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Final Environmental Impact Statement

Outdoor Research, Development, Test & Evaluation Activities

Naval Surface Warfare Center, Dahlgren Division

Dahlgren, Virginia

NSWCDD-AP-12-00299 Statement A: Approved for Public Release. Distribution is Unlimited.

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Department of the Navy
Naval Surface Warfare Center, Dahlgren Division,
in accordance with Chief of Naval Operations
Instruction 5090.1C CH-1;
pursuant to National Environmental
Policy Act Section 102(2)(C)

Final Environmental Impact Statement
Outdoor Research, Development,
Test & Evaluation Activities
Volume I

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Abstract

This EIS has been prepared by the US Department of the Navy, Naval Surface Warfare Center, Dahlgren Division (NSWCDD) to evaluate the effects of expanding research, development, test and evaluation (RDT&E) activities within the Potomac River Test Range and Explosives Experimental Area complexes, the Mission Area, and special-use airspace at Naval Support Facility (NSF) Dahlgren. These capabilities include outdoor operations that require the use of ordnance (guns and explosives), electromagnetic energy, lasers, and chemical and biological simulants (non-toxic substances used to mimic dangerous agents). The purpose of the Proposed Action is to enable NSWCDD to meet current and future mission-related warfare and force-protection requirements by providing RDT&E of surface ship combat systems, ordnance, lasers and directed energy systems, force-level warfare, and homeland and force protection. The need for the Proposed Action is to enable the Navy and other stakeholders to successfully meet current and future national and global defense challenges by developing a robust capability to carry out assigned RDT&E activities at NSF Dahlgren. Three alternatives are analyzed in this EIS: the No Action Alternative, which addresses historical and current mission activities; Alternative 1 which addresses baseline activity levels plus known future requirements; and Alternative 2, which addresses current baseline requirements, known future requirements, and projected increases in the foreseeable future based on current trends. Potential effects associated with the alternatives have been identified and evaluated. The Navy concludes that for all three alternatives there would be no significant impact to land use and plans, coastal zone resources, socioeconomics, low-income and minority populations, children, utilities, air quality, noise levels, cultural resources, hazardous materials and hazardous waste, health and safety, geology, topography, soils, and sediments, water resources, and biological resources.

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EXECUTIVE SUMMARY

ES.1 Introduction

Naval Surface Warfare Center, Dahlgren Division (NSWCDD), the action proponent, proposes to expand research, development, test, and evaluation (RDT&E) activities within the Potomac River Test Range (PRTR) and Explosives Experimental Area (EEA) Range complexes, the Mission Area, and special-use airspace (SUA) at Naval Support Facility Dahlgren (NSF Dahlgren). NSWCDD is a tenant upon NSF Dahlgren on the western shore of the Potomac River in King George County, Virginia (Figure ES-1, NSF Dahlgren Location). NSF Dahlgren, a United States (US) Department of the Navy (Navy) facility under the supporting command of Naval Support Activity, South Potomac, Naval District Washington, is located 25 miles (mi) east of Fredericksburg, Virginia and 53 mi south of Washington, DC. NSWCDD is one of the Naval Sea Systems Command (NAVSEA) surface warfare centers. NSWCDD has multiple sites, but this environmental impact statement (EIS) concerns NSWCDD's range and mission area operations at Dahlgren, Virginia and hence will be referred to as NSWCDD in this document.

The EIS focuses on RDT&E activities that take place outdoors and have the potential to affect the human environment. Much of NSWCDD's research and development takes place inside laboratories and does not generate environmental impacts on the human environment outdoors. NSWCDD's Safety and Environmental Office ensures that no indoor impacts take place. Many of NSWCDD's outdoor activities, such as tests of passive sensors, also have no environmental impact, as determined by NSWCDD's Safety and Environmental Office, and are not considered in this EIS. The operating ranges, mission area, and SUA at NSF Dahlgren are shown on Figures ES-2 (Potomac River Test Range Complex), ES-3 (Range Complexes and Mission Area), ES-4 (Special-Use Airspace), and ES-5 (Potomac River Test Range Primary Gunnery Target Area).

The environmental impact analysis in this EIS addresses activities that take place outdoors on range complexes and in the Mission Area. The analysis does not encompass all of NSWCDD's work, much of which takes place indoors in laboratories. These indoor activities are addressed in other NEPA documents – environmental assessments or categorical exclusions, as appropriate. However, the cumulative impacts of NSWCDD's indoor activities when combined with outdoor activities taking place on range complexes and the Mission Area are considered in the cumulative impact analysis in this EIS.

ES.2 Purpose and Need

The **purpose** of the Proposed Action is to enable NSWCDD to meet current and future mission-related warfare and force-protection requirements by providing RDT&E of surface ship combat systems, ordnance, lasers and directed energy, force-level warfare, and homeland and force protection.

Under 10 United States Code (U.S.C.) § 5062(d): "The Navy shall develop aircraft, weapons, tactics, technique, organization, and equipment of naval combat and service elements. Matters of joint concern as to these functions shall be coordinated between the Army, the Air Force, and the

Navy." The **need** for the Proposed Action is to enable the Navy and other stakeholders to successfully meet current and future national and global defense challenges required under U.S.C. by developing a robust capability to carry out assigned RDT&E activities on range complexes, in the Mission Area, and in SUA at NSF Dahlgren.

ES.2.1 Proposed Action

The Proposed Action evaluated in this EIS is to expand NSWCDD's RDT&E activities within the PRTR and EEA Range complexes, the adjoining Mission Area, and SUA. These activities include outdoor activities that require the use of:

- **Ordnance** – Since its beginnings in 1918 as the US Naval Proving Ground, NSWCDD has been doing proof testing, lot acceptance[1], safety testing, and RDT&E for small- and large-caliber guns (refer to Table ES-1) , and many other types of military munitions[2], some of which result in detonations. Today it is the Navy's primary center for such work. The Proposed Action would increase small-arms firing and detonations annually. Large-caliber gun firing would remain at current levels. Firing into the PRTR's upper Lower Danger Zone (LDZ) (Figures ES-2 and ES-5) would increase to a maximum of 10 days a year, which represents an increase over recent firing levels in this target area.
- **Electromagnetic (EM) Energy –** EM energy is naturally occurring and man-made energy created by the interaction of fluctuating electrical and magnetic forces that travel through space at the speed of light. The equipment used outdoors at NSWCDD emits EM energy in a frequency range that includes radio waves or radio frequency, microwaves, and infrared, visible, and ultraviolet light. Many types of EM energy emitters are present at NSWCDD, ranging from everyday, low-power radios, cell phones, and car door openers, to higher-power radars and sophisticated, one-of-a-kind test equipment used to test whether electronics and ordnance can withstand pulses of EM energy. Only emitters requiring safety zones when operating because their power, frequency, and exposure levels are above established standards for hazards of EM energy to personnel, ordnance, fuel, and/or EM interference are discussed in this EIS. The 2005 Defense Base Closure and Realignment (BRAC) Commission, which reviewed the work of all Department of Defense installations, identified NSWCDD as a center of excellence for weapon systems integration, which involves RDT&E for communications and sensors that use EM energy. NSWCDD is also the Navy's lead laboratory for the RDT&E of issues surrounding EM environmental effects. The Proposed Action would increase the number of annual activities and the power level of some activities; expand activities on the PRTR; and increase use of platforms such as unmanned systems to transmit, receive, or reflect EM energy.

[1] In order to minimize ordnance malfunctions at sea, the Navy randomly tests one or more pieces of ordnance in a lot provided by a contractor. On the basis of information yielded by the sample, a decision is made by the Navy whether to accept or reject the whole lot.

[2] U.S.C. Title 10, Section 101 defines "military munitions" as all ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the Department of Defense, the Coast Guard, the Department of Energy, and the National Guard.

Location of Naval Support Facility (NSF) Dahlgren

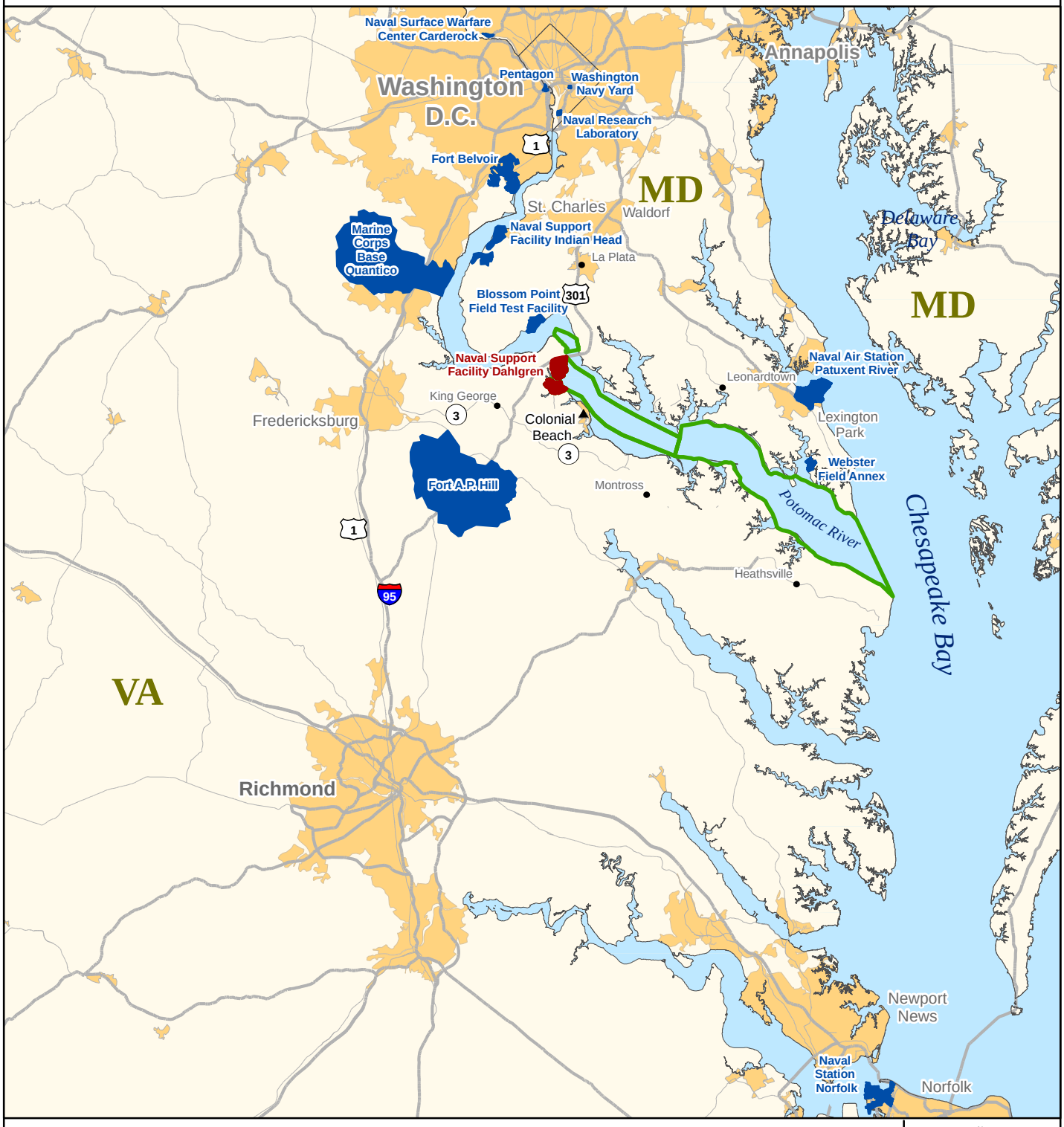

Figure ES-1

Source: NSWCDD GIS (2008 - 2011)

