# FINDING OF NO SIGNIFICANT IMPACT (FONSI)

## NAME OF THE PROPOSED ACTION

Environmental Assessment (EA) Addressing Additional Simulants for Defense Threat Reduction Agency (DTRA) Testing at White Sands Missile Range (WSMR), New Mexico

## DESCRIPTION OF THE PROPOSED ACTION

DTRA prepared an EA to assess potential environmental consequences associated with continued collateral effects testing at the Permanent High Explosive Test Site (PHETS) at WSMR using five additional simulants to those analyzed and approved in the 2007 Programmatic Environmental Impact Statement (PEIS). The use of additional simulants would remain within the total volume, proposed test numbers, test site locations, and existing test bed infrastructure analyzed in the PEIS. The proposed additional simulants include diisopropyl methylphosphonate (also known as DIMP), diethyl ethylphosphonate (also known as DEEP), 2-chloroethyl phenyl sulfide (also known as CEPS), *bacillus thuringiensis* (strain Al Hakam) (also known at BtAH), and ethylene (also known as ethene). Like the original simulants, all collateral effects tests using the five additional simulants would occur when meteorological conditions, such as precipitation and wind direction and speed, are suitable for testing so that the airborne plume and surface deposition areas would be minimized and directed in the desired direction. All testing would occur when no precipitation is predicted; the prevailing wind direction is to the southeast, which would direct the airborne plume and surface deposition areas away from any populations; and wind speeds are no greater than 15 miles per hour. Up to 16 tests per year are permitted for each test material. Each test could include up to 500 mini-release events, ranging from use of micrograms of material up to 15 gallons for a total of 500 gallons per event for non-explosive events. Explosive events can contain up to 4,000 gallons. Simulant tests by DTRA on WSMR do not occur at regular intervals because different types of tests require different preparations.

DOD aims to minimize inadvertent harming of non-military personnel or property after the destruction of a weapon of mass destruction (WMD) target, or collateral effects, by analyzing and using data on simulant plumes obtained during tests at WSMR. Collateral effects also includes impacts from the use of weapon systems on physical property such as military equipment, vehicles, telephone poles, signs, office equipment, and other infrastructure and facilities. During testing, these items are often placed near the intended impact point to obtain damage and durability information. The proposed simulants have been selected for evaluation in the EA because they have physical and chemical characteristics similar to those of chemical and biological agent materials, but are non-hazardous or less hazardous to humans and the environment. The dispersal patterns of the proposed simulants would be used to predict the behavior of WMD with similar properties.

Mitigation and monitoring activities described in the 2007 PEIS are applicable to all tests that utilize the proposed additional simulants. These include ensuring personnel involved in collateral effects testing continue to be adequately trained, using spill containment measures on the ground for simulants used inside test structures and dispersed from unconfined containers, and considering wind direction and velocity when conducting tests to ensure plume movement is toward approved areas within WSMR boundaries. Prediction modeling would continue to be accomplished prior to each test event involving the use of simulants. These predictions assist in determining the fallout areas, or areas of high concentrations of materials. Spill containment, such as plastic sheeting, would continue to be placed on the ground in the vicinity of the test area where heavy fallout or pooling is predicted to occur. Depending on the type of collateral effects test being conducted, spill containment with residual materials is collected at the end of the day or at the conclusion of each test event. This requirement would be included in the Record of Environmental Consideration for each test event/series. Modeling performed in conjunction with the development of this EA was used as the basis for any changes or additions to previously described mitigation and monitoring actions. The DTRA Hazard Prediction and Assessment Capability computer model was used for air dispersion modeling.

The proposed list of simulants that DTRA would potentially release during testing at WSMR would be added to the list of materials already authorized on the WSMR simulant testing operations license issued by the U.S. Army Development Test Command. DTRA would continue to monitor groundwater and soils annually to ensure that the additional simulants have no effect on the environment. Samples would be taken of groundwater for monitoring wells in the area and soils would be sampled near test structures.

