities have comprehensive programs in place that implement responsible stewardship, hazardous materials management and minimization, pollution prevention, recycling, and spill prevention and response. These and other programs allow Navy ships to retain used and excess hazardous material on board for shore offload within five working days of arrival at a Navy port. All activities can return excess and unused hazardous materials to the Navy's Hazardous Material Minimization Centers. Additional information regarding water discharge restrictions for Navy vessels is provided in Table 3.4-1, Water Resources.

3.3.2 Environmental Consequences

3.3.2.1 Approach to Analysis

Regulatory Framework

Hazardous materials are regulated by several federal laws and regulations, including the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Toxic Substances Control Act, the Hazardous Materials Transport Act, the Emergency Planning and Community Right to Know Act, and the Oil Pollution Act. Together, these laws and the accompanying regulations govern the storage, use, and transportation of hazardous materials from their origin to their disposal, including recovery and cleanup of environmental contamination.

Federal Laws and Regulations

Resource Conservation and Recovery Act

RCRA defines a hazardous waste as a solid waste that can kill or incapacitate due to its quantity, concentration, or physical, chemical, or infectious characteristics, or which can pose a hazard to human health or the environment when improperly treated, stored, or disposed of (42 USC 6901, et seq.).

Military ordnance includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot agents, and smoke canisters. The military munitions rule (40 CFR 260, et seq.) directs that conventional and chemical military ordnance are not considered hazardous materials according to RCRA under two conditions:

1) when they are used for their intended purpose, including training of military personnel and explosive emergency response specialists, research and development activities, and when recovered, collected, and destroyed during range clearance events; and
2) when they are unused and being repaired, reused, recycled, reclaimed, disassembled, reconfigured, or subjected to other material recovery activities.

These two conditions cover most uses of missiles, ordnance, and targets in the Study Area. Under the rule, wholly inert items and non-ordnance training materials are not considered military ordnance. Military ordnance become subject to RCRA when: 1) transported off-range for storage, reclamation, treatment, disposal; 2) they are buried or placed in a land filled on- or off-range; or 3) they land off-range and are not immediately rendered safe or retrieved.

Comprehensive Environmental Response, Compensation, and Liability Act

CERCLA – the Superfund program – defines hazardous material as any substance that, due to its quantity, concentration, or physical and chemical characteristics, poses a potential hazard to human health and safety or to the environment. CERCLA has established national policies and procedures to identify and clean up sites contaminated by hazardous substances. CERCLA provisions apply to closed military installations, but not active military ranges.

Toxic Substances Control Act

The Toxic Substances Control Act requires that a facility must file with the USEPA a pre-manufacture notice that characterizes the toxicity of a substance prior to its manufacture (15 USC 2601, et. seq.).

Hazardous Materials Transportation Law

For air, sea, or land transportation, the U.S. Department of Transportation defines a hazardous material as a substance or material that is capable of posing an unreasonable risk to health, safety, and property when transported in commerce (49 USC 5101, et seq.; 49 CFR 172.101, Appendix B).

Emergency Planning and Community Right-to-Know Act

The Emergency Planning and Community Right to Know Act requires federal, state, and local governments and industry to report their use of hazardous and toxic chemicals (42 USC 116, et seq.).

Oil Pollution Act

The Oil Pollution Act requires oil storage facilities and vessels to submit plans to the federal government describing how they will respond to the unplanned release of oil and other hazardous materials (33 USC 2701, et seq.). Oil and hazardous releases are also reported and remediated according to current Navy policies.

State Laws and Regulations

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

Washington

The Washington State Department of Ecology regulates the disposal of solid waste (Revised Code of Washington [RCW] Chapter 36.58), hazardous wastes (RCW Chapter 70.105), and radioactive waste (RCW Chapter 70.98). The state has also adopted the military munitions rule, except for certain transportation exemptions and the management of closed ranges (Washington Administrative Code 173-303). NBK-Bangor is one of 29 entities in Washington authorized to treat, store, dispose, or recycle hazardous materials or to process used oil. NBK-Bangor processes used oil and oily materials; performs heat, chemical, and mechanical processing in tank systems; and is a hazardous waste broker. The base only accepts used oil from Navy vessels and facilities.

Oregon

The Oregon Department of Environmental Quality is authorized by the USEPA to regulate hazardous materials. Oregon has adopted the military munitions rule, except for the chemical ordnance provisions (Oregon Administrative Rules [OAR] 340-100-0002[1]). A facility that generates or processes hazardous materials must be certified, notify the department of its activities, and follow all applicable regulations. These requirements are imposed under RCRA and several federal and state regulations (40 CFR Parts 124, 260-266, 268, 270, 273, and 279; and OAR 340-100 through 109, 111, 113, 124, and 142).

California

California state laws and regulations generally implement federal requirements, but broaden their application or impose additional regulatory requirements in some areas (Table 3.3-6). The California Environmental Protection Agency (CEPA) has general authority over hazardous materials, although much of this responsibility is delegated to local governments under the Certified Unified Program Agency program. In the NWTRC Study Area, this is generally county governments in northern California. Within CEPA, the Department of Toxic Substances Control is responsible for the use, storage, transport, and disposal of hazardous materials.

Study Area

The Study Area for the analysis of hazardous materials is the Northwest Training Range Complex (NWTRC), specifically PACNW OPAREA, nearshore areas such as underwater detonation areas in Puget Sound, and on-land training areas. Greater detail regarding these areas is provided in Section 2.1.

Table 3.3-6: State of California Laws Related to Hazardous Materials

Law	Description
Hazardous Materials Release Response Plans and Inventory Act	Requires facilities using hazardous materials to prepare hazardous materials plans
Hazardous Waste Control Act	Regulates the generation, transportation, storage, treatment, and disposal of hazardous materials
Safe Drinking Water and Toxic Enforcement Act	Regulates the discharge of contaminants to ground water
Emergency Services Act	Similar to the Federal Emergency Planning and Community Right-to-Know Act

Sources of Information

A systematic review of relevant literature was conducted to complete this analysis of hazardous materials in the Study Area, including journals, technical reports published by government agencies, work conducted by private businesses and consulting firms, and Department of Defense reports, operational manuals, natural resource management plans, and current and prior environmental documents for facilities and activities in the NWTRC Study Area. The literature and other information sources cited are identified in Chapter 9, References.

Methods

For each alternative, this document characterizes and quantifies the items and activities that may contribute hazardous materials to various areas within the Study Area, and analyzes those items and activities in terms of the federal and state laws intended to protect public health and the environment. An adverse impact would result if the use of hazardous materials results in a violation of any of the laws cited above.

3.3.2.2 No Action Alternative

Table 3.3-1 summarizes the types and amounts of training items and activities under each alternative that may present issues related to hazardous materials. The amounts and types of specific training materials under the No Action Alternative are analyzed below.

Bombs

Typically, bombing exercises involve one or more aircraft bombing a target at sea that simulates a hostile surface vessel. Bomb bodies are made of steel with fins of steel or aluminum. The bombs used may be live (with explosives) or inert (as called "practice" or "bomb dummy units"). Zinc, lead, antimony, copper, manganese, and iron are found in shell casings and various projectile components. Lead is found in warhead primers in live bombs. All of these metals are found at some natural background levels in the environment. Inert bombs are comprised mainly of iron and steel casings filled with sand, concrete, or vermiculite, and configured to have the same weight, size, center of gravity, and ballistics as a live bomb (DoN 2006a).

Under the No Action Alternative, 108 bombs would be used, of which 88 are inert (81 percent) (Table 3.3.7). With an ocean area of approximately 122,400 square nautical miles (nm^2) (420,163 km^2) and assuming even distribution of activities, this amounts to 0.001 items per nm^2 (0.0003 per km^2).