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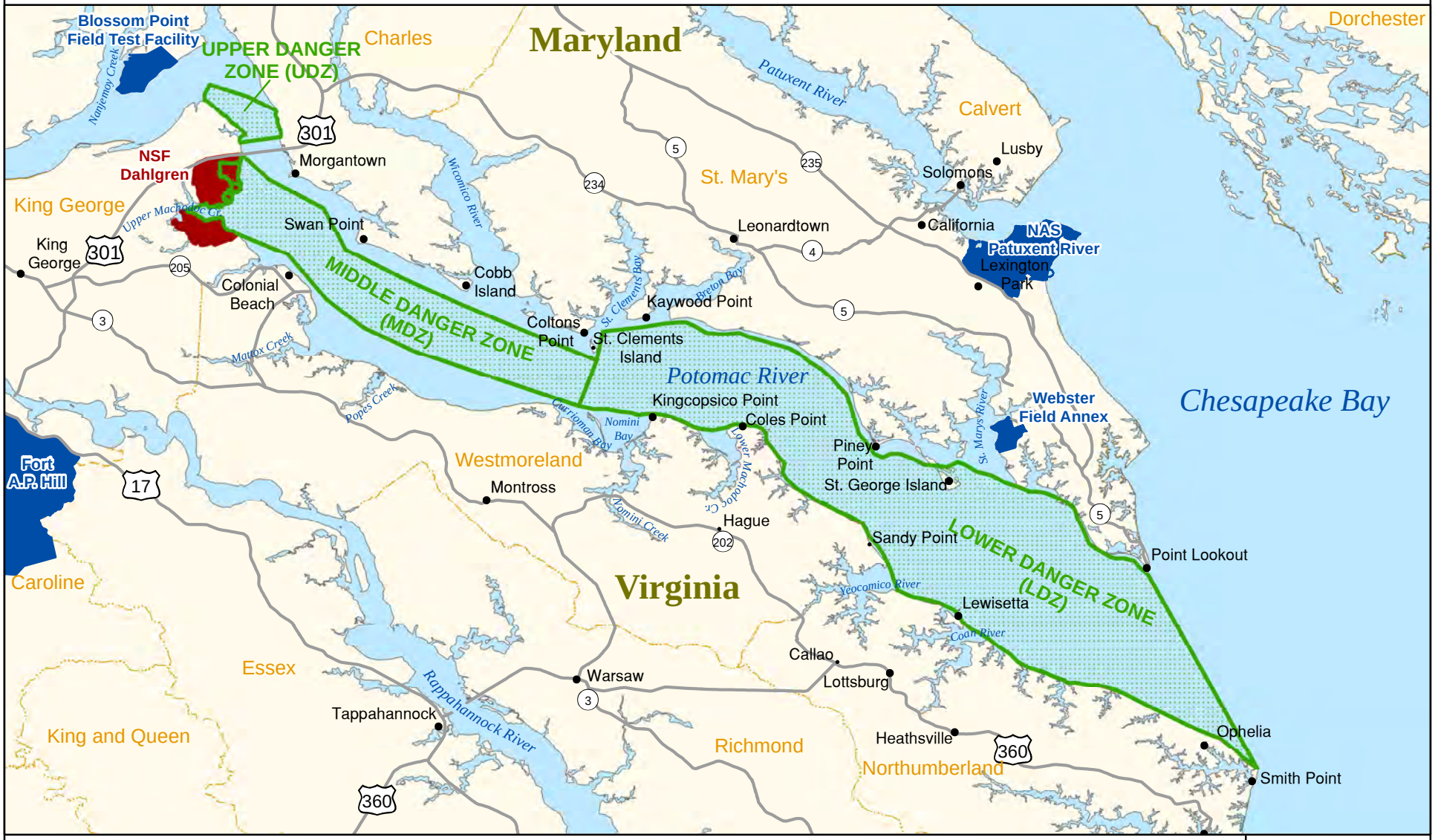
Potomac River Test Range Complex



Source: NSWCDD GIS (2008 - 2011); Danger Zones defined in 33 CFR § 334.230.

Figure ES-2

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Range Complexes and Mission Area

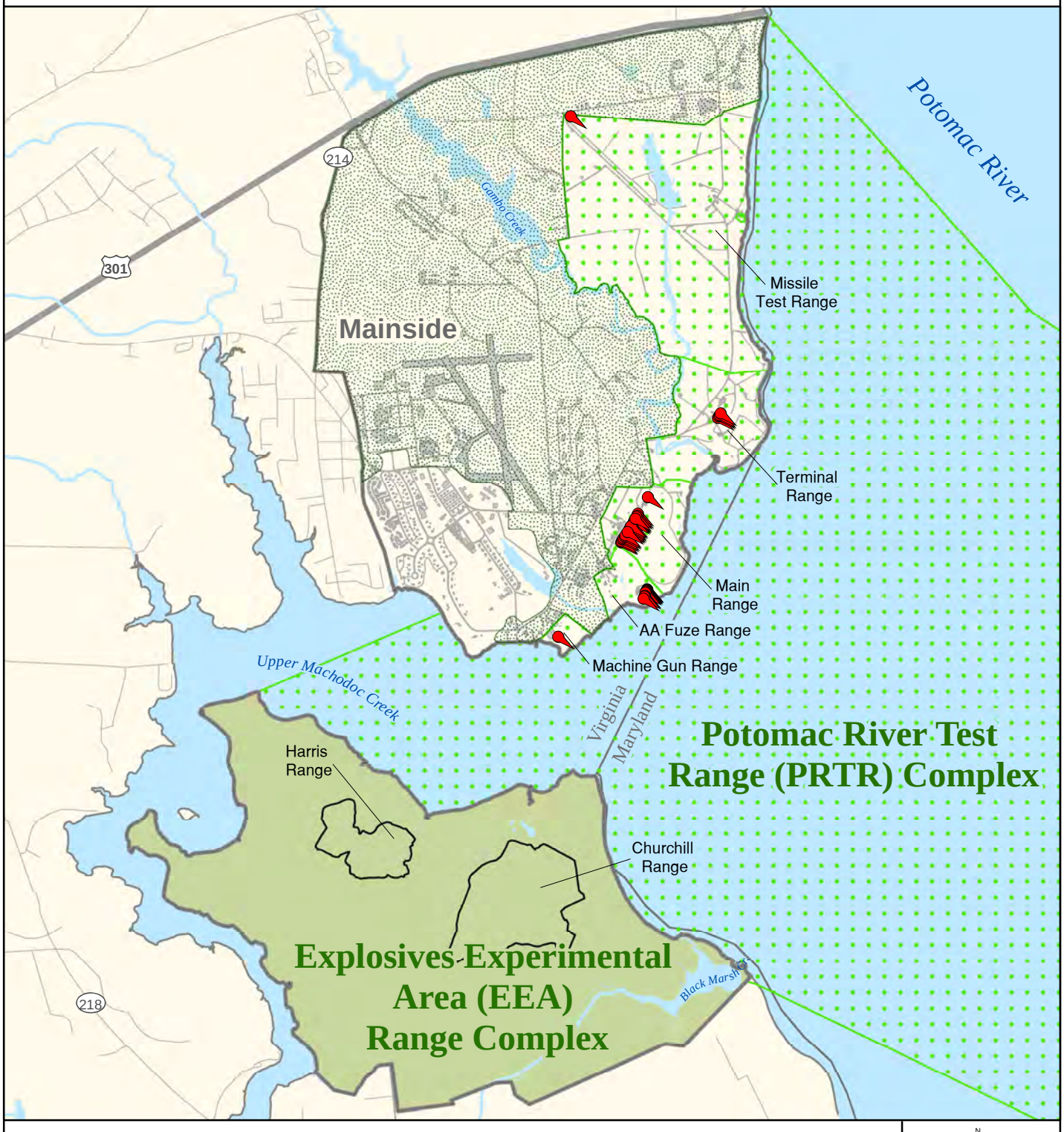

Figure ES-3

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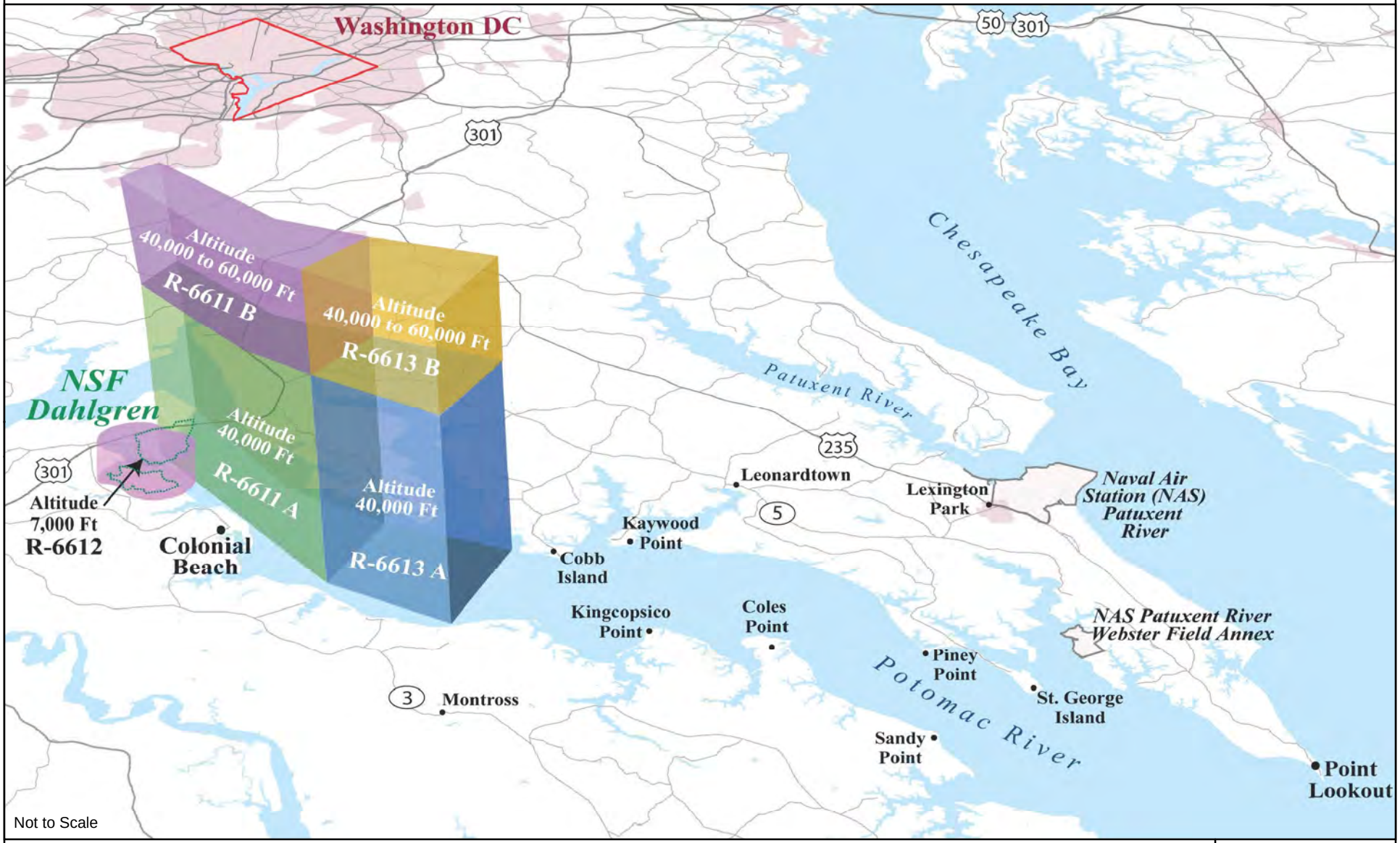
Special-Use Airspace



Source: FAA, 2005.

NSWCDD EIS

Figure ES-4

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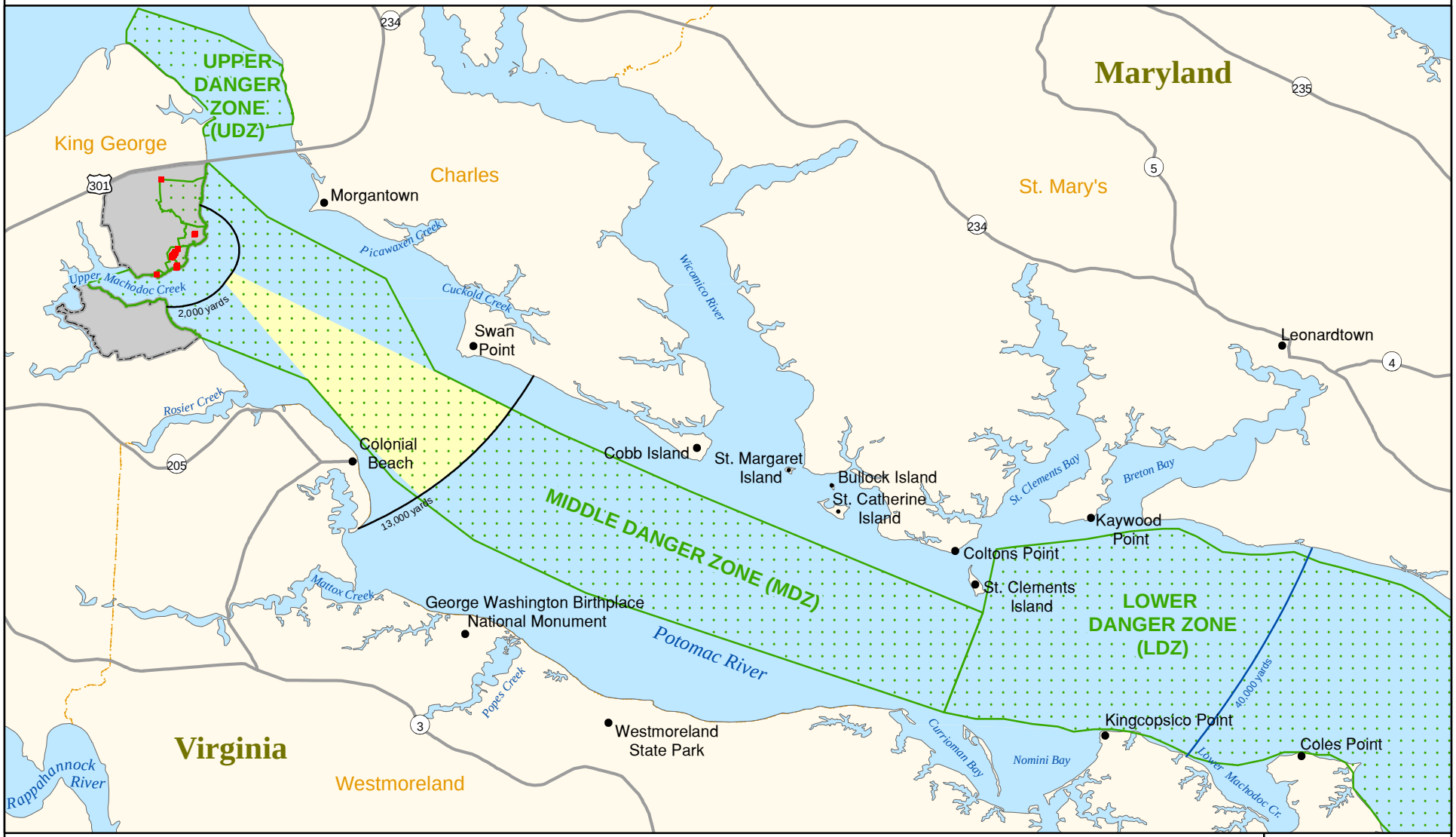
Potomac River Test Range Primary Gunnery Target Area



Source: NSWCDD GIS (2008 - 2011); Danger Zones defined in 33 CFR § 334.230.