Three sizes of tests based on the simulant quantities were evaluated in the EA: 1) small tests would use up to 1 gallon of simulant; 2) mid-size tests would be up to 500 gallons; and 3) large scale tests would be above 500 gallons. The current simulant license limits DTRA to 4,000 gallons of simulant material. The largest amount of simulant released in a single test by DTRA was conducted using 3,000 gallons in the late 1990s.

**PURPOSE AND NEED**

The purpose of the Proposed Action is to provide an expanded range of simulants for testing to allow for better analysis of real-world chemical and biological threats. The Proposed Action is needed to improve response capabilities to enemy chemical and biological threats.

The EA addressing additional simulants for DTRA testing at WSMR, New Mexico, attached hereto and incorporated herein, analyzes the potential impacts of implementing the use of additional chemical and biological simulants in DTRA's collateral effects testing at PHETS. The EA considers all potential impacts of the Proposed Action, Reduced Simulant Quantity Alternative, and the No Action Alternative. The EA also considers cumulative environmental impacts with other projects within the Region of Influence.

**ENVIRONMENTAL CONSEQUENCES**

The EA contains the results of an impact analysis of the Proposed Action, Reduced Simulant Quantity Alternative, and No Action Alternative on the affected environment, including air quality, water resources, biological resources, hazardous materials and wastes, and occupational health and safety. No significant impacts on the environment have been identified for the use of five additional simulants in collateral effects testing at PHETS and no significant cumulative impacts are expected.

**CONCLUSION**

In accordance with the guidelines for determining the significance of proposed federal actions (40 Code of Federal Regulations [CFR] § 1508.27), Department of Defense Instruction 4715.9, and 32 CFR § 651, DTRA and WSMR have concluded that the use of five additional simulants in collateral effects testing at PHETS will not result in a significant environmental impact, either by itself or cumulatively, with other known projects. After careful and thorough consideration of the facts contained herein, the undersigned find that the proposed federal action is consistent with existing national environmental policies and objectives as set forth in Section 101 of the National Environmental Policy Act and other applicable requirements and will not significantly affect the quality of the human environment.

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| SHERRY J. DAVIS<br>DIR, Environmental, Safety, and Health<br>Defense Threat Reduction Agency | Date |

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| DAVID C. TRYBULA<br>Brigadier General<br>Commanding, White Sands Missile Range | Date |

Attachment: *Environmental Assessment Addressing Additional Simulants for Defense Threat Reduction Agency at White Sands Missile Range, New Mexico*.

Final

# Environmental Assessment

## Addressing Additional Simulants for Defense Threat Reduction Agency Testing

White Sands Missile Range, New Mexico

*Prepared for:*

Defense Threat Reduction Agency
U.S. Strategic Command Center for
Combating Weapons of Mass Destruction
Kirtland AFB, NM 87117

*Prepared by:*

U.S. Army Corps of Engineers,
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Approved for public release; distribution unlimited.

November 2020

***U.S. ARMY WHITE SANDS MISSILE RANGE***
***WHITE SANDS MISSILE RANGE, NEW MEXICO 88002-5048***
***ENVIRONMENTAL ASSESSMENT***

**Title:** ENVIRONMENTAL ASSESSMENT ADDRESSING ADDITIONAL SIMULANTS FOR DEFENSE THREAT REDUCTION AGENCY TESTING AT WHITE SANDS MISSILE RANGE, NEW MEXICO

PROPONENT:

DAVIS.SHERRY.J.1105036910 Digitally signed by DAVIS.SHERRY.J.1105036910 Date: 2020.12.11 10:09:40 -05'00'

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DIR, Environmental, Safety, and Health
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M. RYAN HOWELL — Date
Colonel, U.S. Army
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DAVID R. CHENEY — Date
Colonel, AV
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APPROVED:

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DAVID C. TRYBULA — Date
Brigadier General
Commanding