Table 3.3-7: Types and Number of Bombs – No Action Alternative

Type of Bomb	Number
MK-82 – Live	12
BDU-45 – Inert	88
MK-83 – Live	4
MK-84 – Live	4
Total	**108**

Practice bombs entering the water do not contain combustion chemicals found in the warheads of live bombs. Unrecovered ordnance and fragments of detonated bombs settle to the sea floor that is over 200 feet (60 m) at the continental shelf and several thousand feet beyond the continental shelf. On the bottom, the bombs and fragments are exposed to seawater or lodge in sediments. Once settled, metal components slowly corrode in seawater. Over time, natural encrustation of exposed surfaces occurs and reduces the rate of corrosion. Elemental aluminum in seawater tends to be converted by hydrolysis to aluminum hydroxide, which is relatively insoluble, and scavenged by particulates and transported to the bottom sediments (MBARI 2008). Practice bombs are made of materials similar to those used to construct artificial reefs. The steel and iron, though durable, corrode over time, with no noticeable environmental impacts. The concrete is also durable and offers a beneficial substrate for benthic organisms (DoN 2006b). Due to the large size of the PACNW OPAREA, expended ordnance on the ocean floor would be widely scattered and have negligible adverse impacts and possibly some slight benefits.

Missiles

Missiles are fired by aircraft and ships at a variety of airborne and surface targets. Missiles used in most aviation exercises are inert versions and do not explode on contact with the target or sea surface. Exploding warheads may be used in air-to-air missile exercises, but to avoid damaging aerial targets, the missile explodes in the air, disintegrates, and falls into the ocean. Live missiles used in air-to-surface exercises explode near the water surface (DoN 2006b).

Under the No Action Alternative, 10 missiles would be used, eight during air-to-air missile exercises (AAMEX) and vessel-sinking exercises (SINKEX), and two during high-speed anti-radiation missile exercises (HARMEX) (Table 3.3-8). About half of the missiles used for AAMEX and SINKEX have live warheads and the remainder are inert and do not explode on contact with the target. During AAMEX, the target is usually a TALD or LUU-2B/B illumination flare. During SINKEX, the target is a cleaned, decommissioned vessel. Launched missiles are not recovered. During HARMEX, a flight crew receives and identifies an electronic signal from simulated enemy radar. The aircrew positions itself for the optimum firing solution and simulates firing a HARM missile designed to destroy enemy radar. Only non-firing, "captive" HARM missiles are used.

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 are also used in igniters, explosive bolts, batteries (e.g., potassium hydroxide and lithium chloride), and warheads (e.g., PBX-N high explosive components, PBXN-106 explosive, and PBX (AF)-108 explosive). Table 3.3-9 describes the types of propellants for selected types of missiles proposed for use under the No Action Alternative.

Table 3.3-8: Types and Number of Missiles Under the No Action Alternative

Type of Missile	Number
AIM-7 Sparrow	0
AIM-9 Sidewinder	0
AIM-120 AMRAAM	0
NATO Sea Sparrow	0
AGM-88 HARM	2
AGM-114 Hellfire	1
AGM-65 Maverick	3
AGM-84 Harpoon	3
SLAM ER	1
Total	**10**

Table 3.3-9: Propellant in Selected Missiles

Type of Missile	Type of Propellant
AIM-7 Sparrow	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	Propulsion system contains up to 44 lb (20 kg) of solid double-base propellant; warhead contains approximately 10 lb (4.5 kg) of PBX-N HE
AIM-114 Hellfire	Propellant is solid-fuel rocket motor (Thiokol TX-657 (M120E1); warhead contains approximately 17 lb (8 kg) of HE
AIM-120 AMRAAM	Propellant is solid-fuel rocket motor (ATK WPU-6B booster and sustainer with RS HTPB solid propellant fuel); warhead contains 40 lb (18 kg) of HE

Solid propellant fragments would sink to the ocean floor and undergo changes in the presence of seawater. Testing has also demonstrated that water penetrates only 0.06 inches into the propellant during the first 24 hours of immersion, and that fragments will very slowly release ammonium and perchlorate ions (DoN 2008c). These ions will be expected to be rapidly diluted and disperse in the surrounding water such that local concentrations will be extremely low. Section 3.4, Water Resources, discusses missile propellant in the marine environment in further detail.

Table 3.3-10 lists chemical materials associated with missile launches as well as exposure limits for those materials (USAF 1999). Chromium or cadmium may also be found in anticorrosion compounds coating exterior missile surfaces. A discussion of batteries in the marine environment is provided below.

Exploding warheads may be used in air-to-air missile exercises, but to avoid damaging the aerial target, the missile explodes in the air, disintegrates, and falls into the ocean. For these and inert missiles, the main environmental impact would be the physical components of the missile itself entering the water (DoN 2006a). However, the impact of these components is expected to be minimal. More detailed discussion is included in Section 3.4, Water Resources.

Table 3.3-10: Chemical Compounds Associated With Missile Launches

Resource	Chemical Compound	Maximum Exposure (mg/m^3)
Air	Al_2O_3 – alumina	0.021
	CO – carbon monoxide	39.11
	HCl – hydrochloric acid	0.012
	NOx – oxides of nitrogen	0.009
Water	Jet propulsion fuel, Type 8	0.023

Naval Gunfire

Under the No Action Alternative, a total of 25,856 naval gunshells would be would be expended over an ocean area of approximately 122,400 nm^2 (420,163 km^2) (Table 3.3-11). This amounts to 0.2 items per nm^2 (0.06 per km^2), assuming an even distribution of activities.

Table 3.3-11: Types and Number of Naval Gunshells – No Action Alternative

Type of Gunshells	Number	Percent of Total
20mm – live (CIWS)	7,200	28
25mm – live	15,750	61
57mm – live	630	2
76mm – live	560	2
5 inch – live	1,716	7
Total	**25,856**	

Except for the 20mm shells, this ordnance is composed of steel, brass, copper, tungsten, and other metals. Live 5-inch shells are typically fused to detonate within three feet of the water surface. Shell fragments, unexploded shells, and non-explosive ordnance rapidly decelerate in the water and settle to the sea floor. Steel may contain boron, chromium, cobalt, molybdenum, nickel, selenium, titanium, tungsten, or vanadium to improve its strength or corrosion resistance. The steel and metal alloys are relatively insoluble, but seawater will eventually oxidize the expended training material into benign by-products (DoN 2008c). The impact of naval shells on the environment under the No Action Alternative would be negligible given that their fate on the ocean bottom is similar to bombs, that the objects are relatively small, and that they will likely be evenly distributed across the PACNW OPAREA.

The 20-mm cannon shells used in close-in weapons systems (CIWS) are composed of tungsten or depleted uranium, although the latter is being phased out. Please see Section 3.3.1.1 above for a more detailed discussion of depleted uranium.

Targets and Countermeasures

Table 3.3-12 summarizes the number and types of targets and countermeasures anticipated under the No Action Alternative. More detail regarding these training items is provided below. Under all alternatives under most conditions, only the LUU-2B/B illuminating flares, TALDs (tactical air-launched decoy), marine markers, EMATTs (expendable mobile anti-submarine warfare training target), and the sunken vessel(s) are not be recovered.

Table 3.3-12: Types and Number of Targets and Countermeasures – No Action Alternative

Type of Target or Countermeasure		Number	Percent of Total
Aerial	LUU-2B/B*	0	0.0
	TALD*	0	0.0
	BQM-74E	0	0.0
	TDU-34	72	15.6
Surface	HSMST	0	0.0
	Trimaran	0	0.0
	SPAR	0	0.0
	Killer Tomato	60	13.0
	MK-58 Marine Marker*	208	45.0
Subsurface	EMATT*	121	26.2
Sinking Exercise	Decommissioned Vessel*	1	0.2
	Total	**462**	

* Not recovered

Aerial targets. The tactical air-launched decoy (TALD) is a non-powered, air-launched, aerodynamic vehicle that emits signals to confuse air defense systems during aircraft strike warfare training. It is constructed of aluminum, weighs about 400 pounds, and is not recovered. The BQM-74E is a remote-controlled, subsonic, jet-powered aerial target that can be launched from the air or surface and recovered on land or at sea. The target generates signals for tracking purposes. It is powered by a jet engine and thus contains fuel, oils, hydraulic fluid, batteries, and explosive cartridges. The TDU-34 ("towed drone unit") is a passive radar target towed by a variety of aircraft. It is constructed of aluminum, plastic, fiber glass, and lead ballast and weighs about 75 pounds. Both the BQM-74E and the TDU-34 are recovered.

Surface targets. A typical surface target is a remotely-controlled boat such as the high speed maneuverable surface targets (HSMST), a self-propelled, remote-controlled 24-foot platform that is used to tow other targets, such as the trimaran. The HSMST is recovered after use. The trimaran is a three-hulled boat with a four-foot-square sail that provides a moving target. A "Killer Tomato" is a large, inflatable, plastic target that can be towed or left stationary.