Figure ES-5

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- **High-energy (HE) Lasers –** While HE lasers are a form of EM energy, they are treated separately in this EIS because of their unique properties, which create different types of hazards from other EM sources. A laser is a device that emits a coherent beam of light (EM energy). Most light (non-laser) is incoherent, meaning it is made up of many frequencies. Lased light is light of a single frequency, so it does not scatter but rather stays in a narrow, intense beam without dissipating quickly. NSWCDD's laser program, which began in the 1970s, has been recognized by the Navy as a center of excellence for laser RDT&E. NSWCDD's expertise in laser safety and lasers includes RDT&E of sensors, rangefinders, target designators, guidance systems, simulators, communications equipment, and weapons. The Proposed Action would increase the number of annual HE laser activities and the power level of some activities; expand activities on the PRTR; and increase use of platforms such as unmanned systems to serve as laser emitters, targets, or reflectors.
- **Chemical and Biological (Chem/Bio) Simulants –** The threat of terrorist attacks has prompted the Department of Defense to step up RDT&E to counter chem/bio terrorism. Chem/bio agents are very difficult to detect, and the key to minimizing the effects of an attack is early detection and warning. As the Navy's center for RDT&E on chemical and biological warfare sensors and protection systems, NSWCDD uses chemical simulants rather than dangerous agents in the open air to test detection and protection systems. NSWCDD conducts research indoors in the laboratory before tests are performed outdoors. Simulants are substances – many of which are found in common, everyday use, such as acetic acid (strong vinegar) and oil of wintergreen – that mimic chemical and biological agents but do not have the agents' adverse health and environmental effects. The Proposed Action includes increasing the annual number of outdoor test events using chemical simulants, introducing biological simulants, and expanding the areas where testing could take place. The biological simulants proposed for use would be biosafety level 1 (BSL-1) organisms, defined by the Centers for Disease Control and Prevention as well-characterized strains of viable microorganisms not known to consistently cause disease in healthy adult humans and of minimal potential hazard to laboratory personnel and the environment. At the BSL-1 level, precautions against the biohazardous materials are minimal. BSL-1 organisms used as biological simulants may include common bacteria, fungi, proteins, and/or bacteriophages that are naturally found in the environment. The chemical and biological simulants selected would be influenced by parameters such as global threats, homeland security, and technological developments.

Under the Proposed Action, the average number of events that could take place annually would increase above recent levels (with the exception of large-caliber gun firing events). To ensure that equipment and materials work effectively even in less-than-ideal conditions, some of the tests would take place under conditions in which they are not currently conducted, such as at dusk, dawn, and night and in adverse weather.

ES.3 Public Involvement

Public involvement is an integral component of the NEPA process, and the Navy has both kept the public informed as well as listened to what the public has to say about the Proposed Action. NSWCDD developed a public-outreach program specifically for this EIS. The program began in

2003 with 96 interviews with various community leaders, business owners, on-base residents, and residents of the five counties bordering the PRTR about their concerns with respect to NSWCDD's current activities. Drawn from the interviewees, a Public Involvement Working Group was formed, which helped to develop messages and materials for the public. The concerns of those interviewed and the Public Involvement Working Group members were taken into consideration in developing the work plan for the EIS.

The next step in the program was notifying the public that NSWCDD was considering expanding certain RDT&E activities and was going to prepare an EIS to evaluate potential impacts. A Notice of Intent to prepare an EIS was published in the *Federal Register* on June 18, 2007 (72 Federal Register 33456). Soon after, notices were placed in six newspapers in the counties around the PRTR and letters were sent to public agencies, advising readers of the EIS process and inviting them to come to one or more of five public scoping meetings held in the counties around the PRTR to learn more about, and comment on, the proposed scope of the EIS. The scoping meetings – one in each of the counties around the PRTR: King George, Westmoreland, and Northumberland counties in Virginia; and Charles and St. Mary's counties in Maryland – were held in the last two weeks of July 2007. Seventy-seven people attended. Comments were received from twenty-one individuals and three agencies (the Virginia Department of Environmental Quality, the Virginia Department of Game and Inland Fisheries, and the Maryland Transportation Authority).

Subjects raised during the scoping process included NSWCDD's mission, noise and vibration, the environment, the scoping meeting format, socioeconomics, public safety, human and animal health, wildlife resources, EIS content, air space, coastal consistency, air quality, and the Harry W. Nice Memorial Bridge improvement project.

When the Draft EIS (DEIS) was completed, a notice of availability was published in the *Federal Register* on August 17, 2012, beginning a 45-day public review period during which the DEIS was available for review in five local libraries, on the project website, or by mail, upon request. Letters indicating that the DEIS was available for review were sent and notices of the DEIS' availability were published in local newspapers. Public hearings were held to describe the environmental impacts of the Proposed Action and alternatives and to receive comment on the impacts analysis. These comments have been taken into consideration in preparing this Final EIS (FEIS).

Public hearings for the DEIS were held in King George and Westmoreland counties, Virginia, and Charles County, Maryland the week of September 10, 2012. Twenty-nine people attended the hearings. By the end of the comment period, comments had been received from ten individuals, two non-governmental organizations, and 15 public agencies. These comments were submitted orally or in writing at the meetings or by fax, e-mail, or US Mail. Appendix A includes the comments in their original form, and a matrix that includes each comment and a response to the comment, which indicates changes incorporated into the FEIS.

ES.4 Operational Range Complexes and Mission Area

NSWCDD's RDT&E activities take place on the operational range complexes, the Mission Area, and SUA at NSF Dahlgren:

- **Potomac River Test Range (PRTR) Complex** – The PRTR Complex consists of land and water test areas that support RDT&E for ordnance, EM energy, HE lasers, and chemical defense. Figures ES-2, ES-3, ES-4, and ES-5 show the water areas and land ranges that comprise the PRTR, and the special use airspace that lies over it.

  The PRTR Complex allows the Navy to conduct testing in a realistic, controlled environment, which effectively operates as a "ship on shore," collecting real-time data from a number of instrument stations. The water portion of the range is 51 nautical miles long, covers 169 square nautical miles, and is divided into areas designated on nautical charts as the Upper, Middle, and Lower Danger Zones (UDZ, MDZ, and LDZ, respectively)[3]. The upper half of the MDZ receives the heaviest use; it is 2.6 nautical miles wide, 15.4 nautical miles long, and covers 38.5 sq nautical miles (Figure ES-5). Public use of the danger zones is restricted during test events by NSWCDD range control boats and by staff observers stationed at range stations along the Potomac River. Gun firing can be performed up to 40,000 yards (approximately 20 nautical miles) down range (Figure ES-5).

  Testing over water is vital when evaluating the performance of detection and engagement systems such as radars and electro-optical tracking systems to ensure that systems work over water as well as they do on land. The over-water range provides tracker and sensor testing with low over-water targets in situations in which background clutter, reflectivity, and wave height conditions can all vary. The range has a comprehensive instrumentation system, with both fixed and mobile components located along the PRTR to accurately measure test results. The PRTR also serves as a safety buffer for land-based range activities.

  The 725 acres (ac) of land ranges that are part of the PRTR Complex (Figure ES-3) include the Main Range, Anti-Aircraft Fuze Range (a name assigned during World War II – the range is no longer used for anti-aircraft RDT&E), Missile Test Range (another historical name – the range is no longer used for testing missiles), Machine Gun Range, and Terminal Range.
- **Explosives Experimental Area (EEA) Range Complex** – The 1,641-ac EEA Range Complex (Figure ES-3) supports performance, lethality, safety, and ordnance testing on full-scale weapon systems and components containing explosives, propellants, and inert materials. Although the EEA mainly supports RDT&E and safety testing for ordnance weapon systems, such as rocket-propelled grenades, rockets, and restrained missile launchers, this complex also supports RDT&E of EM energy and lasers. The EEA is extensively instrumented for conducting explosive tests such as blast measurements, target testing, arena testing, and live-fire tests. Two ranges – Churchill and Harris – are located within the EEA, as are two EM energy test facilities.
- **Mission Area** – The 1,593-ac Mission Area (Figure ES-3) lies immediately north and west of the PRTR land ranges and is used by NSWCDD for RDT&E activities that do not use explosives. Facilities in this area include the NSF Dahlgren Airfield and EM energy facilities.

[3] The limits of the danger zones are defined in 33 Code of Federal Regulations (CFR) § 334.230 and shown on the National Oceanic and Atmospheric Administration's Nautical Charts: 12288, Lower Cedar Point to Mattawoman Creek; 12286, Potomac River – Piney Point to Lower Cedar Point; and 12233, Chesapeake Bay to Piney Point.

- **Special-Use Airspace (SUA)** – SUA has been established by the Federal Aviation Administration to prevent hazards to aircraft from NSWCDD's RDT&E activities (Figure ES-4). The maximum altitudes are 40,000 feet for Restricted Areas (R)-6611A and R-6613A, and 60,000 feet for R-6611B and R-6613B. For safety reasons, flying through special-use airspace by non-military aircraft is restricted during testing. When testing is completed early or a scheduled test is cancelled, the airspace is returned to the control of the Federal Aviation Administration for normal civilian air traffic use. Additionally, a small restricted airspace – R-6612 – lies directly over the EEA, and extends to 7,000 feet. Helicopters occasionally use the main airfield. Unmanned aerial vehicles, which fly only within the special-use airspace, are either launched from small launchers or take off and land at small landing strips on the EEA and Terminal Range.

ES.5 Alternatives

ES.5.1 Development of Alternatives

The process of developing alternatives began by establishing NSWCDD's RDT&E activity baseline. NSWCDD's programs are diverse and numerous. Over several years, the EIS team interviewed the managers of 75 NSWCDD programs at least once, with subsequent interviews focusing on programs that were expanding and that had the potential to generate environmental impacts. With extensive knowledge of their field, Department of Defense requirements, customer needs, and future trends, the program managers helped to clarify which programs were growing, describe the ways in which the technology was evolving, and define future RDT&E needs and requirements.

From these interviews and from reviewing range operational logs, the operational baseline for each RDT&E activity was established. In most cases, because of the cyclical nature of RDT&E – which can vary considerably from year to year – the baseline was generated by averaging data collected for the years 1993-2009 and then weighting the data for the highest years in the RDT&E cycle to arrive at an average annual number of large-caliber gun and small arms firings; detonations; EM energy, HE laser, and chem/bio sensor events; and PRTR use hours. The data collected for those years are typical of activity levels after 2009. The No Action Alternative column in Table ES-1 lists the average annual baseline activity levels.

For each of the components of the Proposed Action, potential alternatives were developed and evaluated based on the following criteria:

Criterion 1 – Accommodate historical and current, baseline RDT&E mission requirements for activities that have the potential to affect human health and/or the environment – namely, those involving ordnance, the use of EM energy, the use of HE lasers, the use of chemical simulants, and the use of the PRTR.

Criterion 2 – Accommodate known future requirements, which include the use of biological simulants alone.

Criterion 3 – Accommodate a margin of growth for those programs for which it is difficult to accurately forecast future needs. Mixtures of biological and chemical simulants would be included.

Criterion 4 –Minimize impacts to commercial and recreational use of the Potomac River.

Table ES-1
EIS Alternatives

RDT&E Activity	No Action Alternative Activity Magnitude	No Action Alternative Average Annual Activity Levels	Alternative 1 Average Annual Activity Levels	Alternative 2 Average Annual Activity Levels
Large-caliber Guns/ Projectiles	>20 mm to 8" caliber gun/ projectile	**4,700 projectiles**	**4,700 projectiles**	**4,700 projectiles**
Small Arms	≤20 mm caliber gun/bullet	**6,000 bullets**	**25,500 bullets**	**30,000 bullets**
Detonations	<0.01 lbs to 1,000 lbs net explosive weight	**190 events**	**200 events**	**230 events**
EM Energy	300 kilohertz to 300 gigahertz frequency 10 Watts to 500 megawatts average power	**490 events**	**590 events**	**680 events**
Lasers	500 nanometers to 11 micrometers wavelength 1 milliwatt to 100 kilowatts maximum power	**60 events** 100 kW maximum power	**125 events** 500 kW maximum power	**145 events** 500 kW maximum power
Chemical & Biological Defense	≤20 gals/event	**12 events** Chemical simulants only	**60 events** Chemical and biological simulants used separately	**70 events** Chemical and biological simulants used separately and together
PRTR Use	750 hours total annual use	**750 hours**	**870 hours**	**1,000 hours**

Alternatives that do not accommodate historical and current, baseline RDT&E mission requirements and known future requirements – and therefore do not meet Criteria 1 and 2 – do not satisfy the purpose and need for the Proposed Action and are considered unreasonable. Such alternatives were eliminated from further analysis, as were alternatives that substantially increase use of the PRTR beyond levels proposed in Alternatives 1 and 2 and therefore do not meet Criterion 4.