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# Acronyms and Abbreviations

| | |
|---|---|
| AEGL | Acute Exposure Guideline Level |
| APHC | Army Public Health Center |
| BGEPA | Bald and Golden Eagle Protection Act |
| BLM | Bureau of Land Management |
| BMP | best management practice |
| Bt | *Bacillus thuringiensis* |
| BtAH | *Bacillus thuringiensis* (strain Al Hakam) |
| CDC | Center for Disease Control |
| CEPS | 2-chloroethyl phenyl sulfide |
| CEQ | Council on Environmental Quality |
| CFR | Code of Federal Regulations |
| CO | carbon monoxide |
| DEEP | diethyl ethylphosphonate |
| DIMP | diisopropyl methylphosphonate |
| DOD | Department of Defense |
| DTRA | Defense Threat Reduction Agency |
| EA | Environmental Assessment |
| EIS | Environmental Impact Statement |
| EO | Executive Order |
| ERPG | Emergency Response Planning Guideline |
| ESA | Endangered Species Act |
| FONSI | Finding of No Significant Impact |
| ft | feet |
| HPAC | Hazard Prediction and Assessment Capability |
| HCS | Hazard Communication Standard |
| IMA | isopropyl-methylphosphonic acid |
| IPaC | Information for Planning and Consultation |
| $LD_{50}$ | lethal dose 50 |
| m | meter(s) |
| MBTA | Migratory Bird Treaty Act |
| mg/kg | milligrams per kilogram |
| mg/L | milligrams per liter |
| $mg/m^2$ | milligram per square meter |
| $mg/m^3$ | milligram per cubic meter |
| mph | miles per hour |
| NEPA | National Environmental Policy Act |
| OSHA | Occupational Safety and Health Administration |
| PAC | Protective Action Criteria |
| PEIS | Programmatic Environmental Impact Statement |
| PHETS | Permanent High Explosive Test Site |
| POL | petroleum, oils, and lubricants |
| PPE | personal protective equipment |
| PPM | parts per million |
| RCRA | Resource Conservation and Recovery Act |
| RMP | Resource Management Plan |
| ROI | region of influence |
| SDS | Safety Data Sheet |
| SOI | species of interest |
| SOP | standard operating procedure |
| TDS | total dissolved solids |
| TEEL | Temporary Emergency Exposure Limit |
| µg/L | micrograms per liter |
| USC | United States Code |
| USEPA | U.S. Environmental Protection Agency |
| USFWS | U.S. Fish and Wildlife Service |
| UXO | unexploded ordnance |
| WIT | Warhead Impact Target |
| WMD | weapons of mass destruction |
| WSMR | White Sands Missile Range |

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# 1 Introduction

This Environmental Assessment (EA) describes the potential environmental effects of the proposed use of additional chemical and biological simulants by the Defense Threat Reduction Agency (DTRA) at White Sands Missile Range (WSMR), New Mexico. This EA assesses the impacts of DTRA utilizing additional simulants not approved in the 2007 Record of Decision for the Programmatic Environmental Impact Statement (PEIS) for DTRA Activities on WSMR, a U.S. Army installation (DTRA 2007a).

This EA is being prepared in compliance with the National Environmental Policy Act (NEPA) of 1969 as amended (42 United States Code [USC] §§ 4321-4370d), the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 Code of Federal Regulations [CFR] §§ 1500–1508), Department of Defense (DOD) Instruction 4715.9, *Environmental Planning and Analysis*, and the Department of the Army's *Environmental Analysis of Army Actions* (32 CFR § 651).

## 1.1 Background

WSMR is located in south-central New Mexico encompassing 2,048,000 acres in the five counties of Doña Ana, Socorro, Lincoln, Otero, and Sierra (see **Figure 1-1**). DTRA's Permanent High Explosive Test Site (PHETS) occupies 22,000 acres in the northern portion of WSMR and lies mostly within the boundaries of the 49,602-acre Trinity National Historic Landmark. Most test activities at PHETS take place in three test beds that cover a smaller area of approximately 5,246 acres.