Underwater targets. Expendable mobile anti-submarine warfare training targets (EMATTs) are air or surface-launched vehicles that maneuver in the ocean and emit magnetic or acoustic signals that are monitored by airborne and surface vessels for training purposes. The duration of operation is about three hours at which time the vehicle is usually retrieved. EMATTs contain fuel and use lithium sulfur dioxide batteries.

Sinking exercise. A decommissioned ship is used during a vessel-sinking exercise (SINKEX). These ships are selected from a list of U.S. Navy-approved vessels that have been cleaned in accordance with U.S. Environmental Protection Agency (USEPA) guidelines. The target is towed to a designated location where various weapons fire at the vessel. By rule, SINKEX is conducted at least 50 nautical miles offshore (92 km^2) and in water at least 6,000 feet deep (1,830 m) (40 CFR 229.2). Only minimal concentrations of hazardous chemicals have been detected in water and sediments around Navy ships that were sunk to create artificial reefs (SPAWAR Systems Center 2006).

Markers and flares. The LUU-2B/B is a flare that illuminates targets by burning magnesium at high temperature while suspended from a parachute. The LUU-2B is constructed of aluminum and weighs about 30 pounds (13.6 kg). The entire assembly is usually consumed during flight (Global Security 2008).

Marine markers are pyrotechnic devices dropped on the water's surface used in training exercises to mark a surface position on the ocean surface. The chemical flame of a marine marker burns like a flare but also produces smoke. The MK-58 marker is a tin tube that weighs about four pounds (1.8 kg) and produces a yellow flame and white smoke for 10 to 20 minutes. It contains a red phosphorous compound that is ignited by a seawater-activated battery (Ordnance Shop 2008). Any remaining materials from marine markers would sink into bottom sediments or become encrusted by chemical processes or by marine animals.

The major constituents of flares are aluminum and magnesium. Some flares also contain chromium and lead. Elemental aluminum in seawater tends to be converted by hydrolysis to aluminum hydroxide, which is relatively insoluble, and scavenged by particulates and transported to the bottom sediments (MBARI 2008). Combustion products from flares are mostly non-hazardous, including magnesium oxide, sodium carbonate, carbon dioxide, and water. Small amounts of metals are used to give flares and other pyrotechnic materials bright and distinctive colors. The amounts of flare residues are negligible, and the chemical constituents do not substantially affect water quality resources (DoN 2008c).

Illuminating flares and marine markers are consumed during use. Smoke from marine markers rapidly diffuses by air movement. The marker itself is not designed to be recovered and would eventually sink to the bottom and become encrusted or incorporated into the sediments (Q&S Engineering 2007). Phosphorus contained in the marker settles to the sea floor, where it reacts with the water to produce phosphoric acid until all phosphorus is consumed by the reaction. Phosphoric acid is a variable, but normal, component of seawater. Combustion of red phosphorus produces phosphorus oxides, which have a low toxicity to aquatic organisms and is not anticipated to have a significant effect on the marine environment (DoN 2006a). Seawater-activated batteries would be expended during their normal service life and would not present a significant impact to the environment.

Most target fragments would sink quickly in the sea. Expended material that sinks to the sea floor would gradually degrade, be overgrown by marine life, or be incorporated into the sediments. Floating, non-hazardous expended material may be lost from target boats and would either degrade over time or wash ashore as flotsam. An extensive study conducted at Canadian Forces Maritime Experimental and Test Ranges near Nanoose, British Columbia, concluded that in general, the direct impact of debris accumulation on the sea floor appeared to be minimal and had no detectable effects on wildlife or sediment quality (CFMETR 2005).

Under the No Action Alternative, no measurable impact on the environment from targets and countermeasures will occur within the PACNW OPAREA because: 1) the majority of targets (62 percent) are marine markers that are consumed by chemical reactions that produce smoke; 2) most of the remaining targets and countermeasures are recovered after use; and 3) the majority of weighting and anchoring materials used for proposed range enhancements are inert and are buried in bottom sediments.

For vessel-sinking exercises (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 is conducted at least 50 nautical miles offshore and in water at least 6,000 feet deep (1,830 m) (40 CFR 229.2). USEPA considers the contaminant levels released during the sinking of a target to be within the standards of the Marine Protection, Research, and Sanctuaries Act (16 USC 1341, et seq.). As with other inert materials discussed in the text, the vessel would become encrusted by chemical processes and biological organisms and not pose a hazard to ocean water resources.

Infrequently, a recoverable target may be lost. In those cases, the hazardous materials of concern include propellant, petroleum products, metals, and batteries. Small concentrations of fuel and ionic metals released during battery operation could enter the water and contaminate limited areas. However, they do not represent a source of substantial environmental degradation. The potential impact of batteries on

water quality is discussed in Section 3.4, Water Resources. The potential impact of the vessel-sinking exercise on marine communities is discussed in Section 3.6, Invertebrates and Plants.

Torpedoes

The MK-48 ADCAP torpedo is the Navy's only torpedo used for engagement of other submarine and surface targets in the Study Area. The ADCAP torpedo is an acoustic homing torpedo used in force protection. It is 19 feet long (5.8m) with a 21-inch diameter and weighs roughly 3,700 pounds (1,680 kg). It is not recovered after use. Although the hazardous materials list for the MK-48 is classified, it uses Otto fuel II as a propellant. Otto fuel II is composed of propylene glycol dinitrate and nitro diphenylamine (76 percent), dibutyl sebacate (23 percent) and 2-nitrodiphenylamine as a stabilizer (2 percent). The exhaust products of the combustion are nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), hydrogen (H_2), nitrogen (N_2), methane (CH_4), ammonia (NH_3), and hydrogen cyanide (HCN) (DoN 2008a). During normal venting of excess pressure or upon failure of the torpedo's buoyancy bag, the following are discharged: CO_2, water, H_2, N_2, CO, methane, ammonia, hydrochloric acid (HCl), hydrogen cyanide (HCN), formaldehyde (CH_2O), potassium chloride (KCl), ferrous oxide (FeO), potassium hydroxide (KOH), and potassium carbonate (K_2CO_3) (DoN 1996). Each torpedo also deploys a guidance wire during each run that can be up to 15 miles long (28 km). It is composed of copper and cadmium within a plastic coating and is about 0.04 inches in diameter (0.1 cm) (DoN 2008b).

Under the No Action Alternative, one MK-48 ADCAP torpedo would be used. This will have no measurable impact on the PACNW OPAREA environment.

Small Caliber Rounds

Under the No Action Alternative, a total of 59,724 small caliber rounds would be used in the PACNW OPAREA (Table 3.3-13). This amounts to 0.5 items per nm^2 (0.2 per km^2), assuming an even distribution of activities.

Table 3.3-13: Types and Number of Small Caliber Rounds – No Action Alternative

Type of Ordnance	Number	Percent of Total
7.62 mm projectile	1,224	2
.50 caliber rounds	58,500	98
Total	**59,724**	

All of these materials would come to rest on the bottom of the ocean exposed to seawater or lodge in bottom sediments. The .50 caliber rounds are composed of steel with small amounts of aluminum and copper and brass casings that are 70 percent copper and 30 percent zinc. As they corrode, these materials would release small amounts of iron, aluminum, and copper into the sediments and the overlying water column. All three elements are widespread in the natural environment, although elevated levels can cause toxic reactions in exposed plants and animals. Any elevation of metals in sediments would be restricted to a small zone around the bullet, and any release to the overlying water column would be diluted. The 7.62mm projectiles have lead cores and lead has been identified as a toxic contaminant under Section 307 of the Clean Water Act. However, lead is nearly insoluble in water, particularly at the near-neutral pH levels. While it is reasonable to assume some dissolution of lead could occur, such releases into the water column would be small and would be diluted (DoN 2006a). Given these observations and the widespread distribution of the items across the PACNW OPAREA, small caliber rounds would have negligible impacts on the environment.