NSWCDD considered an alternative that would utilize the range complexes, the Mission Area, and SUA, to the maximum extent possible – up to 1,800 hours a year compared to the current 750 hours – in order to accommodate the maximum amount of growth in mission operations. This increase would more than double the number of hours during which public access could be restricted. While this theoretical increase in current outdoor RDT&E activity levels would use the range complexes and the Mission Area to the fullest feasible level, the alternative would require substantial increases in public access restrictions to the PRTR, negatively affecting public commercial and recreational use of the river well beyond the levels resulting from implementing either Alternative 1 or Alternative 2. For almost three-quarters of a century, the

Navy and its community neighbors in Virginia's Northern Neck and Southern Maryland have prospered in a much-treasured partnership that was established and is secured by the common bonds of friendship, patriotism, national defense, and economics. NSWCDD actively engages with the local community to maintain this partnership. Because this alternative would not meet Criterion 4, it was dismissed from further consideration.

The activities that comprise the Proposed Action are not new technology, nor are they programs new to NSWCDD, but rather expansions of current programs based at NSWCDD. Relocation of these programs is neither desirable nor feasible. It would involve moving existing, active programs from NSWCDD to a new location, which would needlessly disrupt program operations, cause unnecessary delays, and generate substantial additional costs, all without any additional benefits. The 2005 Defense Base Closure and Realignment (BRAC) Commission concurred with this thinking and recommended that NSWCDD's programs remain in place. Therefore, the Navy concluded that no other location for expanding these programs was a reasonable alternative.

Operations, Tests, and Events

An **operation** is a group of **tests** that has a common objective and that may take place over one or more days under one standard operating procedure (SOP). For purposes of this EIS, an **event** consists of all the tests that take place under one SOP on one day. If the same test occurs the following day, it is considered a separate event. If two groups of tests are conducted on the same day under separate SOPs, then each group counts as a separate event.

Standard Operating Procedure

A **standard operating procedure (SOP)** is prepared for every operation determined by performance of a **risk hazard assessment** to be potentially hazardous**.** SOPs are prepared to ensure the safety of participants and the public and to minimize environmental impacts. An SOP includes a description of the proposed operation; a statement of responsibilities; a listing of which persons will be in charge of what actions; the operational location; a description of personnel and material limits (including buffer zones for safety); safety requirements; emergency response and contingency plans; applicable environmental protection procedures; security requirements; a hazard control brief; an equipment list; and step-by-step descriptions of the procedures to follow, with highlighted warning and caution boxes.

The process resulted in the development of three alternatives:

- **No Action Alternative** – This alternative constitutes baseline activity levels for the portion of NSWCDD's outdoor activities that have the potential to affect the human environment – namely, those involving ordnance, the use of EM energy and HE lasers, the use of chemical simulants, and the use of the PRTR. This alternative meets Criteria 1 and 4.
- **Alternative 1** – This alternative includes baseline activity levels plus reflects the growth necessary to meet the minimum RDT&E mission requirements in the reasonably foreseeable future, and constitutes increases in current activities of: 108 percent for laser events, 20 percent for EM energy events, 325 percent for small-arms firing, 5 percent for detonations, 400 percent for chem/bio events, and 16 percent for PRTR hours of use. Large-caliber gun activities would remain at baseline levels. This alternative includes outdoor use of chemical and biological simulants separately. Alternative 1 meets Criteria 1, 2, and 4.
- **Alternative 2** – This alternative is NSWCDD's Preferred Alternative, which provides for roughly 15 percent growth in activity levels above Alternative 1, averaged across activities. There would be increases in all activities except large-caliber gun activities, which would remain at baseline levels. It satisfies current baseline requirements, includes the growth necessary to meet minimum RDT&E mission requirements for the reasonably

foreseeable future, includes the use of biological and chemical simulants together and separately, and includes a margin of growth for the most actively evolving programs – those for which the numbers of future annual test events, firings, and hours of use are harder to predict because of the uncertainties inherent in carrying out RDT&E. Alternative 2 optimizes NSWCDD's outdoor RDT&E activities and meets all four criteria.

Table ES-1 summarizes the annual activity levels for each RDT&E activity proposed under each alternative. The alternatives are described in more detail below.

ES.5.2 No Action Alternative

The annual activity levels for the No Action Alternative constitute the existing baseline condition, and the number of outdoor RDT&E large-caliber gun and small-arms firings, detonations, events, and hours of PRTR use would remain at existing levels. Even though the Navy proposes to increase RDT&E activities, including the No Action Alternative in the evaluation of impacts provides a baseline against which to measure the impacts of the other two alternatives.

Ordnance Activities

Large-caliber guns at NSF Dahlgren mainly fire inert (non-explosive) projectiles (74 percent fired from 1995-2009 were inert) but also fire live (explosive) projectiles into the Potomac River mainly within the PRTR's MDZ but infrequently into the upper LDZ. Live (explosive) projectiles produce noise both at the gun when they are fired and at the target downriver when they detonate. Inert projectiles only produce noticeable noise at the gun when they are fired. The guns range in caliber from more than 20 mm (0.8") up to 8" (203 mm). The largest gun normally fired is the 155 mm (6.1") gun, but it is fired infrequently and usually into a backstop on land. The gun fired most frequently is the 5" (127 mm) gun, which is standard on Navy ships. The 8" gun is no longer used to fire normal projectiles but rather to launch canisters filled with electronics to test how well they can withstand high gravitational forces.

In the years 1995-2009, NSWCDD fired an average of 2,900 projectiles annually, ranging from a low of 910 fired in the year with the smallest number of firings (2005) to a high of 6,170 (all inert) in 2004. In particularly active years since 1995, the average has been approximately 4,700 large-caliber projectiles fired. Not all projectiles go into the river; guns on the Missile Test and Terminal ranges sometimes fire projectiles into backstops on land rather than targets in the river.

NSWCDD's small-arms tests usually employ inert bullets with small propellant charges that produce noise levels that affect a far smaller area than the noise resulting from firing the large-caliber guns. Approximately 10 percent of the bullets are fired into the PRTR. Each bullet fired counts as one of the 6,000 bullets fired annually, on average.

Annual detonations average 190 individual detonations. The explosives used in the ordnance being detonated can vary from less than 0.1 pounds (lbs) up to 1,000 lbs of explosives. Detonations above 200 lbs of explosives are covered with at least eight feet of dirt to minimize noise and fragmentation. Most detonations take place on the EEA Range Complex.

EM Energy Activities

The EM energy devices included operate in the frequency range of 300 kilohertz to 300 gigahertz and at powers ranging from 10 watts up to 500 megawatts. An average of 490 events take place annually, three-quarters of which are ground plane tests of whether electrical and electronic systems can withstand high-power EM energy. The remaining events involve emissions from radars on the Search and Track Sensor Test Site, from the Navy Directed Energy Center to targets on the river or to the Counter Explosive Test Facility, within the Maginot Open Air Test Site, and within the Naval Ordnance Transient Electromagnetic Simulator. Devices, such as radios and range radars with power, frequency, and exposure levels below established thresholds for EM energy hazards to personnel, ordnance, fuel, and EM interference are not included in the Proposed Action.

HE Laser Activities

The HE lasers operated at NSWCDD and included under the No Action Alternative emit focused, coherent (lased) light ranging in power from more than 1 milliwatt (Laser Class 3) to 100 kilowatts (Laser Class 4) in a wavelength range from 500 nanometers to 11 micrometers. Class 3 and Class 4 lasers are HE lasers. Eye-safe Laser Class 1 (such as laser printers) and usually eye-safe Class 2 lasers (such as laser pointers) are not included in the Proposed Action because they have negligible environmental and safety impacts.

NSWCDD currently conducts approximately 60 outdoor HE laser events a year (see "Operations, Tests, and Events" text box for the definition of a laser event). For lasers and EM energy devices, effects are possible only when the device is emitting. The time of emission is usually brief – varying from less than a second to several minutes – and there are no residual effects. However, one event may entail several hundred instantaneous pulses while another event with a different device may be one single pulse of five minutes. Laser corridors over the land ranges and Mission Area as well as over the river from PRTR land ranges to the EEA have been established; laser tests take place on these corridors. Laser beams are directed from either mobile emitters or the Naval Directed Energy Center to strike targets surrounded by backstops.

Chemical Defense Activities

Activities outdoors using chemical simulants have been conducted by NSWCDD since the 1980s on the PRTR Complex. Up to 12 events using chemical simulants are conducted annually. Chemical simulants are dispersed from a blower on a land range or on a barge, helicopter, or small vessel in the MDZ. Detectors, located on a land range or on a barge or small vessel in the MDZ, remotely detect chemical simulant vapors some distance from the source using a scanner, a detector, and an electronics module to process and communicate information.

A chemical defense event is defined in the same way that EM energy and HE laser events are defined (see "Operations, Tests, and Events" text box). The quantities of simulant used for an event may vary depending on the tests being conducted. Each test may include small quantities of a number of simulants or larger quantities of one or two simulants, consisting of no more than 20 gallons of simulant per release or test.

Potomac River Test Range (PRTR) Use

Use of the PRTR for RDT&E activities would remain at present levels, which average approximately 750 hours per year. Use is defined by the number of hours that range control boats are on the PRTR to restrict public access to ensure public safety. For many of these hours, test

set-ups and equipment calibrations are occurring, so testing takes place for only some of the 750 hours. Currently, only access to the MDZ or upper LDZ to 40,000 yards from Main Range (Figure ES-5) is restricted. The MDZ is the area that receives most of the use, and it includes the main gunnery target area (Figure ES-5). Normally, only the part of the range being used is restricted, unless large guns are being fired, in which case, the whole MDZ or upper LDZ is restricted. When the range is in use, vessels are cleared from the range or the part in use to protect their safety. NSWCDD's Range Operations Center works with vessel operators to minimize waits by allowing them to pass by or across the range during lulls in testing. Small watercraft can always pass by the range on the Maryland side even when access to the whole MDZ is restricted. When the range is restricted, small vessels may wait up to 30 minutes to move through, but 10-minute waits are more typical. For deep-draft vessels, which must use the main channel through the range, delays are no more than one hour, and more typically last less than 30 minutes.

ES.5.3 Alternative 1

The numbers shown in the Alternative 1 column of Table ES-1 represent average annual activity levels under Alternative 1 and were determined by combining:

1. An average of the annual number of bullets, events, or hours, as appropriate, for each RDT&E activity from 1993 (1995 for ordnance) to 2009, weighted to take into account years with the highest activity levels (No Action Alternative levels);
2. ***Plus*** growth above No Action Alternative levels necessary to meet known RDT&E mission requirements in the near future.

Ordnance

- There would be no increase in large-caliber gun use, which would vary from year to year but would remain at the current level of approximately 4,700 projectiles on average fired in a particularly active year.
- EM launchers, a type of large-caliber gun using EM energy rather than explosives to fire projectiles, would fire inert, shaped metal projectiles at conventional targets on land and river ranges. Projectile speeds would be no greater than conventional large Navy gun projectile speeds.
- Long-range guns would fire into a target area from 32,000 to 35,000 yards in the upper LDZ approximately 10 days a year, which is more frequently than over the last 15 years.
- Outdoors small arms use would increase more than fourfold from 6,000 to 25,500 bullets fired annually.
- Detonations would increase by 10 detonations, or five percent annually.

EM Energy

- Under Alternative 1, the number of annual events using EM energy would increase from No Action Alternative levels of 490 to 590. This represents a 20 percent increase in the number of tests annually using EM energy in the frequency range of 300 kilohertz to 300 gigahertz and at average powers ranging from 10 watts up to 500 MW.
- Directed EM energy sensors and emitters may be mobile (operating from a moving vehicle or aircraft, for example).

- EM energy may be directed at unmanned aerial vehicles (drones) and unmanned surface vehicles (small vessels on the river) on the MDZ; unmanned surface vehicles may be disabled or destroyed; unmanned aerial vehicles would only be tracked.
- EM energy emitted from a land range or a vessel on the PRTR may be reflected off an unmanned aerial vehicle or similar airborne platform over the horizon to a target on the land ranges or to a platform, such as a barge, located in the UDZ, MDZ, or LDZ.
- Some EM energy operations would take place beyond the normal 8 am to 5 pm, Monday-to-Friday PRTR range schedule because of the increasing need to test systems in all kinds of weather conditions and at dawn, dusk, and at night.

HE Lasers

- Under Alternative 1, the number of HE laser events would increase from current/No Action levels of 60 annually to 125 annually, which is a 108 percent increase.
- The maximum HE laser power levels would increase from the current/No Action Alternative level of 100 kilowatts to 500 kilowatts.
- HE lasers would be directed from land ranges to a target on a barge on the MDZ.
- HE lasers would use tracking to target mobile unmanned aerial vehicles; HE lasers would disable/destroy mobile unmanned surface vehicles on the water and mortar shells in the air.
- HE laser beams emitted from a land range or a vessel on the PRTR may be reflected off an unmanned aerial vehicle or similar airborne platform located over the horizon to a target on land ranges or on various types of platforms, such as a barge, in the UDZ, MDZ, or LDZ.
- If lighter-weight power sources are developed, lasers may be fired from manned and unmanned aerial vehicles at targets on the MDZ water surface.
- Some laser operations would take place beyond the normal 8 am to 5 pm, Monday-to-Friday PRTR range schedule because of the increasing need to test systems in all kinds of weather conditions and at dawn, dusk, and at night.