PHETS is located west of the Oscura Mountains in the alluvial plain of the northern Jornada del Muerto, a closed basin. The overall topography at PHETS is nearly level with a very gentle westward slope. Elevation ranges from 4,652 feet (ft) in the Intermediate Test Bed to 5,098 ft at the southern end of the site. The area has historically been used for high explosive tests, bombing, and missile impacts since the creation of WSMR in the 1940s. The Trinity Site was the location of the first atomic bomb test conducted 16 July 1945 (WSMR 2015a).

PHETS is used for high explosive events and tests to evaluate the effectiveness of various weapon systems against hardened targets. Collateral effects resulting from the release of chemical and biological agents after target defeat are also evaluated at PHETS using simulants and taggants (materials used to track the path of simulant plumes through the air).

DTRA was established in 1998 to assist in safeguarding the United States and its allies from weapons of mass destruction (WMD). DTRA and its predecessor agencies, the Defense Nuclear Agency and the Defense Special Weapons Agency, have operated and maintained testing sites and related infrastructure at WSMR since 1976. DTRA maintains several test beds and target types at WSMR to support DOD and other federal agencies, as well as friendly nations' programs to counter proliferation of WMD. DTRA facilities are specialized areas within WSMR, and the PHETS area would be used to implement the Proposed Action (see **Figure 1-1**).