Sonobuoys

Sonobuoys are expendable metal cylinders launched from aircraft and ships that collect and generate information about the marine environment and potential threats and targets. Sonobuoys are about five inches in diameter (13 cm) and 36 inches in length (one meter), weigh 14 to 39 pounds (6 to 18 kilograms). They consist of two main sections, a surface unit that contains a seawater battery and a metal subsurface unit. The seawater battery becomes energized following contact with the water. The subsurface assembly descends to a selected depth, the metal case falls away, and sea anchors deploy to stabilize the hydrophone (underwater microphone). At this point, an active sonobuoy emits a sound pulse to generate an echo from a potential threat or target, and a passive sonobuoy listens for sound from a potential threat or target. Other sonobuoys (e.g., SSQ-36 BT) gather information about conditions in the water, such as temperature and ambient noise, that improve accuracy of detection or that may assist in avoiding detection. In addition to the sonobuoy's power source, expendable materials include a parachute assembly (12- to 18-inch diameter nylon chute), nylon cord, plastic casing, antenna float, metal clips, and electrical wires).

Under the No Action Alternative, a total of 9,132 sonobuoys would be expended in the PACNW OPAREA (Table 3.3-14). With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to 0.07 sonobuoys per nm^2 (0.02 per km^2). In terms of the inert components of sonobuoys, this level of deposition would have a negligible impact on ocean water resources. Sonobuoy components of potential concern for hazardous materials are the seawater batteries, lithium batteries, battery electrodes, metal housing, lead solder, copper wire, and lead used for ballast (NFEC 1993).

Table 3.3-14: Types and Number of Sonobuoys – No Action Alternative

Type of Sonobuoy	Number	Percent of Total
SSQ-53 DIFAR (passive)	7,283	80
SSQ-62 DICASS (active)	844	9
SSQ-77 VLAD (passive)	593	7
SSQ-36 BT (passive)	288	3
SSQ-110A (explosive)	124	1
Total	**9,132**	

Sonobuoy Batteries – Potential Impacts

Regardless of type, each sonobuoy contains a seawater battery housed in the upper, floating portion and 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 (Green et al. 1996). In cases where the upper portion of the sonobuoy is lost to the seabed, the lead batteries are also lost (CFMETR 2005). Silver chloride, lithium, or lithium iron disulfide thermal batteries are used to power subsurface units. The lithium-sulphur batteries used typically contain lithium sulphur dioxide and lithium bromide, but may also contain lithium carbon monofluoroxide, lithium manganese dioxide, sulphur 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 DICASS sonobuoys. An important component of the thermal battery is a hermetically-sealed casing of welded stainless steel 0.03 to 0.1-inches thick that is resistant to the battery electrolytes.

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 that have been established for the protection of aquatic life (USEPA 2006) or the best available literature values that

established conservative toxicity thresholds. USEPA recommends application of a one-hour acute limit and four-day chronic limit (Table 3.3-15). Either limit cannot be exceeded more than once every three years on the average.

Table 3.3-15: Threshold Values for Safe Exposure to Selected Metals

Metal	Acute Criteria (µg/L, 24-hr exposure)	Chronic Criteria (µg/L, 4-hr mean exposure)
Lead	210	8.1
Silver	1.9	n/a
Copper	4.8	3.1
Lithium	6,000	n/a

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

Chemical reactions with 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 characteristics for the most soluble battery constituent, lead chloride, there is low potential for substantial accumulation of such material in sediments. In addition, the outside metal case can become encrusted from seawater processes and marine organisms, thus slowing the rate of further corrosion. Also, 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 and Roberge 2005).

Lithium always occurs as a stable mineral or salt, such as lithium chloride or lithium bromide (Kszos et al. 2003). Lithium is naturally present in freshwater, soil, and sediment, and has an average concentration of 150 parts per million (ppm) in the water column, 35 ppm in sediments at Dabob Bay (Crecelius 2001), and 57 ppm in marine pelagic sediments in the Strait of Georgia (CFMETR 2005). A study conducted by Kszos et al. (2003) demonstrated that sodium ions in saltwater mitigate the toxicity of lithium to sensitive aquatic species. Fathead minnows (*Pimephales promelas*) and the water flea (*Ceriodaphnia dubia*) were unaffected by lithium concentrations as high as 6 mg/L in the presence of tolerated concentrations of sodium. Therefore, it is expected that, in the marine environment where sodium concentrations are at least an order of magnitude higher than tolerance limits for the tested freshwater species, lithium would be essentially nontoxic. One estimate concluded that 99 percent of the lithium in a battery would be released to the environment over 55 years (Klassen and Roberge 2005). The release will result in a dissolved lithium concentration of 83 mg/L in the immediate area of the breech in the sonobuoy housing. At a distance of 5.5 mm from the breech, 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 discern the additional concentration due to the lithium leakage from the background concentration (Klassen and Roberge 2005). Because of these factors, lithium batteries would not adversely affect marine water quality.

Several studies have evaluated the potential impacts of batteries expended in seawater (NFEC 1993, USCG 1994, Borener and Maugham 1998, and CFMETR 2005). Sediment samples were taken adjacent to and near the navigation sites and analyzed for all metal constituents in the batteries. Results indicated that metals were either below or consistent with background levels or they compared favorably with National Oceanic and Atmospheric Administration (NOAA) sediment screening levels (NOAA 2008), reportable quantities under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §103(a), or USEPA toxicity procedures (USEPA 2008).

A study by the Department of the Navy examined the impact of materials from activated seawater batteries in sonobuoys that dissolve in the water column (e.g., lead, silver, and copper), as well as nickel-plated steel housing, lead solder, copper wire, and lead shot used for sonobuoy ballast (NFEC 1993). The study concluded that constituents released from saltwater batteries as well as the decomposition of other sonobuoy components did not exceed state and federal standards and that the reaction products are short-lived in seawater.

The sonobuoy battery experiment employed lead chloride batteries in a 17-gallon seawater bath for eight hours (NFEC 1993). Under these conditions, the dilution assumptions are conservative relative to normal ocean bottom conditions. The concentration released from the battery was diluted to 0.2 mg/L or 200 micrograms per liter (µg/L) in two seconds, which is less than the acute criteria of 210 µg/L, a criteria applied as a 24-hour mean. Further, since lead chloride tends to dissolve more readily ($K_{sp} = 1.0 \times 10^{-4}$) than either silver chloride ($K_{sp} = 1.56 \times 10^{-10}$) and copper thiocyanate ($K_{sp} = 1.64 \times 10^{-11}$) (IUPAC/NIST 2008), this assures that the potential effects from batteries employing silver chloride or copper thiocyanate are substantially lower than those for the lead chloride battery. While the copper thiocyanate battery also has the potential to release cyanide, a material often toxic to the marine environment, thiocyanate is tightly bound and can form a salt or bind to bottom sediments. Therefore, the risk associated with thiocyanate is very low.

A study of the impacts of lead and lithium (among other materials) was conducted at the Canadian Forces Maritime Experimental and Test Ranges near Nanoose Bay, British Columbia, Canada (CFMETR 2005). These materials are common to EMATTs, acoustic device countermeasures (ADCs), sonobuoys, and torpedoes. The study noted that lead is a naturally-occurring heavy metal in the environment. Typical concentrations of lead in seawater in the test range are between 0.01 and 0.06 ppm, and from 4 to 16 ppm in sediments (Crecelius 2001). Factors that are generally understood to reduce risks associated with contaminated sediments include acid-volatile sulfide concentrations and organic carbon. Both act to reduce the bioavailability of metals (EPA 2001). 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 inches (20 cm). This depth corresponds to the late 1970s and early 1980s and was attributed to atmospheric deposition from lead as a gasoline additive. The sediment cores showed a general reduction in concentration to the present time, coincident with the phasing out of lead 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 taken of marine sediments in the test range showed fairly consistent lithium concentrations with depth, indicating little change in lithium deposition with time. Given ambient lithium concentrations taken outside the range, the report concluded that "it is difficult to demonstrate an environmental impact of lithium caused by CFMETR."

Explosive Sonobuoys – Potential Impacts of Detonation Byproducts

Only one type of explosive sonobuoy is proposed for use in the PACNW OPAREA, the SSQ-110A. This sonobuoy is composed of two sections, an active – explosive – section and a passive section. The upper section is similar to the upper electronics package of the SSQ-62 DICASS sonobuoy, while the lower section consists of two explosive payloads of Class A explosive weighing 4.2 pounds each (1.9 kg). This explosive is composed of cyclo-1,3,5-tetramethylene-2,4,6-tetranitramine (HLX), which is 90 percent RDX, plus small amounts (less than 0.3 grams) of plastic-bonded explosive (PBXN) and hexanitrostilbene, a detonator component. Once in the water, the charges explode, creating a loud acoustic signal.