Chem/Bio Defense

- Like the No Action Alternative, chemical and biological simulants would be dispersed from a blower on a land range or on a barge, helicopter, or small vessel in the MDZ. Detectors, located on a land range or on a barge or small vessel, would remotely detect chemical or biological simulant vapors some distance from the source using a scanner, a detector, and an electronics module to process and communicate information.
- The annual number of outdoor chem/bio defense events would increase fivefold from 12 to 60.
- A wider range of chemical simulants would be used for outdoor chemical defense operations.
- Biological simulants would be used as well as chemical simulants outdoors, but they would not be tested together.

- Chemical and biological simulants would be used on the land ranges, the Mission Area, and the whole MDZ. Under the No Action Alternative, only the upriver part of the MDZ and the land ranges have been used for testing.
- Some chem/bio sensor activities would take place beyond the normal 8 am to 5 pm, Monday-to-Friday PRTR range schedule because of the increasing need to test systems in all kinds of weather conditions and at dawn, dusk, and at night.

PRTR Use

- There would be an overall increase in the number of hours that public access to some part of the PRTR would be restricted from 750 hours under the No Action Alternative to 870 hours annually under Alternative 1.
- Public access to the PRTR UDZ and the LDZ would be restricted approximately two days a year each to allow, for example, for weapon systems integration operations using vessels and aircraft, compared to no restrictions under the No Action Alternative.
- Public access to the upper LDZ would be restricted up to 10 days a year for long-range, large-caliber gun firing, compared to only infrequent restrictions under the No Action Alternative.

ES.5.4 Alternative 2

This alternative is the Navy's preferred alternative because it satisfies current requirements, known outdoor RDT&E activities scheduled for the coming years, and projected increases in activities in the foreseeable future based on current trends. In most respects, Alternative 2 would include the same types of activities described for Alternative 1. The number of annual activities under Alternative 2 represents:

- An average of the annual number of firings, detonations, and events for each RDT&E activity from 1993 (1995 for ordnance) to 2009, weighted to take into account years with the highest activity levels (No Action Alternative levels);
- ***Plus*** the increase in average annual RDT&E activities under Alternative 1 above No Action Alternative levels;
- ***Plus*** roughly 15 percent growth in the number of average annual RDT&E activities above Alternative 1 levels.

This alternative satisfies current requirements, known outdoor RDT&E scheduled for the coming years, and projected increases in tests in the foreseeable future based on current trends. It provides the flexibility required in RDT&E to accommodate future developments that may influence global threats, homeland security, and future missions. Alternative 2 includes the following increases above Alternative 1 levels:

- Small-arms activities would be approximately 30,000 bullets fired annually (an 18 percent increase over Alternative 1 levels). The number of large-caliber projectiles fired would not increase (0 percent).
- The number of detonations on the EEA would increase by about 30 annually (15 percent) above Alternative 1 levels.

- RDT&E activities using EM energy events would increase above Alternative 1 levels by 90 (15 percent) annually; HE laser events would increase by 20 (16 percent); and chem/bio simulant events would increase by 10 (17 percent).
- Biological simulants may be tested simultaneously with chemical simulants. Detectors capable of immediately recognizing a mixture of chemical and biological threats would be tested.
- NSWCDD's use of the PRTR (hours when range control boats restrict public access) would increase by 130 hours annually (15 percent above Alternative 1 levels). The number of days that the UDZ and LDZ would be restricted would be similar to Alternative 1 – approximately two times a year – and the upper LDZ would be restricted approximately 10 days a year.

ES.5.5 Environmental Impacts

Each alternative was evaluated for its potential to produce environmental impacts. The following defines the impact attributes that were used to assess potential impacts:

- **Context** – Context refers to the geographic, social, and environmental circumstances within which a proposed action may have effects on an environmental resource, as well as the size of the area affected by the action.
- **Intensity** – Intensity refers to the severity of the impacts. Intensity is rated as negligible, minor, moderate, or major, in accordance with the framework presented below.
- **Short-term or Long-term** – In general, short-term impacts are those that would occur only with respect to a particular discontinuous activity or for a finite period, or only during the time required for installation activities. Long-term impacts are those that are more likely to be persistent and chronic.
- **Direct or Indirect** – A direct impact is caused by a proposed action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a proposed action but might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action.
- **Positive or Negative** – A positive impact is one having beneficial outcomes on an environmental resource. A negative impact is one having adverse, unfavorable, or undesirable outcomes.

The following scale is the qualitative framework used in this EIS to evaluate the intensity of impacts:

- **No Impacts** – No change to the environmental resource.
- **Negligible Impacts** – Impacts either are non-detectable or, if detected, are well within natural or normal variability and do not appreciably affect the extent or value of the environmental resource. Adverse impacts are easily absorbed by the natural or human environment without mitigation or long-term consequences.

- **Minor Impacts** – Impacts are clearly detectable but they approximate natural or normal variability and do not appreciably affect the extent or value of the resource. If needed to offset adverse impacts, mitigation is simple and mitigation success is likely.
- **Moderate Impacts** – Impacts exceed natural or normal variability; impacts appreciably affect the value or extent of the resource, but do not affect its viability. Although mitigation typically would be needed for the environment to absorb adverse impacts without long-term deterioration, mitigation success is likely.
- **Major Impacts** – Impacts exceed natural or normal variability and likely affect the viability of the resource or, as the impacts are highly uncertain or involve unique or unknown risks, the future viability of the resource is in question. Full mitigation of adverse impacts may not be possible or mitigation success is not likely, and some long-term deterioration of the environment may be unavoidable.

Table ES-2 summarizes the environmental impacts that would result from implementing each of the three alternatives.

Table ES-2
Summary of Environmental Impacts

Resource	No Action Alternative	Alternative 1	Alternative 2
Land Use, Plans, & Coastal Zone Management			
NSF Dahlgren	No military construction proposed. Activities would continue to use existing facilities and corridors within operational ranges and the Mission Area. No direct or indirect impacts on NSF Dahlgren land use pattern. Negligible, short-term, direct, negative impacts and no indirect impacts on non-operational uses of ranges and the Mission Area on NSF Dahlgren. Consistent with Navy plans to guide development at NSF Dahlgren, except that alternative would not support regional plans to further promote district as an RDT&E center.	No military construction proposed. Activities would use existing facilities and existing plus some new areas within operational ranges and the Mission Area. Activities would take place more frequently than under No Action Alternative (Alt). No direct or indirect impacts on NSF Dahlgren land use pattern. Negligible, short-term, direct, negative impacts and no indirect impacts on non-operational uses of ranges and the Mission Area on NSF Dahlgren. Consistent with Navy plans for NSF Dahlgren. Would support regional plans to promote district as an RDT&E center and maximize existing facilities for highest and best use.	No military construction proposed. Activities would use existing facilities and existing plus some new areas within operational ranges and the Mission Area. Activities would take place more frequently than under other alternatives. No direct or indirect impacts on NSF Dahlgren land use pattern. Negligible, short-term, direct, negative impacts on non-operational uses of ranges and the Mission Area on NSF Dahlgren. Consistent with Navy plans for NSF Dahlgren. Would support, to a greater extent than Alt 1, regional plans to promote district as an RDT&E center and maximize existing facilities for highest and best use.
Dahlgren Area and Potomac River Shoreline	Master plans, market forces, and the presence of NSF Dahlgren have determined current land use pattern and development projects. Therefore, continuing RDT&E activities would have no direct or indirect impacts on land use near NSF Dahlgren or along the shoreline of the PRTR. Consistent with master plans and policies of counties and towns near the PRTR. No direct or indirect impacts on existing access to the Potomac River for commercial or recreational purposes.	PRTR use increase of 16% plus 20% increase in EM energy and 108% increase in HE laser events would have negligible, short-term, direct, negative impacts and no indirect impacts on river use. No direct impacts and negligible, long-term, indirect, negative impacts on the desirability of waterfront property based on the slight increase in noise levels in the upper LDZ. NSWCDD gives notice of restrictions in advance, boat traffic is allowed to pass during lulls in tests, and recreational boating mainly takes place on weekends when operations rarely are conducted. No direct impacts and negligible, long-term, indirect, negative impacts on land use, land use planning, and ongoing development projects.	PRTR use increase of 33% plus 39% increase in EM energy and 142% increase in HE laser events would have negligible, short-term, direct, negative impacts and no indirect impacts on river use. No direct impacts and negligible, long-term, indirect, negative impacts on the desirability of waterfront property for the reasons described under Alt 1. No direct impacts and negligible, long-term, indirect, negative impacts on land use, land use planning, and ongoing development projects.
Special-Use Airspace	No change from existing conditions; no direct or indirect impacts on civilian air traffic.	Negligible, short-term, direct, negative impacts and no indirect impacts on civilian air traffic. No change in the hours that airspace is restricted annually. Although	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
		fewer hours would be turned back to FAA for civilian use, commercial and general aviation operators normally stay out of the special-use airspace at all times; many operators consider the special-use airspace to be off-limits at all times. It is expected that few aircraft would actually use the airspace during hours normally restricted.	
Coastal Zone	The Proposed Action is consistent to the maximum extent practicable with the enforceable policies of Virginia's and Maryland's coastal zone management (CZM) programs. The Virginia Department of Environmental Quality (VDEQ) concurred that the Proposed Action will be consistent with the Virginia Coastal Zone Management Program. The Maryland Department of the Environment (MDE) received a copy of the DEIS and the Federal Coastal Consistency Determination (Appendix I) but did not respond within 60 days to the Navy's consistency determination nor ask for an extension, so under the provisions of the Coastal Zone Management Act, the state has waived its consistency rights, stating neither that it concurs with nor objects to the Navy's consistency determination.	Same as No Action Alt.	Same as No Action Alt.
Socioeconomics			
Demographics	No significant increase in NSWCDD's outdoor RDT&E personnel anticipated; unlikely to affect population projections and would have no direct or indirect impacts on demographics.	No significant increase in NSWCDD's outdoor RDT&E personnel anticipated; unlikely to affect population projections and would have no direct impacts and negligible, long-term, indirect, negative impacts on demographics.	Same as Alt 1.
Economics	Current PRTR activities have not suppressed real estate development driven by proximity to Washington, DC and attractiveness of the Potomac River. Marine navigation (freight movement, commercial fishing, and recreational boating) coexists with range use; inconvenience of delays of	Based on No Action Alt experience, the 16% increase in PRTR use and no significant increase in noise, coupled with Range Operations Center measures to facilitate river traffic movement (as described under No Action Alt), are expected to have no direct and negligible,	Based on No Action Alt experience, the 33% increase in PRTR use and no significant increase in noise, coupled with Range Operations Center measures to facilitate river traffic movement (as described under No Action Alt.), are expected to have no direct and negligible, long-term, indirect, negative

Resource	No Action Alternative	Alternative 1	Alternative 2
	up to 30 minutes (10 minutes typical) for small vessels and up to one hour (half-hour typical) for large vessels is mitigated by Range Operations Center's early notices of upcoming operations and working with vessel operators to allow them to pass during lulls in testing. No direct or indirect impacts on economic conditions in the study area because it would not change factors such as noise and river use, which are already incorporated into existing economic activities.	long-term, indirect, negative impacts on real estate development; and minor, short-term, direct and minor, long-term, indirect, negative impacts on marine commerce.	impacts on real estate development; and minor, short-term, direct and minor, long-term, indirect, negative impacts on marine commerce.
Environmental Justice and Protection of Children	No disproportionately high and adverse human health or environmental effects on minority populations and low-income populations. No disproportionate environmental health or safety risks to children.	Same as No Action Alt.	Same as No Action Alt.
Utilities			
Utilities	NSWCDD's current power requirements are being adequately supplied by the power grid and NSF Dahlgren's auxiliary generators. RDT&E activities would have no direct or indirect impacts on utilities. The Dominion Virginia Power (DVP) application to build a new 230 kilovolt transmission source and substation at NSF Dahlgren has been approved and construction is scheduled to be completed in 2014. This would meet NSF Dahlgren's needs and King George County's growth and development.	Despite 20% increase in EM energy and 108% increase in HE laser events, RDT&E activities would have no direct and negligible, long-term, indirect impacts on the Virginia power grid. RDT&E activities would have no direct or indirect impacts on other utility systems, which are sufficient to support proposed activities.	Despite 39% increase in EM energy and 142% increase in HE laser events, RDT&E activities would have no direct and negligible, long-term, indirect impacts on the Virginia power grid. RDT&E activities would have no direct or indirect impacts on other utility systems, which are sufficient to support proposed activities.
Air Quality			
Stationary & Mobile Sources	No construction of any new major stationary sources is proposed. The land-based portion of NSF Dahlgren is in an attainment area and has a state operating permit for stationary air emissions. Annual emission levels do not exceed Title V major source thresholds. The emissions from the portion of the PRTR's MDZ located within an ozone	Same as No Action Alt.	Same as No Action Alt.

Resource	No Action Alternative	Alternative 1	Alternative 2
	nonattainment area would be unchanged. RDT&E activities would result in negligible, long-term, direct and indirect, negative impacts on air quality.		
Greenhouse Gases	NSWCDD RDT&E activities make an incremental contribution to greenhouse gas emissions, representing a very small percentage of total United States emissions. Based on an estimate of CO_2 equivalents generated, NSF Dahlgren's facility-wide total greenhouse gas emissions in 2008 represented approximately 0.0001% of the total emissions for the country as a whole. NSWCDD RDT&E activities when combined with other past, present, and reasonably foreseeable future actions would have the potential for negligible, long-term, indirect, negative impacts on climate.	Same as No Action Alt because increases in greenhouse gas emissions would be negligible.	Same as No Action Alt because increases in greenhouse gas emissions would be negligible.
Other Sources	Chemical simulants released have low toxicity and are rapidly dispersed to low concentrations. NSWCDD personnel exposed to simulants use personal protective equipment. Chemical defense activities would result in negligible, long-term, direct and indirect, negative impacts on air quality.	The 400% increase in chem/bio defense events and the addition of biological simulants would result in negligible, long-term, direct and indirect, negative air quality impacts comparable to impacts under the No Action Alt.	The 483% increase in chem/bio defense events and the addition of biological simulants, which may be mixed with chemical simulants, would result in negligible, long-term, direct and indirect, negative air quality impacts comparable to impacts under the No Action Alt.
Noise			
Noise	Noise levels resulting from firing large guns and small arms and from detonations would remain the same as at present. Ordnance activities would have minor, long-term, direct, negative weapons-testing noise impacts; negligible, long-term, direct, negative vibration impacts; and no indirect noise or vibration impacts. EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect noise or vibration impacts.	Although small-arms firing would increase by 325% and detonations by 5%, there would be no significant overall increase in noise levels. Ordnance activities would have minor, long-term, direct, negative weapons-testing noise impacts; negligible, long-term, direct, negative vibration impacts; and no indirect noise or vibration impacts. EM energy, HE laser, chemical and biological defense activities, and PRTR use would have no direct or indirect noise or vibration impacts.	Although small-arms firing would increase by 400% and detonations by 21%, there would be no significant overall increase in noise levels. Ordnance activities would have minor, long-term, direct, negative weapons-testing noise impacts; negligible, long-term, direct, negative vibration impacts; and no indirect noise or vibration impacts. EM energy, HE laser, chemical and biological defense activities, and PRTR use would have no direct or indirect noise or vibration impacts.

Resource	No Action Alternative	Alternative 1	Alternative 2
Cultural Resources			
Archaeolog-ical Resources	RDT&E activities would have no direct or indirect impacts on previously identified archaeological resources and are not expected to affect unknown resources within the Archaeological Area of Potential Effect (APE) because no groundbreaking activities and no expansion of outdoor RDT&E activities are proposed. In accordance with Section 106 of the National Historic Preservation Act, the Virginia Department of Historic Resources (VDHR) and Maryland Historic Trust (MHT) concurred that this alternative would not have an adverse effect on archaeological resources within the archaeological APE.	RDT&E activities would have no direct or indirect impacts on previously identified archaeological resources and are not expected to affect unknown resources within the Archaeological APE. In accordance with Section 106 of the National Historic Preservation Act, the VDHR and MHT concurred that this alternative would not have an adverse effect on archaeological resources within the archaeological APE. No archaeological resources are known to occur in the heavily-disturbed range areas used for detonations so an increase in detonations would have no effect. There would be no increase in large-caliber gun firing.	Same as Alt 1.
Historic Architectural Resources	In accordance with Section 106, ordnance noise and vibration modeling indicates no adverse effect to either the National Register-eligible Dahlgren Residential Historic District or the three proposed districts on NSF Dahlgren. The VDHR and MHT concurred that the Proposed Action would have no direct or indirect adverse effect on National Register of Historic Places-eligible or -listed properties within the Historic Architectural APE. In accordance with NEPA, the No Action Alt would have minor direct impacts and no indirect negative impacts on historic architectural resources within the APE.	Same as the No Action Alt. Although there would be a 325% increase in small-arms use, the area affected is limited and would not include National Register-listed or -eligible resources. There would be no increase in large-caliber gun firing.	Same as the No Action Alt. Although there would be a 400% increase in small-arms use, the area affected is limited and would not include National Register-listed or -eligible resources. There would be no increase in large-caliber gun firing.
Hazardous Materials and Waste			
Hazardous Materials and Hazardous Waste	The numerous policies and programs in place to remediate and to safely use, store, transport, and dispose of hazardous materials and hazardous waste ensure that they are safely handled and do not enter the environment. The environmental restoration	The numerous policies and programs in place to remediate and to safely use, store, transport, and dispose of hazardous materials and hazardous waste would ensure that they are safely handled and do not enter the environment. The	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
	program is addressing past range use when environmental programs were less stringent. Ordnance activities would have minor, long-term, direct and indirect, negative impacts and EM energy, HE laser, and chemical defense activities would have negligible, long-term, direct and indirect, negative impacts.	environmental restoration program is addressing past range use when environmental programs were less stringent. Comparable to the No Action Alt, ordnance activities would have minor, long-term, direct and indirect, negative impacts and EM energy, HE laser, and chem/bio defense activities would have negligible, long-term, direct and indirect, negative impacts.	
Health & Safety			
Health and Safety	Activities are conducted in accordance with Navy policies, carefully-conceived management controls, and operation-specific risk hazard assessments and standard operating procedures, which are implemented to ensure safety during the RDT&E activities. Input of munitions constituents (MCs) into the Potomac River from current and past ordnance use are well below concentrations that could cause adverse effects on human health. Ordnance, EM energy, HE laser, and chemical defense activities would have negligible, long-term, direct and indirect, negative impacts. PRTR use would have negligible, long-term, direct, negative impacts and no indirect impacts.	The 325% increase in small-arms firing and 5% increase in detonations would not increase releases of MCs on or off range or pose unacceptable risks to human health. Most bullets are fired into butts and those entering the PRTR are likely to be buried in sediments and be isolated from exposure pathways. The MC contribution of the additional number of bullets settling near the surface of the sediments is negligible (0.1% of duds and inert bullets or about 26 bullets). Treatment of explosive waste from the additional detonations would take place at NSWCDD, consistent with current operations. Biological simulants would be tested, but simulants proposed for use are common and found naturally in the environment. Ordnance, EM energy, HE laser, and chem/bio defense activities would have negligible, long-term, direct and indirect, negative impacts. PRTR use would have negligible, long-term, direct, negative impacts and no indirect impacts.	The 400% increase in small-arms firing and 21% increase in detonations would not increase releases of MCs on or off range or pose unacceptable risks to human health. Most bullets are fired into butts and those entering the PRTR are likely to be buried in sediments and be isolated from exposure pathways. The MC contribution of the additional number of bullets settling near the surface of the sediments is negligible (0.1% of duds and inert bullets or about 30 bullets). Treatment of explosive waste from the additional detonations would take place at NSWCDD, consistent with current operations. Biological simulants would be tested, but simulants proposed for use are common and found naturally in the environment. Biological simulants tests could be performed in combination with chemical simulants; there are no known synergistic interactions between the proposed types of biological organisms and low-toxicity chemical simulants. Ordnance, EM energy, HE laser, and chem/bio defense activities would have negligible, long-term, direct and indirect, negative impacts. PRTR use would have negligible, long-term, direct, negative impacts and no indirect impacts.

Resource	No Action Alternative	Alternative 1	Alternative 2
Geology, Topography, Soils & Sediments			
Geology, Topography, Soils and Sediments	Ordnance activities would have minor, long-term, direct, negative impacts on soils and sediments, based on localized disturbances to soil and sediments, and no direct or indirect impacts on geology or topography. EM energy, HE laser, and chemical defense activities would have negligible, short-term, direct impacts and no indirect impacts on geology, topography, soils, or sediments, as there would be minimal contact with these features. Use of boats during activities on the PRTR would have no direct impacts and negligible, long-term, indirect, negative impacts on geology, topography, soils, and sediments.	Same as No Action Alt.	Same as No Action Alt.
Water Resources			
Surface Water	RDT&E activities would have little contact with surface water resources and minimal potential to affect them. Low concentrations of MCs and simulants enter surface water with predicted concentrations below standard detection levels. Ordnance activities and PRTR use would have negligible, long-term, direct and indirect, negative impacts on surface waters. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Any incidental EM/laser energy would be quickly diminished by reflection, absorption, or scattering by water. Chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts. PRTR use would have negligible, long-term, direct and indirect, negative impacts on surface waters.	Same as No Action Alt. Naturally-occurring biosafety level (BSL)-1 organisms used in bio defense tests would not affect surface water.	Same as Alt 1.
Wetlands and	Ordnance and PRTR use would have no direct impacts and negligible, long-term,	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Floodplains	indirect, negative impacts on wetlands and floodplains. EM energy, HE laser, and chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	would not affect wetlands and floodplains.	
Groundwater	Ordnance activities would have no direct impacts and negligible, long-term, indirect, negative impacts on groundwater. EM energy, HE laser, chemical defense activities, and PRTR use do not contact groundwater and therefore would not directly or indirectly impact groundwater.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not enter the groundwater.	Same as Alt 1.
Potomac River Biological Resources			
Submerged Aquatic Vegetation (SAV)	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on SAV communities. Exposure concentrations of MCs and simulants are below levels that could cause adverse effects in aquatic organisms. EM energy, HE laser, and PRTR use would have negligible, short-term, direct, negative impacts and no indirect impacts on SAV. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect SAV.	Same as Alt 1.
Plankton	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on plankton communities. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Chemical defense and PRTR activities would have no direct impacts and negligible, short-term, indirect, negative impacts.	Same as No Action Alt.Naturally-occurring BSL-1 organisms used in bio defense tests would not affect plankton communities.	Same as Alt 1.
Aquatic Invertebrates	Ordnance, activities would have negligible, long-term, direct and indirect, negative impacts on aquatic invertebrate communities. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect	Same as No Action Alt.Naturally-occurring BSL-1 organisms used in bio defense tests would not affect aquatic invertebrate communities.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
	impacts. Chemical defense and PRTR activities would have no direct impacts and negligible, short-term, indirect, negative impacts.		
Fish	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on fish communities. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts. PRTR use would have negligible, short-term, direct and indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect fish communities.	Same as Alt 1.
Essential Fish Habitat (EFH)	The RDT&E activities conducted by NSWCDD on the PRTR may adversely affect EFH, but likely would result in minimal adverse effects on EFH, as the resulting changes to EFH and its ecological functions would be relatively small and insignificant. The National Marine Fisheries Service (NMFS) concurred that the proposed action would not substantially adversely affect EFH or habitat areas of particular concern. In accordance with NEPA, ordnance activities would have negligible, long-term, direct and indirect, negative impacts on EFH. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts on EFH. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts. PRTR use would have negligible, short-term, direct and indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect EFH.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Potomac River Birds			
Potomac River Birds	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on Potomac River birds. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. Chemical defense activities would have no direct impacts and negligible, short-term, indirect, negative impacts. PRTR use would have negligible, short-term, direct and indirect, negative impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect birds. .	Same as Alt 1.
NSF Dahlgren's Biological Resources			
Ponds, Streams, and Creeks	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on biological resources associated with NSF Dahlgren's ponds, streams, and creeks. Large-caliber guns are mostly fired into the river rather than at land targets; 90% of small arms are fired at targets on land that trap the bullets, but 10% are fired at targets in the water up to 4,000 yds out and end up in the river. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts, as most activities occur well away from ponds, streams, and creeks. Chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect ponds, streams, and creeks.	Same as Alt 1.
Vegetation	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's vegetation. HE laser, EM energy, and chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect vegetation.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Wildlife	Ordnance activities would have negligible, long-term, direct and indirect, negative impacts on NSF Dahlgren's wildlife. EM energy and HE laser activities would have negligible, short-term, direct, negative impacts and no indirect impacts. EM and laser corridors are checked for presence of wildlife before and during tests. Chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect wildlife.	Same as Alt 1.
Special Interest Areas (SIAs)	Ordnance, EM energy, HE laser, and chemical defense activities would have no direct or indirect impacts on biological resources associated with SIAs.	Same as No Action Alt/Biological defense activities would have no direct or indirect impacts on biological resources associated with SIAs.	Same as Alt 1.
Hunting and Fishing	Ordnance activities would have no direct impacts and negligible, long-term, indirect, negative impacts on hunting and fishing. EM energy, HE laser, and chemical defense activities would have negligible, short-term, direct, negative impacts and no indirect impacts. These activities have little or no spatial overlap with hunting and fishing areas.	Same as No Action Alt. Biological defense activities would have little or no spatial overlap with hunting and fishing areas.	Same as Alt 1.
Protected Species			
Fish	NMFS has provided concurrence in accordance with Section 7 of the Endangered Species Act (ESA) that existing RDT&E activities may affect, but are not likely to adversely affect the endangered shortnose sturgeon and Atlantic sturgeon. In accordance with NEPA, ordnance activities and PRTR use would have negligible, long-term, direct and indirect, negative impacts on the shortnose sturgeon and Atlantic sturgeon. EM energy, HE laser, and chemical defense activities would have no direct or indirect impacts.	Same as No Action Alt. Biological defense activities would have no direct or indirect impacts.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Sea Turtles	Ordnance use is more than 6.5 nautical miles above the lowest reach of the Potomac River where sea turtles (ESA-listed loggerhead, Kemp's ridley and green) are found seasonally. There is minimal spatial overlap between RDT&E activities conducted by NSWCDD on the PRTR and sea turtles using the lower Potomac River. NMFS has provided concurrence in accordance with Section 7 of the ESA that the baseline RDT&E activities impacts are considered to be insignificant or discountable, and may affect, but are not likely to adversely affect sea turtles. In accordance with NEPA, ordnance activities would have no direct and negligible, short-term, indirect negative impacts on sea turtles. EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.
Birds	Ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would not affect the birds protected by the Bald and Golden Eagle Protection Action (BGEPA), Migratory Bird Treaty Act (MBTA), Lacey Act, or the ESA. In accordance with NEPA, ordnance, EM energy HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on the bald eagle or other protected bird species.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.
Marine Mammals	There are no reasonably foreseeable takes of marine mammals associated with ordnance, EM energy, HE laser, chemical defense activities, and PRTR use in accordance with the MMPA. In accordance with NEPA, ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on marine	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
	mammals.		
Insects	The ESA-listed threatened northeastern beach tiger beetle is found on sandy beaches in the lowest reach of the Potomac River, but no RDT&E activities, inclusive of ordnance, EM energy, HE laser, and chemical defense activities, would take place near the shoreline of the LDZ. In accordance with Section 7 of the ESA, RDT&E activities would have no effect on listed insect species. In accordance with NEPA, ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on tiger beetles.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not affect the tiger beetle, and in any event, would not be released near the beaches on which they live.	Same as Alt 1.
Plants	A USFWS Virginia Field Office online project review of the Proposed Action determined that because suitable habitat exists for the ESA-listed sensitive joint-vetch in tidal wetlands within NSF Dahlgren, the Proposed Action may adversely affect the sensitive joint-vetch. However, based on site- and project-specific information, the No Action Alt would have no effect on this species. Even if the species occurs in tidal wetlands on the installation, it is unlikely to be present in the parts of the range used for ground-disturbing activities, because there is no suitable habitat in these areas. Further, the No Action Alt would not cause ground disturbance outside of existing target areas and other areas subject to recent and continuing disturbance. In accordance with NEPA, ordnance, EM energy, HE laser, chemical defense activities, and PRTR use would have no direct or indirect impacts on rare, threatened, or endangered plants.	Same as No Action Alt. Naturally-occurring BSL-1 organisms used in bio defense tests would not change the conclusions.	Same as Alt 1.