The explosion creates an air bubble of gaseous byproducts that travels to the surface and escapes into the atmosphere. A small amount of the gas, however, dissolves into the water column. Explosive byproducts using the Cheetah 4 computational program are summarized on Table 3.3-16. The byproducts with the greatest toxicity are hydrogen fluoride compounds (H_xF_x), a reaction byproduct associated with the binding agent used to stabilize the HLX (DoN 2008b).

Table 3.3-16: Detonation Byproducts from Explosive Sonobuoys

Detonation Byproducts	Initial Detonation State		Ambient	
	Grams per charge	Percent of total	Grams per charge	Percent of total
Hydrogen fluoride compounds (H_xF_x)	24.6	1.23%	12.5	0.63%
Nitrogen (N_2)	634		675	
Carbon dioxide (CO_2)	669		565	
Water (H_2O)	211		332	
Ammonia (NH_3)	61		13.4	
Formic acid (CH_2O_2)	156		1.7	
Ethylene (C_2H_6)	84.6		2.1	

Laboratory studies with freshwater species indicate a probable no effect concentration of 0.9 and 0.4 mg/L for hard and soft water, respectively. These values are apparently close to background levels measured in many natural water bodies. Characterization of natural exposure levels and effects in saltwater are needed to provide further basis for the assessment of risks in marine systems. However, only a small percentage (0.63 percent) of the available hydrogen fluoride explosion byproduct is expected to dissolve in the water prior to reaching the surface, and the dilution that would occur upon mixture with ambient water would be rapid (DoN 2008b). Given this dilution, the size of the PACNW OPAREA across which the sonobuoys will be deployed, and the relatively few explosive sonobuoys used under the No Action Alternative, adverse impacts from detonation byproducts would be negligible.

Underwater Detonations

Mine countermeasure training (MCT) involves underwater explosive ordnance disposal (EOD) at three locations – Crescent Harbor, Floral Point in Hood Canal at NBK-Bangor, and west of Indian Island in Port Townsend Bay. These are the Navy's designated locations for MCT and have been used consistently for this purpose for several years. The sites at EOD Crescent Harbor and EOD Indian Island are between 1,000 to 7,200 feet (330 to 2200 m) from the nearest shoreline and the detonations typically occur in 50 to 60 feet (15 to 20 m) of water over sandy or muddy bottoms. EOD Floral Point is about 600 feet (183 m) offshore and charges are placed on a training structure that is 3 to 8 feet (1 to 3 m) above the bottom (NMFS 2008).

MCT familiarizes personnel with the destruction of mines, unexploded ordnance, obstacles, and other structures. Table 3.3-17 summarizes the materials and the level of activity at each site. The number of charges proposed for Crescent Harbor represents 88 percent of the total.

The mines involved are inert shapes similar in composition to practice bombs in that they are pieces of concrete or steel cases formed in the shape of a mine. Underwater detonation training involves detonation of charges at or near the surface and the bottom. The explosive charges are typically raised above the seafloor prior to detonation in order to minimize impact to the seafloor. Each exercise entails placement of the dummy mine in the training area, location of the mine by EOD personnel, placement of the charge on or near the mine, attachment of detonating equipment, detonation, debris retrieval, and in-water

inspection of the detonation site. In some of the exercises, a disabled mine is raised and moved ashore for dismantling and inspection. However, the disabled mines are eventually recovered. Typically two blocks of C-4 are used per activity, with each activity consisting of one surface and one subsurface detonation. The total duration of the exercise is five hours (NMFS 2008).

Table 3.3-17: Mine Countermeasure Training – No Action Alternative

Location	Charge Size	Number
EOD Crescent Harbor	< 2.5 lbs	3
	2.5 lbs	45
	5.0 lbs	1
	20.0 lbs	4
EOD Floral Point	2.5 lb	3
EOD Indian Island	2.5 lbs	3
	20.0 lbs	1
	Total	**60**

After the detonation, both boats return to the detonation site. All surface debris, consisting mainly of floats and attached equipment, is retrieved. The divers retrieve debris from the seafloor, which consists mainly of pieces of the mine and the explosive housing (i.e., pieces of aluminum, plastic, or copper). The majority of the explosive itself is consumed. In cases where the mine is only disabled, not destroyed, the mine is either loaded into the primary boat, if the mine is small enough, or suspended below the boat. The mine is then taken to a remote beach for dismantling and inspection. Again, this is a dummy mine (lacking explosive), so an explosion is not possible at this point (NMFS 2008).

Two issues are of potential concern for hazardous materials – solid debris and the byproducts of the underwater detonations.

Adverse impacts from solid debris resulting from mine countermeasure training at each site under the No Action Alternative would be negligible because of standard site investigation, and clean up procedures.

The explosive used is C-4, composed of RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine) (approximately 95 percent), plus a plastic binder (polyisobutylene). Most of the charges are linear "shaped" charges contained in copper, aluminum, or plastic housing. Some of these charges are intended to disable "limpet" mines on the hulls of ships, while others are designed to disable moored or bottom mines (NMFS 2008).Table 3.3-18 details the byproducts of underwater detonation of C-4.

High-order detonations result in almost complete conversion of explosives (99.997 percent; USACE 2007). The majority of these byproducts are commonly found in seawater, that is, water, carbon dioxide (CO_2), hydrogen (H_2), carbon monoxide (CO), nitrogen (N_2), and ammonia (NH_3) (Renner and Short 1980, DoN 2000). These byproducts represent 98 percent of all byproducts produced. The remaining byproducts are either gases or liquids that will dissipate, evaporate, or dilute to undetectable or insignificant levels, or they react with constituents of salt water in the existing currents to form harmless substances. During mine countermeasure training under the No Action Alternative, the prospects of adverse impacts from low-order or no detonation are minimal because procedures require EOD personnel to return to and inspect the detonation site, to clean up debris, and to retrieve unexploded materials for further examination. Therefore, the overall impact of these constituents would be negligible.

Table 3.3-18: Byproducts of Underwater Detonation of RDX

Byproducts	Percent of Total, by Weight
Nitrogen	37.0
Carbon dioxide	24.9
Water	16.4
Carbon monoxide	18.4
Ethane	1.6
Hydrogen	0.3
Propane	0.2
Ammonia	0.9
Methane	0.2
Hydrogen cyanide	< 0.01
Methyl alcohol	< 0.01
Formaldehyde	< 0.01
Other compounds	< 0.01

Land Detonations

Land detonations occur at demolition training ranges (DTRs) at Seaplane Base and at Naval Base Kitsap-Bangor. Each DTR is a designated area and structure in which EOD training is conducted. EOD personnel must re-qualify on a monthly basis to use explosives. Per Navy requirements, the overall DTR area is relatively flat and 1,000 feet in diameter (152 m) within which a 100-foot-diameter area is cleared of all vegetation and combustible materials. A detonation enclosure is constructed at the center. The enclosure is roughly 20 feet square with walls that are 8 feet (2.4 m) high, 8 inches (20 cm) thick, and composed of wood or plastic lumber, concrete, and sandbags. The interior of the enclosure is lined with an impermeable material to prevent infiltration of constituents through the soil to water pathways. A 12-inch (30 cm) layer of sand is placed over this layer. DTRs are also covered when not in use to prevent water intrusion [OPNAVINST 8027.6B]. These actions prevent the movement of ordnance constituent contamination to soils beyond the impact area. Site access is usually controlled by a perimeter fence, with additional security patrols operating during training activities. DTRs are subject to routine testing and clearing actions. Because of the long-term use of the DTRs and repeated disturbances in these areas, little vegetation is present and the areas are considered disturbed.

Table 3.3-19 summarizes the amount and size of the ordnance used at DTR Seaplane and DTR Bangor under the No Action Alternative. Based on 102 training sessions per year, there would be about 29 detonations per session, over half of which are 1.25-pound charges. In addition to C-4, other explosives and explosive components include detonating cord, fuses, igniters, blasting caps, hand grenades, and smoke grenades.