Resource	No Action Alternative	Alternative 1	Alternative 2
Cumulative Impacts			
Cumulative Impacts	The baseline RDT&E activities when combined with other past, present, and reasonably foreseeable future actions would have the potential for negligible or minor, but recoverable, negative impacts to the resources evaluated in this EIS.	Same as No Action Alt. The addition of biological defense activities would not change the conclusion.	Same as No Action Alt. The addition of biological defense activities alone or in combination with chemical defense activities would not change the conclusion.

ES.6 Protective Measures

In order to minimize the environmental impacts of current RDT&E activities, NSWCDD and NSF Dahlgren have developed environmental management processes, comprising the established NSWCDD Environmental Management System (EMS) and Safety Program, the NSF Dahlgren Comprehensive Work Approval Process, and protective measures. For the purposes of this EIS:

- *Protective measures* are actions taken by NSWCDD to protect sensitive resources, but that are not implemented in response to the impact findings of this EIS.
- *Mitigation measures* differ from protective measures in that they would be implemented specifically in response to the impact findings described in Chapter 4 of this EIS.

The protective measures already implemented for current No Action Alternative activities, which rely heavily on ongoing process improvements, would continue to be used as the means of mitigating environmental impacts for the Proposed Action alternatives. NSWCDD identifies environmental and safety risks for current No Action activities and responds with mitigation and protective measures based on experience from earlier RDT&E. Developing mitigation based on the projected risk when the RDT&E activity is being planned and then implementing these responsive measures when the activity takes place can effectively reduce the impact of the activity below that level at which the impact would be significant.

The impact findings summarized in Table ES-2 were determined in the context of the existing environmental management processes and protective measures that are integral to current and future NSWCDD RDT&E activities. Basically, mitigation is and would continue to be built into current activities and future activities under the Proposed Action. Because the protective measures in place reduce the impact of activities discussed in this EIS below the level at which the impact would be significant, no mitigation measures are necessary. NSWCDD is committed to applying the same processes used to mitigate safety and environmental impacts for current activities to all future activities under the No Action Alternative, and Alternatives 1 and 2. NSWCDD's Safety and Environmental Office is responsible for carrying out these processes for NSWCDD's current activities and would do so for future activities.

In order to minimize potential impacts, and consistent with NSWCDD's Environmental Policy and current environmental procedures, NSWCDD would include **general safety and environmental protective measures** in the planning and implementation of activities under the Proposed Action and ensure that:

- All activities proposed under the Proposed Action strictly adhere to all health, safety, and environmental protocols, including Risk Hazard Assessments (RHAs), SOPs or General Operating Procedures (GOPs) with associated Operation Procedures Supplements (OPSs) that cover RDT&E activities.
- All activities proposed strictly adhere to all safety zones – i.e., PRTR danger zones, Airfield Safety Zones and special-use airspace, explosive safety quantity distance (ESQD) arcs, unexploded ordnance (UXO) areas, EM hazard arcs, and laser safety buffer zones.

- Members of the public and personnel not involved in a test are excluded from ranges and the Mission Area prior to and during tests on the waters of the PRTR through the use of patrol boats and range restrictions and on land through the use of lookouts, road barriers, and signs.
- The Range Operations Center (ROC) in general notifies the public in advance of upcoming range activities through the Naval Surface Warfare Center Dahlgren Division (NSWCDD) website and a toll-free telephone recording. The information given includes daily range schedules, types of tests, use of substances such as smoke or lights, hours of testing, where on the PRTR tests will take place, whether tests are on schedule, whether noise will be made, and contact numbers to obtain more information.
- ROC notifies the public specifically of any activities that will restrict access within and from Upper Machodoc Creek or when any test is scheduled to take place before or after normal PRTR operating hours of 8 am to 5 pm weekdays. ROC notifies the public through NSWCDD's range website, its toll-free information line, and by placing notices in local newspapers.
- ROC coordinates with the operators of private vessels via the range control boats or marine radio to minimize delays when activities are taking place on the PRTR and public access to an operational area is restricted. ROC allows vessels to pass through the operational area on the PRTR during lulls in testing; delays for smaller craft are normally no longer than one-half hour, and, for larger vessels that must use the shipping channel in the middle of the range, are normally no longer than one hour (and in most cases, less than these times).
- Noise from an activity does not exceed the standards in the Outdoor Noise Management Process (NSWCDL, 2011, included as Appendix C). When there is a possibility that noise levels higher than policy standards may occur, mitigation measures are implemented to ensure that installation personnel and the public are not exposed to hazardous noise levels. Potential mitigation measures may include avoiding testing when weather conditions are likely to result in higher noise levels to avoid exposing the public to increased noise levels and/or single and double hearing protection for on-installation personnel conducting the testing.
- Impacts to wildlife during testing are avoided when possible or minimized. Before an activity begins, trained observers look for wildlife in the target area or test area, and alert operators if any are present. Either the test is postponed temporarily or the wildlife is startled within legally allowable means to encourage movement out of the area. Trained observers watch for wildlife that may move into the target area or operations area during tests, and the test is stopped while they clear the area. Dead animals are removed prior to tests on land to limit the chances of scavenging wildlife's entering the test area.
- Bald eagle protection zones around active bald eagle nests are respected during the planning and execution of test activities, and, as necessary, coordination with the US Fish and Wildlife Service (USFWS) and the Virginia Department of Game and Inland Fisheries (VDGIF) occurs.

- Testing of new ordnance and EM directed energy and HE laser equipment scales up gradually, and monitoring takes place to ensure that higher intensity levels do not generate impacts.
- Trees, shrubs, and taller grasses and herbaceous plants that grow in range and Mission Area operating areas and are obscuring lines-of-sight are trimmed prior to tests.

For **activity-specific protective measures** NSWCDD would ensure that for chem/bio defense activities under the Proposed Action:

- Weather conditions are monitored and simulant releases modeled before chem/bio simulant tests to ensure that simulant releases stay on ranges and the Mission Area.
- Simulant concentrations are monitored during and after releases to provide feedback for future modeling and to verify that modeled levels are not exceeded. The SOP includes the distance at which vapors and aerosols are diluted to a safe level based on the simulants and maximum quantities used. It also specifies that release point will be selected so that the simulant cloud must travel this distance before landfall.
- Simulant releases are spaced so that no land or water area would be exposed multiple times to the same simulant.
- Prior to each chem/bio operation, coordination takes place with the NSF Dahlgren Environmental and Safety Divisions, the Maryland Department of the Environment (MDE) and the Virginia Department of Environmental Quality (VDEQ), as applicable, concerning the types and quantities of simulants proposed for use.

In addition, NSWCDD is developing and will implement a new, formalized Project Environmental Review and Monitoring Process for ordnance, EM energy, HE laser, and chemical and biological defense projects under the Proposed Action. NSWCDD's Safety and Environmental Office will be responsible for carrying out the new process under the Environmental Management System (EMS). The Project Environmental Review and Monitoring Process will be integrated with the NSWCDD safety program and the NSF Dahlgren CWAP, and together with those processes will ensure that:

- All new proposed RDT&E projects either will be covered under the scope of this EIS or will have sufficient independent environmental planning (NEPA) documentation.
- New proposed RDT&E projects will incorporate all applicable protective measures, as agreed to in the EIS Record of Decision and other decision documents and authorizations.
- Ordnance, EM energy, HE laser, and chemical and biological defense activity tempos and intensities will be tracked and compared to those analyzed in this EIS.
- Protective measures will be implemented, the effectiveness of the measures to achieve desired environmental outcomes will be continually assessed, and measures will be reviewed, reconsidered, and revised as needed to increase their effectiveness.

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ACRONYMS AND ABBREVIATIONS

A	
AA	Anti-Aircraft
ac	acre(s)
ACGIH	American Conference of Governmental Industrial Hygienists
ACHP	Advisory Council on Historic Preservation
ACUB	Army Compatible Use Buffer
ADNL	A-weighted DNL
AET	Apparent Effects Threshold
AICUZ	Air Installations Compatible Use Zone
AOC	Area of Concern
APE	Area of Potential Effect
Army	Department of the Army
ASMFC	Atlantic States Marine Fisheries Commission
ASSRT	Atlantic Sturgeon Status Review Team
ATSDR	Agency for Toxic Substances and Disease Registry
AWQC	Ambient Water Quality Criteria
A/m	Ampere(s) per meter (magnetic field strength)

B	
B	Magnetic Flux Density
BA	Biological Assessment
BCC	Birds of Conservation Concern
BCF	Bioconcentration Factor
BGEPA	Bald and Golden Eagle Protection Act
B-IBI	Benthic Index of Biotic Integrity
BMP	Best Management Practices
BNOISE	DoD's Blast Noise Prediction Program
BNOISE2	DoD's large-caliber weapon-noise model
BPRF	Blossom Point Research Facility
BRAC	Base Closure and Realignment
BSL	Biosafety Level
BUORD	Bureau of Ordnance (historic)
bw	Body weight

C	
C	Speed of light in a vacuum (186,000 miles/s [299,792,458 m/s])
C3	Computer Control Center
CAA	Clean Air Act
CATEX	Categorical Exclusion
CBD	Chemical/Biological Defense
CBDP	Chemical and Biological Defense Program
CBP	Chesapeake Bay Program
CBPA	Chesapeake Bay Preservation Act (State of Virginia)
CCC	Criterion Continuous Concentration
CCD	Coastal Consistency Determination
CDC	Centers for Disease Control and Prevention
CDNL	C-weighted DNL
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CETFAC	Counter Explosive Test Facility
CFR	Code of Federal Regulations
CH_4	Methane
cm	centimeter(s)
cm^2	square centimeter(s)
CMC	Criterion Maximum Concentration
CNO	Chief of Naval Operations
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COC	Communities of Concern
COLPRO	Collective Protection
COMAR	Code of Maryland Regulations
COPC	Constituent(s) of Potential Concern
CRC	Chesapeake Research Consortium
CRI	Center for Research Information
CSEL	C-weighted sound exposure limit
CTR	Chesapeake Test Range
CWA	Clean Water Act
CWAP	Comprehensive Work Approval Process
CZMP	Coastal Zone Management Program
^oC	degrees Celsius

D	
dB	Decibel(s)
dBA	A-weighted decibel(s)
DBE	Dibasic Ether
dBC	C-weighted decibel(s)
dBP	Peak Decibel(s)
DC	District of Columbia
DDT	dichlorodiphenyl trichloroethane
DEA	Drug Enforcement Administration
DEEP	Diethyl Ethyl Phosphonate
DEIS	Draft Environmental Impact Statement
DEM	Diethyl Malonate
DEP	Diethyl Phthalate
DEWO	Directed Energy Warfare Office
DGS	Department of General Services (State of Maryland)
DHS	Department of Homeland Security
DMA	Dimethyl Adipate
DMMP	Dimethyl Methylphosphonate
DNL	Day-night average sound level
DO	Dissolved Oxygen
DoD	Department of Defense
DoN	Department of the Navy
DPGME	Dipropylene Glycol Methyl Ether
DPS	Distinct Population Segment
DRMO	Defense Reutilization and Marketing Office
DVP	Dominion Virginia Power
dw	dry weight