The byproducts of C-4 detonation are the following substances in gaseous or liquid form: nitrogen, carbon dioxide, water, carbon monoxide, hydrogen, ethane, ammonia, propane, and methane (Renner and Short 1980). Table 3.3-20 details the amount of each of these byproducts by weight based on a 1.25-lb charge. By weight, 78 percent of these materials are not harmful (i.e., nitrogen, carbon dioxide, and water). In total, there would be 4.0 pounds (1.8 kg) released per activity at DTR Seaplane Base and 0.25 pound (0.1 kg) per activity at DTR Bangor. These materials could potentially contaminate the soils contained in the detonation enclosure. However, all of these byproducts will dissipate or evaporate in the open air and would not be considered hazardous under those circumstances.

Table 3.3-19: Size and Number of DTR Detonations – No Action Alternative

Training Location	Detonation Type	Number	Percent of Total*
DTR Seaplane Base	Detasheet C-2	800	27.3
	Detasheet 2.0 lbs	240	8.2
	C-4 – 1.25 lb block	1,476	50.4
	C-4 – 2.0 lbs block	240	8.2
	Subtotal	**2,756**	
DTR Bangor	Detasheet C-2	50	1.7
	Detasheet 2.0 lbs	15	0.5
	C-4 – 1.25 lb block	94	3.2
	C-4 – 2.0 lb block	15	0.5
	Subtotal	**174**	
	Total	**2,930**	

* Numbers may not sum due to rounding

Table 3.3-20: Byproducts of C-4 Detonation – 1.25-Pound Charge

Byproduct of C-4 Detonation	Pounds Released	Percent
Nitrogen	0.463	37.0
Carbon dioxide	0.313	25.0
Carbon monoxide	0.230	18.4
Water	0.205	16.4
Ethane	0.020	1.6
Ammonia	0.011	0.9
Hydrogen	0.004	0.3
Propane	0.003	0.2
Methane	0.003	0.2

Aviation Fuel and Other Propellants

Under the No Action Alternative, a total of 7,586 sorties would be flown by fixed-wing aircraft, helicopters, and unmanned aerial vehicles (Table 3.3-21).

Table 3.3-21: Aircraft Sorties per Year – No Action Alternative

Type of Aircraft	Number of Sorties	Percent of Total
Fixed-wing aircraft	7,478	98.5
Helicopter	96	1.3
Unmanned aerial vehicles	12	0.2
Total	**7,586**	

Issues associated with aviation fuel arise with the need to jettison fuel from a manned aircraft or with the loss of an unmanned aircraft. Both situations are infrequent and occur only in emergency situations. Aircraft with offshore in-flight emergencies that require the craft to weigh less will jettison stores, not

fuel. Aircraft operating from an aircraft carrier prefer to divert to a land-based airfield rather than a carrier landing. Fuel that is jettisoned is discarded above 8,000 feet (2,500 m) over water west of Naval Air Station Whidbey Island just prior to landing. At that elevation, the fuel dissipates in the air before any liquid reaches the ground. Given the small number of such incidents and the wide area across which they might occur, neither increase would have a measurable impact on the environment.

Other Expended Training Materials

Under the No Action Alternative, a total of 539 smoke canisters would be used during DTR exercises. These canisters are sheet metal cylinders that contain an oxidizer, a fuel, a dye, and a substance to keep the subsequent chemical reaction from getting too hot. Burning of this mixture evaporates the dye and forces it out of the device, where it condenses in the atmosphere to form a smoke of finely dispersed particles. Smoke canisters are not recovered. The primary pollutants from smoke canisters are carbon dioxide and particulates (smoke). Other pollutants are emitted at low levels. These materials were dismissed from further analysis because the majority of the constituents are consumed by heat and smoke, both of which dissipate in the air.

3.3.2.3 Alternative 1

Table 3.3-1 summarizes the types and amounts of training items under each alternative that may present issues related to hazardous materials. The text below compares the amounts and types of training materials under the No Action Alternative with Alternative 1.

Bombs

Under Alternative 1, a total of 144 bombs would be expended in the PACNW OPAREA, a 33 percent increase over the No Action Alternative (Table 3.3-22). Over 75 percent of the bombs would be inert. With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to 0.001 items per nm^2 (0.0003 per km^2). Given the potential impacts of bombs as described for the No Action Alternative, this increase under Alternative 1will not have a measurable impact on the PACNW OPAREA environment.

Table 3.3-22: Types and Number of Bombs – No Action and Alternative 1

Type of Bomb	No Action	Alternative 1		
	Number	Number	Numerical Increase	Percent Increase
MK-82 – Live	12	18	6	50
BDU-45 – Inert	88	110	22	25
MK-83 – Live	4	8	4	100
MK-84 – Live	4	8	4	100
Total	**108**	**144**	**36**	**33**

Missiles

Under Alternative 1, an additional 25 missiles would be used over the No Action Alternative (Table 3.3-23). Of these additional missiles, 15 (43 percent) would be new models – Sparrow, Sidewinder, and AMRAAM – that would support target training with new equipment. No new types of exercises would be planned. Given the number of missiles and the wide area across which they would be used, there would be no measurable impact on the PACNW OPAREA environment.

Table 3.3-23: Types and Number of Missiles – No Action and Alternative 1

Type of Missile	No Action	Alternative 1	
	Number	Number	Numerical Increase
AIM-7 Sparrow	0	6	6
AIM-9 Sidewinder	0	5	5
AIM-120 AMRAAM	0	4	4
NATO Sea Sparrow	0	0	0
AGM-88 HARM*	2	4	2
AGM-114 Hellfire	1	2	1
AGM-65 Maverick	3	6	3
AGM-84 Harpoon	3	6	3
SLAM ER	1	2	1
Total	**10**	**35**	**25**

* Not fired

Naval Gunfire

Under Alternative 1, 14 percent more shells (3,495) would be used compared to the No Action Alternative (Table 3.3-24). With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to less than 0.2 gunshells per nm^2 (0.07 per km^2). Almost 60 percent of the shells are 25mm. Given the inert nature of these materials and the wide dispersion across the PACNW OPAREA, Alternative 1 would not have a measurable impact on the environment.

Table 3.3-24: Types and Number of Naval Gunshells – No Action and Alternative 1

Type of Gunshell	No Action	Alternative 1	
	Number	Number	Percent Increase
20mm – live (CIWS)	7,200	8,000	11
25mm – live	15,750	17,500	11
57mm – live	630	700	11
76mm – live	560	800	43
5 inch – live	1,716	2,351	37
Total	**25,856**	**29,351**	**14**

The 20-mm cannon shells used in close-in weapons systems (CIWS) are composed of tungsten or depleted uranium, although the latter is being phased out. Please see Section 3.3.1.1 above for a more detailed discussion of depleted uranium.

Targets and Countermeasures

Under Alternative 1, there would be a 17 percent increase in the number of targets and countermeasures over the No Action Alternative (Table 3.3-25).

Table 3.3-25: Summary of Targets and Countermeasures – No Action and Alternative 1

Type of Target or Countermeasure		No Action	Alternative 1		
				Change from No Action	
		Number	Number	Numerical Increase	Percent Increase
Aerial	LUU-2B/B*	0	6	6	–
	TALD*	0	11	11	–
	BQM-74E	0	0	0	–
	TDU-34	72	80	8	11
Surface	HSMST	0	5	5	–
	Trimaran	0	11	11	–
	SPAR	0	17	17	–
	Killer Tomato	60	67	7	12
	MK-58 Marine Marker*	208	215	7	3
Subsurface	EMATT*	121	126	5	4
Sinking Exercise	Decommissioned vessel*	1	2	1	100
	Total	**462**	**540**	**78**	**17**

* Not recovered

Almost half of the targets and countermeasures under Alternatives 1 would be marine markers that are consumed by chemical reactions that produce smoke. Most of the remaining targets and countermeasures are constructed of inert materials and are recovered after use. Should they be lost at sea, they will become buried in bottom sediments or wash up onshore. Under Alternative 1, no measurable impact on the PACNW OPAREA environment would occur.

Torpedoes

Under Alternative 1, two torpedoes would be used, an increase of one over the No Action Alternative. This increase in ordnance will not have a measurable impact on the PACNW OPAREA environment.