E	
E	Electric Field Strength
E3	Electromagnetic Environmental Effects
EA	Environmental Assessment
EC	Effective Concentration
EC50	Lowest Effect Concentration Threshold/Effect Concentration 50
EEA	Explosives Experimental Area
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EHW	Explosive Hazardous Waste
EIS	Environmental Impact Statement
EJ	Environmental Justice

ELMR	Estuarine Living Marine Resources
EM	Electromagnetic
EMF	Electromagnetic Field
EMI	Electromagnetic Interference
EMLF	Electromagnetic Launch Facility
EMREF	Electromagnetic Research and Engineering Facility
EMS	Environmental Management System
EO	Executive Order
EOD	Explosive Ordnance Disposal
ER	Environmental Restoration
ER-L	Effects Range – Low
ER-M	Effects Range – Median
ERP	Environmental Restoration Program
ESA	Endangered Species Act
ESRI	Environmental Systems Research Institute
ESQD	Explosive Safety Quantity Distance

F

f	Frequency
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FP	Federal Proposed
FE	Federal Endangered
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FGD	Flue Gas Desulfurization
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FS	Feasibility Study
FT	Federal Threatened
ft	foot/feet
ft/s	feet per second
ft/sec^2	feet per second per second
FW	Freshwater
°F	degrees Fahrenheit

G

G	Gauss
g	gram(s)
g/kg	grams per kilogram
GAA	Glacial Acetic Acid

gal(s)	gallon(s)
GARM	Groundfish Assessment Review Meeting
GEMS	Graphical Exposure Modeling System
GHz	gigahertz
GIS	Geographic Information System
GOP	General Operating Procedure
gpd	gallon(s) per day
gpm	gallon(s) per minute
GPS	Global Positioning System

H

H	Magnetic Field Strength
ha	hectare(s)
HAP	Hazardous Air Pollutant
HAPC	Habitat Area of Particular Concern
HARP	Historic and Archaeological Resource Protection
HE	High-energy
HERF	Hazards of Electromagnetic Radiation to Fuel
HERO	Hazards of Electromagnetic Radiation to Ordnance
HERP	Hazards of Electromagnetic Radiation to Personnel
HFC	Hydrofluorocarbon
HM	Hazardous Material(s)
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HMX-1	Marine Helicopter Squadron – 1
HPM	High-power Microwave
HQ	Hazard Quotient
hr	hour(s)
HRS	Hazard-Ranking System
HSDB	Hazardous Substances Data Bank
HSWA	Hazardous and Solid Waste Amendments to RCRA
HW	Hazardous Waste
Hz	Hertz

I

IBI	Index of Biotic Integrity
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICPRB	Interstate Commission on the Potomac River Basin
ICRMP	Integrated Cultural Resources Management Plan
IEEE	Institute of Electrical and Electronics Engineers
in	inch(es)
in/sec	inches per second

in/yr	inches per year
INRMP	Integrated Natural Resources Management Plan
IPCS	International Program on Chemical Safety
IR	Infrared
IRIS	Integrated Risk Information System

J

J	Current Density
JSLSCAD	Joint Service Lightweight Stand-off Chemical Agent Detector

K

kg	kilogram(s)
K_h	Henry's Law Constant
kHz	kilohertz
km	kilometer(s)
K_{ow}	Octanol-water Coefficient
kV	kilovolt(s)
kV/m	kilovolts per meter
kW	kilowatt(s)

L

lb(s)	pound(s)
LC	Lethal Concentration
LC0	Lethal Concentration Zero
LD	Lethal Dose
LD50	Lethal Dose Resulting in 50 Percent Mortality
LDZ	Lower Danger Zone, PRTR
LGAC	Laser-generated Air Contaminant
LOAEL	Lowest Observed Adverse Effect Level
LPPRP	Land Preservation, Parks, and Recreation Plan
LSRB	Laser Safety Review Board
λ	wavelength

M

m	meter(s)
MA	mega amps
MAFMC	Mid-Atlantic Fishery Management Council
MBTA	Migratory Bird Treaty Act
MC	Munitions Constituent
MCB	Marine Corps Base

MCOPC	Munitions Constituent of Potential Concern
MD	Maryland
MDE	Maryland Department of the Environment
MDNR	Maryland Department of Natural Resources
MdTA	Maryland Transportation Authority
MDZ	Middle Danger Zone, PRTR
MEMC	Military Expended Material Constituent(s)
MeS	Methyl Salicylate
mi	mile
MILCON	Military Construction
mg	milligram(s)
mgpd	millions of gallons per day
MGS	Maryland Geological Survey
mg/cm^2	milligrams per square centimeter
mg/kg	milligrams per kilogram
mg/l	milligrams per liter
mg/m^2	milligrams per square meter
mg/m^3	milligrams per cubic meter
MHT	Maryland Historic Trust
MHz	megahertz
MIDAS	Munitions Items Disposition Action System
MJ	megajoule
MK	Mark
ml	milliliter(s)
mlpd	millions of liters per day
mm	millimeter(s)
MMAP	Maryland Maritime Archaeology Program (Maryland Historic Trust)
MMD	mass median diameter
MMPA	Marine Mammal Protection Act
MOATS	Maginot Open Air Test Site
MPE	Maximum Permissible Exposure
mph	miles per hour
MPPRP	Maryland Power Plant Research Program
MR	Munitions Rule
MRI	Magnetic Resonance Imaging
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
mW	milliwatt(s)
MW	megawatt(s)
MWH	megawatt-hour(s)

m/s	meters per second
µg	microgram(s)
µg/kg dw	micrograms per kilogram dry weight
µg/l	micrograms per liter
µm	micrometer(s)
µs	microsecond(s)

N

N_2O	Nitrous Oxide
NA	Not Applicable or Not Available
NAAQS	National Ambient Air Quality Standards
NAS	Naval Air Station
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
Navy	Department of the Navy
NAWCAD	Naval Air Warfare Center, Aircraft Division
NAWMP	North American Waterfowl Management Plan
ND	Non-detect
NDEC	Navy Directed Energy Center
NDW	Naval District Washington
NEFMC	New England Fishery Management Council
NEPA	National Environmental Policy Act
NEW	Net Explosive Weight
NFPA	National Fire Protection Association
NHC	Naval Historical Center
NHHC	Naval History and Heritage Command
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NHZ	Nominal Hazard Zone
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
nm	nanometer(s)
NM	nautical mile(s)
NMBSC	Non-migratory Bird Species of Concern
NMFS	National Marine Fisheries Service
NMP	Noise Management Procedure
NO_2	Nitrogen Dioxide
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOB	Natural Oyster Bar
NOEC	No Observed Effect Concentration

NOHD	Nominal Ocular Hazard Distance
NOI	Notice of Intent
NOS	National Ocean Service
NOSSA	Naval Ordnance Safety and Security Activity
NOTAM	Notice to Airmen
NOTES	Naval Ordnance Transient Electromagnetic Simulator
NO_x	Oxides of Nitrogen
NPL	National Priority List
NPS	National Park Service
NRC	National Research Council
NRCS	Natural Resources Conservation Service
NRL	Naval Research Laboratory
NSDWS	National Secondary Drinking Water Standard
NSA	Naval Support Activity
NSF	Naval Support Facility
NSWC	Naval Surface Weapons Center / Naval Surface Warfare Center
NSWCDD	Naval Surface Warfare Center, Dahlgren Division
NSWCDL	Naval Surface Warfare Center, Dahlgren Division at Dahlgren
NTP	National Toxicology Program
NWI	National Wetland Inventory
ν	Frequency

O

O_3	Ozone
OB/OD	Open Burn/Open Detonation
ONR	Office of Naval Research
OPNAVINST	Chief of Naval Operations Instruction
OPS	Operation Procedures Supplement
ORC	Operational Range Clearance
ORM	Operational Risk Management
OSC	Operations Safety Committee
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
oz	ounce(s)

P

Pa	Pascal(s)
PAO	Public Affairs Office
Pb	Lead
PCBs	Polychlorinated Biphenyls

PEG	Polyethylene Glycol
PEL	Permissible Exposure Limit
PET	Polyethylene terephthalate
PFC	Perfluorocarbons
PFN	pulse forming network
pH	Potential of Hydrogen
P-IBI	Phytoplankton Index of Biotic Integrity
PIF	Partners in Flight
PIWG	Public Involvement Working Group
PK	peak sound pressure levels
PMMA	Polymethyl methacrylate
PM_{10}	Particulate Matter with Diameters up to 10 µm
$PM_{2.5}$	Particulate Matter with Diameters up to 2.5 µm
POTMH	Potomac Mesohaline
POTOH	Potomac Oligohaline
POTTF	Potomac Tidal Fresh
PPE	Personal Protective Equipment
ppm	parts per million
ppt	parts per thousand
PPV	peak particle velocity
PRFC	Potomac River Fisheries Commission
PRTR	Potomac River Test Range
PRTRC	Potomac River Test Range Complex
psi	pounds per square inch
PZ	Protection Zone

R	
R-134	1,1,1,2-tetrafluoroethane
R-152a	1,1-difluoroethane
RCA	Range Condition Assessment
RCRA	Resource Conservation and Recovery Act
RDT&E	Research, Development, Test And Evaluation
RDX	Royal Demolition Explosive (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
Redox	Reduction-oxidation reaction
RF	Radio Frequency
RFW	Radio-frequency Warfare
RHA	Risk Hazard Assessment
RI	Remedial Investigation
RMA	Resource Management Area
RMP	Range Management Plan
ROC	Range Operations Center

ROD	Record of Decision
ROPS	Range Operation Policy Statement
RPA	Resource Protection Area
RPMP	Real Property Master Plan
RSD	Range Safety Director
RSEPA	Range Sustainability Environmental Program Assessment
RSIP	Regional Shore Infrastructure Plan
RSSRA	Range-Specific Screening-Level Risk Assessment
R&D	Research and Development

S

S	Power Density
S_{eq}	Equivalent Plane Wave Power Density
s	second
SAFMC	South Atlantic Fishery Management Council
SAR	Specific Absorption Rate
SARA	Superfund Amendments and Reauthorization Act
SARC	Stock Assessment Review Committee
SARNAM	Small Arms Range Noise Assessment Model
SAV	Submerged Aquatic Vegetation
SAW	Northeast Regional Stock Assessment Workshop
SCL	Straight Carapace Length
SCP	Shorebird Conservation Plan
SCS	Soil Conservation Service
SE	State Endangered
SEL	Sound Exposure Level
SF_6	Sulfur Hexafluoride
SHPO	State Historic Preservation Office/Officer
SIA	Special Interest Area
SIP	State Implementation Plan
SIPS	Sound Intensity Prediction System
SO_2	Sulfur Dioxide
SOH	Safety and Occupational Health
SOP	Standard Operating Procedure
sq ft	square foot/feet
SQG	Small Quantity Generator
sq km	square kilometer(s)
sq m	square meter(s)
sq mi	square mile(s)
sq NM	square nautical mile(s)

SQuiRT	Screening Quick Reference Table
SRT	Status Review Team
ST	State Threatened
STEL	Short-term Exposure Limit
STSTS	Search and Track Sensor Test Site
SUA	Special-Use Airspace
SW	Saltwater
SWMU	Solid Waste Management Unit
SWP3	Stormwater Pollution Prevention Plan

T

T	Tesla
TEP	Triethyl Phosphate
TMDL	Total Maximum Daily Load
TNT	2,4,6-Trinitrotoluene
TRACON	Terminal Radar Approach Control
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TSS	Total Suspended Solids
TWA	Time-weighted Average

U

UAV	Unmanned Aerial Vehicle
UDZ	Upper Danger Zone, PRTR
UGV	Unmanned Ground Vehicle
UMS	Unmanned System
UNEP	United Nations Environmental Program
US	United States
USACE	United States Army Corps of Engineers
USACHPPM	United States Army Center for Health Prevention and Preventive Medicine
USAEC	United States Army Environmental Command
USAF	United States Air Force
USAG ALC	United States Army Garrison, Adelphi Laboratory Center
USBEA	United States Bureau of Economic Analysis
USBLS	United States Bureau of Labor Statistics
USC	United States Code
USCPSC	United States Consumer Product Safety Commission
USDOL	United States Department of Labor
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

USGS	United States Geological Survey
USHUD	United States Department of Housing and Urban Development
UST	Underground Storage Tank
USV	Unmanned Surface Vehicle
UV	Ultraviolet
UXO	Unexploded Ordnance

V

VA	Virginia
VAC	Virginia Administrative Code
VDCR	Virginia Department of Conservation and Recreation
VDEQ	Virginia Department of Environmental Quality
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
VDHR	Virginia Department of Historic Resources
VDNR	Virginia Department of Natural Resources
VEC	Virginia Employment Commission
VIMS	Virginia Institute of Marine Science
VLSTRACK	Vapor, Liquid, and Solid Tracking Model
VOC	Volatile Organic Compound
VPDES	Virginia Pollutant Discharge Elimination System
VR	Virginia Regulation
V/m	volts per meter (electric field strength)

W

W	watt(s)
wk	week(s)
W/kg	watt(s) per kilogram
W/m	watts per meter (electric)
WHO	World Health Organization
ww	Wet weight
WWI	World War I
WWII	World War II

Y

yd	yard(s)

Misc	
<	less than
≤	less than or equal to
>	greater than
≥	greater than or equal to