Small Caliber Rounds

Under Alternative 1, 11 percent more small caliber rounds would be used compared to the No Action Alternative (from 59,724 to 66,360), of which 98 percent would be .50 caliber rounds (Table 3.3-26). With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to about one-half round per nm^2 (0.2 per km^2). Given the inert nature of these materials, their small size, and the wide dispersion across the PACNW OPAREA, this increase would not have a measurable impact on the environment.

Table 3.3-26: Types and Number of Small Caliber Rounds – No Action and Alternative 1

Type of Ordnance	No Action	Alternative 1		
	Number	Number	Numerical Increase	Percent Increase
7.62 mm projectiles	1,224	1,360	136	11.1
.50 cal munitions	58,500	65,000	6,500	11.1
Total	**59,724**	**66,360**	**6,636**	**11.1**

Sonobuoys

Under Alternative 1, there would be a three percent increase in the number of sonobuoys compared to the No Action Alternative (Table 3.3-27). With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to less than 0.08 items per nm^2 (0.02 per km^2).

Table 3.3-27: Types and Number of Sonobuoys – No Action and Alternative 1

Type of Sonobuoy	No Action	Alternative 1		
	Number	Number	Numerical Increase	Percent Increase
SSQ-36 BT (passive)	288	295	7	2.4
SSQ-53 DIFAR (passive)	7,283	7,503	220	3.0
SSQ-62 DICASS (active)	844	865	21	2.5
SSQ-77 VLAD (passive)	593	623	30	5.1
SSQ-110A (explosive)	124	136	12	9.7
Total	**9,132**	**9,422**	**290**	**3.2**

In terms of the inert components of sonobuoys, this level of deposition would not have a measurable impact on the PACNW OPAREA environment. As previously discussed for the No Action Alternative, sonobuoy batteries and explosive components would not result in adverse hazardous material impacts. This remains true for the three percent increase in sonobuoys proposed under Alternative 1.

Underwater Detonations

In April 2008, the Navy decided to relocate Explosive Ordnance Disposal Mobile Unit Eleven (EODMU Eleven) forces out of the NWTRC Study Area to Imperial Beach, CA. This move is planned to be completed in the fall of 2009. Two EOD Shore Detachments (Bangor and Northwest) will remain in the NWTRC. These Shore Detachments report to Commander, Navy Region Northwest and respond to regional Navy taskings and incidents. As a result of the EODMU Eleven relocation, mine warfare underwater detonation training will significantly decrease from a yearly maximum of 60 underwater detonation as analyzed in the No Action Alternative (the baseline) to no more than four annual underwater detonation as analyzed in Alternatives 1 and 2. The maximum charge size for these four explosions will be 2.5 pounds. Adverse impacts would not be measurable because of low level of activity, the benign nature of the majority of explosion byproducts, and standard site investigation and clean up procedures.

Land Detonations

Under Alternative 1, there would be an eight percent increase in the number of DTR explosions compared to the No Action Alternative (Table 3.3-28). Training sessions would increase from 102 to 110, resulting in about 29 detonations per session, over half of which would be 1.25-pound charges. In addition to C-4, other explosives and explosive components include detonating cord, fuses, igniters, blasting caps, hand grenades, and smoke grenades.

The majority of the detonation byproducts (78 percent) are not hazardous. Of the potentially hazardous byproducts, there would be 4.0 pounds (1.8 kg) released per exercise at DTR Seaplane Base and 0.25 pound (0.1 kg) per exercise at DTR Bangor. However, because those by-products would evaporate or dissipate, potential impacts are considered negligible.

Table 3.3-28: Size and Number of DTR Detonations – All Alternatives

Training Location	Detonation Type	No Action	Alternatives 1 and 2	Percent Increase
DTR Seaplane Base	Detasheet C-2	800	862	8
	Detasheet 2.0 lbs	240	259	8
	C-4 – 1.25 lb block	1,476	1,591	8
	C-4 – 2.0 lb block	240	259	8
	Subtotal	**2,756**	**2,971**	8
DTR Bangor	Detasheet C-2	50	55	10
	Detasheet 2.0 lbs	15	17	13
	C-4 – 1.25 lb block	94	102	9
	C-4 – 2.0 lb block	15	16	7
	Subtotal	**174**	**190**	9
	Total	**2,930**	**3,161**	8

Aviation Fuel

Under Alternative 1, sorties would increase 21 percent compared to the No Action Alternative (Table 3.3-29). The relative proportion among the aircraft types would remain unchanged. Issues associated with aviation fuel arise with the need to jettison fuel from a manned aircraft or with the loss of an unmanned aircraft. Both situations are infrequent. Given the small number of such incidents and the wide area across which they might occur, the 8 percent increase would not have a measurable impact on the environment.

Table 3.3-29: Aircraft Sorties – No Action and Alternative 1

Type of Aircraft	No Action	Alternative 1		
	Number of Sorties	Number of Sorties	Numerical Increase	Percent Increase
Fixed-wing aircraft	7,478	8,983	1,505	20
Helicopter	96	109	13	14
Unmanned aerial vehicles	12	112	100	833
Total	**7,586**	**9,204**		**21**

Other Expended Training Materials

Under Alternative 1, an additional 42 smoke canisters would be used, an eight percent increase over the No Action Alternative. Given the relatively small increase in canisters used and the speed with which the majority of pollutants would dissipate, there will be no measurable impact on the environment.

3.3.2.4 Alternative 2, The Preferred Alternative

Table 3.3-1 summarizes the types and amounts of training items under each alternative that may present issues related to hazardous materials. The text below compares the amounts and types of training materials under the No Action Alternative with Alternative 2, the Preferred Alternative.

Bombs

Under Alternative 2, an additional 36 bombs would be used, a 33 percent increase over the No Action Alternative (Table 3.3-30), the same as Alternative 1. Over 75 percent of the bombs would be inert. With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to 0.001 items per nm^2 (0.0003 per km^2). Given the negligible impacts of bombs as

described for the No Action Alternative, this increase under Alternative 2 will not have a measurable impact on the PACNW OPAREA environment.

Table 3.3-30: Types and Number of Bombs – No Action and Alternative 2

Type of Bomb	No Action	Alternative 2	
	Number	Number	Percent Increase
MK-82 – Live	12	18	50
BDU-45 – Inert	88	110	25
MK-83 – Live	4	8	100
MK-84 – Live	4	8	100
Total	**108**	**144**	**33**

Missiles

Under Alternative 2, an additional 47 missiles would be used compared to the No Action Alternative (Table 3.3-31). Of these additional missiles, 37 (65 percent) would be new models – Sparrow, Sidewinder, AMRAAM, and Sea Sparrow – to support target training with new equipment. No new types of exercises would be planned. Given the number of missiles and the wide area across which they would be used, there would be no measurable impact on the PACNW OPAREA environment.

Table 3.3-31: Types and Number of Missiles – No Action and Alternative 2

Type of Missile	No Action	Alternative 2	
	Number	Number	Numerical Increase
AIM-7 Sparrow	0	13	13
AIM-9 Sidewinder	0	9	9
AIM-120 AMRAAM	0	7	7
NATO Sea Sparrow	0	8	8
AGM-88 HARM	2	4	2
AGM-114 Hellfire	1	2	1
AGM-65 Maverick	3	6	3
AGM-84 Harpoon	3	6	3
SLAM ER	1	2	1
Total	**10**	**57**	**47**

Naval Gunfire

Under Alternative 2, a doubling of the gun shells used would occur (from 25,856 to 53,343; Table 3.3-32). With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to about 0.4 shells per nm^2 (0.1 per km^2). Given the largely inert nature of these materials and the wide dispersion across the PACNW OPAREA, this increase would not have a measurable impact on the environment.

Table 3.3-32: Types and Number of Naval Gunshells – No Action and Alternative 2

Type of Gunshell	No Action	Alternative 2	
	Number	Number	Percent Increase
20mm – live (CIWS)	7,200	16,000	122
25mm – live	15,750	31,500	100
57mm – live	630	1,260	100
76mm – live	560	1,120	100
5 inch – live	1,716	3,463	102
Total	**25,856**	**53,343**	**106**

The 20-mm cannon shells used in close-in weapons systems (CIWS) are composed of tungsten or depleted uranium, although the latter is being phased out. Please see Section 3.3.1.1 above for a more detailed discussion of depleted uranium.

Targets and Countermeasures

Table 3.3-33 compares proposed changes in the numbers and types of targets and countermeasures under Alternative 2 with the No Action Alternative.

Table 3.3-33: Summary of Targets and Countermeasures – No Action and Alternative 2

Type of Target or Countermeasure		No Action	Alternative 2		
				Change from No Action	
		Number	Number	Numerical Increase	Percent Increase
Aerial	LUU-2B/B*	0	11	11	—
	TALD*	0	22	22	—
	BQM-74E	0	16	16	—
	TDU-34	72	160	88	122
Surface	HSMST	0	9	9	—
	Trimaran	0	20	20	—
	SPAR	0	31	31	—
	Killer Tomato	60	120	60	100
	MK-58 Marine Marker*	208	220	12	6
Subsurface	EMATT*	121	126	5	4
Sinking Exercise	Decommissioned vessel*	1	2	1	100

* Not recovered

The largest increase is in towed drone units (TDU-34) which are recovered after use, and more than one-third of the total increase is marine markers that would be consumed by chemical reactions that produce smoke. Most of the remaining targets and countermeasures are recovered after use. Those that are not are constructed mostly of inert materials. This increase of targets and countermeasures proposed under Alternative 2 would not have a measurable impact on the environment.

Torpedoes

Under Alternative 2, two torpedoes would be used, an increase of one over the No Action Alternative, and the same as Alternative 1. This increase would have no measurable impact on the PACNW OPAREA environment.

Small Caliber Rounds

Under Alternative 2, a doubling of the small caliber rounds would occur (from 59,724 to 119,720; Table 3.3-34). With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to one round per nm^2 (0.3 per km^2). Given the inert nature of these materials, their small size, and the wide dispersion across the PACNW OPAREA, this increase would have no measurable impact on the environment.

Table 3.3-34: Types and Number of Small Caliber Rounds – No Action and Alternative 2

Type of Ordnance	No Action	Alternative 2	
	Number	Number	Percent Increase
7.62 mm projectiles	1,224	2,720	122
.50 cal munitions	58,500	117,000	100
Subtotal	**59,724**	**119,720**	**101**

Other Expended Training Materials

Under Alternative 2, an additional 41 smoke canisters would be used compared to the No Action Alternative (8 percent increase; same as Alternative 1). Given the relatively small increase in canisters used and the speed with which the majority of pollutants would dissipate, there will be no measurable impact on the environment.

Sonobuoys

Under Alternative 2, a total of 9,651 sonobuoys would be used, an increase of six percent (519) over the No Action Alternative (Table 3.3-35). With an ocean area of approximately 122,400 nm^2 (420,163 km^2) and assuming even distribution of activities, this amounts to less than 0.08 items per nm^2 (0.2 per km^2).

Table 3.3-35: Types and Number of Sonobuoys – No Action and Alternative 2

Type of Sonobuoy	No Action Alternative	Alternative 2	
	Number	Number	Percent Increase
SSQ-36 BT (passive)	288	302	4.9
SSQ-53 DIFAR (passive)	7,283	7,661	5.2
SSQ-62 DICASS (active)	844	886	5.0
SSQ-77 VLAD (passive)	593	653	10.1
SSQ-110A (explosive)	124	149	20.2
Total	**9,132**	**9,651**	**5.7**

In terms of the inert components of sonobuoys, this level of deposition would have a negligible impact on ocean water resources. As previously discussed for the No Action Alternative and Alternative 1, sonobuoy batteries and explosive components would not result in adverse hazardous material impacts, therefore, the proposed increase in sonobuoy use under Alternative 2 would not have a measurable impact on the PACNW OPAREA environment.

Underwater Detonations

Like Alternative 1, the Navy has decided to relocate Explosive Ordnance Disposal Mobile Unit Eleven (EODMU Eleven) forces out of the NWTRC Study Area to Imperial Beach, CA. This move is planned to

be completed in the fall of 2009. Two EOD Shore Detachments (Bangor and Northwest) will remain in the NWTRC. These Shore Detachments report to Commander, Navy Region Northwest and respond to regional Navy taskings and incidents. As a result of the EODMU Eleven relocation, mine warfare underwater detonation training will decrease from a yearly maximum of 60 underwater detonation as analyzed in the No Action Alternative (the baseline) to no more than four annual underwater detonation as analyzed in Alternatives 1 and 2, a decline of over 90 percent. The maximum charge size of would be 2.5 pounds. Adverse impacts would not be measurable because of low level of activity, the benign nature of the majority of explosion byproducts, and standard site investigation and clean up procedures.

Land Detonations

Under Alternative 2, there would be an eight percent increase in the number of DTR explosions compared to the No Action Alternative (Table 3.3-28). This is the same as Alternative 1. Therefore, hazardous material impacts would be negligible.

Aviation Fuel and Other Propellants

Under Alternative 2, overflights would increase 55 percent (4,200) over the No Action Alternative (Table 3.3-36). Hazardous material issues associated with aviation fuel arise with the need to jettison fuel from a manned aircraft or with the loss of an unmanned aircraft. Given how infrequent such events are, that they occur above 8,000 feet (2,500 m), and the wide area across which they might occur, the increase would not have a measurable impact on water resources.

Table 3.3-36: Aircraft Sorties – No Action and Alternative 2

Type of Aircraft	No Action	Alternative 2		
	Number of Sorties	Number of Sorties	Numerical Increase	Percent Increase
Fixed-wing aircraft	7,478	11,565	4,087	55
Helicopter	96	109	13	14
Unmanned aerial vehicles	12	112	100	833
Total	**7,586**	**11,786**	**4,200**	**55**

3.3.3 Mitigation Measures

As summarized in Section 3.3.4, the alternatives would contribute low amounts of hazardous material to the environment of the NWTRC Study Area. Given the large size of the Study Area and the fate and transport of the constituents, it is unlikely that hazardous materials resulting from the proposed actions could be detectable. Standard Navy protective measures would be employed and no additional mitigation measures would be needed. See Chapter 5 for additional discussion of mitigation measures.

3.3.4 Summary of Effects by Alternative

The overall amount of hazardous materials generated during training under Alternatives 1 and 2 would be more than that generated under the No Action Alternative, due primarily to the increased number of training activities.

All hazardous materials would continue to be managed in compliance with applicable federal and state regulations, and Department of Defense guidelines. No substantial changes in hazardous materials management practices are anticipated under any of the alternatives. The anticipated amounts of hazardous materials generated are well within the capacity of the Navy's afloat and ashore hazardous waste management systems.

As summarized in Table 3.3-37, less than significant overall impacts from hazardous materials are anticipated under the No Action Alternative, Alternative 1, or Alternative 2, the Preferred Alternative. Discarded training materials would be deposited in offshore areas or become buried in the sea floor sediments, and would have no substantial environmental effects. The overall volume of expended training items would increase in Alternative 1 and Alternative 2, the Preferred Alternative, in correlation to changes in activities.

Table 3.3-37: Summary of Effects – Hazardous Materials

Alternative and Stressor	Summary of Effects and Impact Conclusion	
	NEPA (Territorial Waters, 0 to 12 nm)	Executive Order 12114 (Non-territorial Waters, >12 nm)
No Action		
Expended Materials	Long-term, minor, and localized accumulation of expended materials on the ocean floor.	Long-term, minor, and localized accumulation of expended materials on the ocean floor.
Hazardous Materials	Negligible effects.	Negligible effects.
Alternative 1		
Expended Materials	Increase in expended materials compared to No Action. Long-term, minor, and localized accumulation of expended materials on the ocean floor. Most materials inert.	Increase in expended materials compared to No Action Alternative. Long-term, minor, and localized accumulation of expended materials on the ocean floor. Most materials inert.
Hazardous Materials	Negligible effects.	Negligible effects.
Alternative 2 (Preferred Alternative)		
Expended Materials	Increase in expended materials compared to No Action. Long-term, minor, and localized accumulation of expended materials on the ocean floor. Most materials inert.	Increase in expended materials compared to No Action. Long-term, minor, and localized accumulation of expended materials on the ocean floor. Most materials inert.
Hazardous Materials	Negligible effects.	Negligible effects.

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