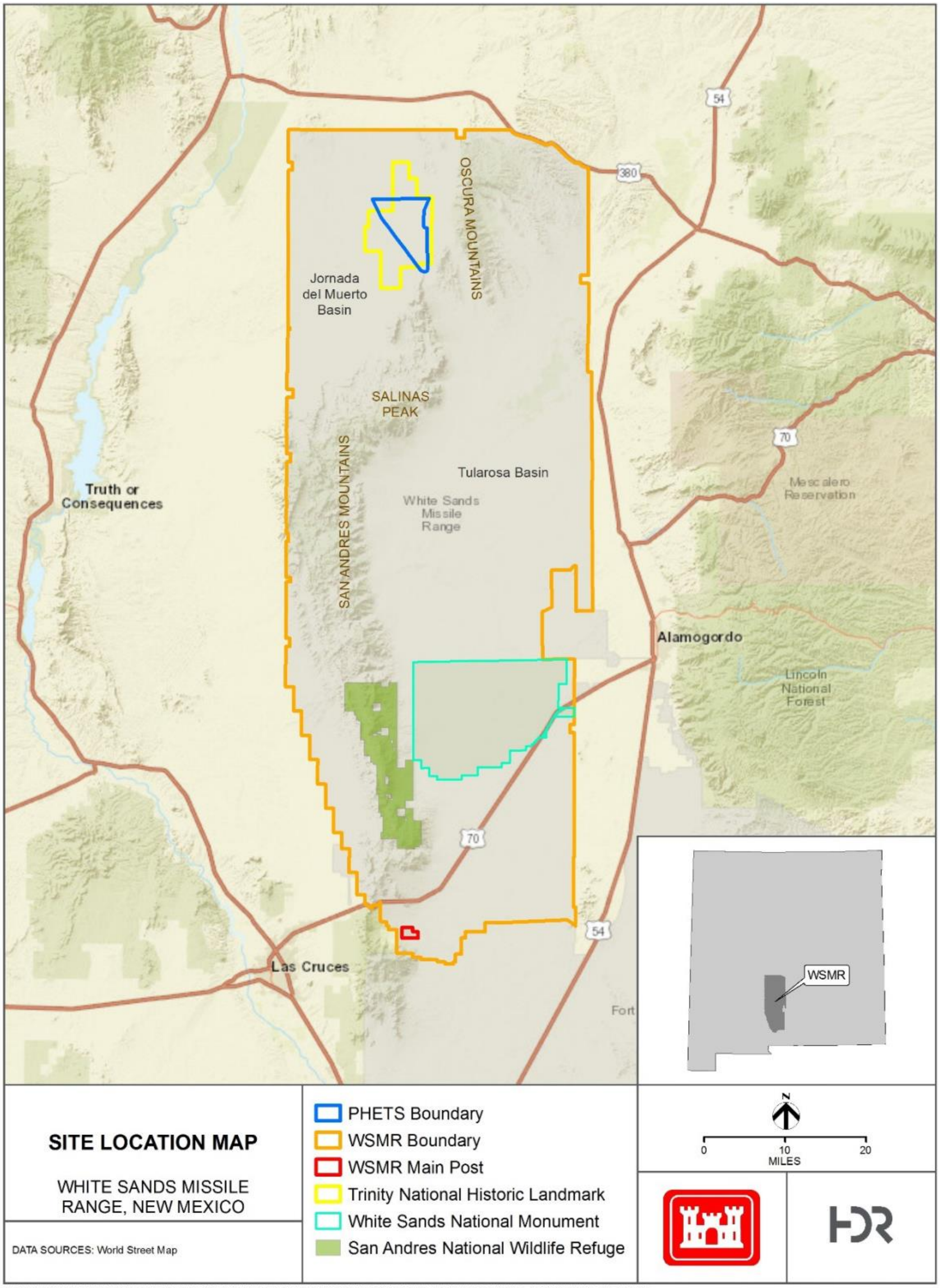


Figure 1-1. Site Location Map

DTRA maintains several different target types (including generic WMD underground and aboveground structures) on its test beds and directs the development and implementation of new weapons technologies against these targets. To evaluate weapon defeat capabilities and advance sensor development for WMD agents, simulant test materials are used that have similar characteristics to the agent materials, but are non-hazardous or less hazardous than WMD agents. When a mock WMD facility that contains simulants is destroyed, the airborne simulant plume is tracked and analyzed to obtain models for the behavior of actual WMD plumes.

This EA describes the use of additional chemical simulants at the PHETS. Use of these additional simulants would fall within the timeframe, location, and level of testing previously addressed by the 2007 PEIS for DTRA activities on WSMR (DTRA 2007b). The PEIS covered nine categories of testing. The Proposed Action falls entirely within the category of collateral effects testing using simulant materials.

## 1.2 Purpose and Need of the Proposed Action

The purpose of the Proposed Action is to provide an expanded range of simulants for testing to allow for better analysis of real-world chemical and biological threats. The Proposed Action is needed to improve response capabilities to enemy chemical and biological threats.

## 1.3 Regulatory Compliance

This EA assesses the potential environmental impacts of implementing the use of additional chemical and biological simulants in DTRA's collateral effects testing at PHETS. Based on an examination of the data generated and an assessment of the magnitude of the potential impacts, a determination will be made whether an Environmental Impact Statement (EIS) is required, or if a Finding of No Significant Impact (FONSI) is sufficient.

DTRA and WSMR served as the lead agencies in preparing the EA. As the tenant conducting the Proposed Action, DTRA possesses the expertise to conduct a collateral effects testing program into which it would incorporate the additional simulants. As the federal landowner, WSMR possesses both jurisdiction by law and special expertise on the environmental resources within and adjacent to WSMR. In addition to previously mentioned guidelines, this EA was also prepared in compliance with all applicable federal statutes, regulations, and executive orders (EOs), as amended, including the following:

- Clean Air Act (42 USC § 7401 et seq.)
- Clean Water Act (33 USC § 1251 et seq.)
- Endangered Species Act (ESA) (16 USC § 1531 et seq.)
- Fish and Wildlife Coordination Act (48 Stat. 401; 16 USC § 661 et seq.)
- Bald and Golden Eagle Protection Act (BGEPA) (16 USC § 668 et seq.)
- Migratory Bird Treaty Act (MBTA) (16 USC § 703, et seq.)
- EO 13751, Safeguarding the Nation from the Impacts of Invasive Species

- National Historic Preservation Act, as amended (54 USC § 300101 et seq.)
- Archaeological Resources Protection Act (16 USC § 4701 et seq.)
- Native American Graves Protection and Repatriation Act (25 USC § 3001 et seq.)
- Occupational Safety and Health Act (29 USC § 651 et seq.)
- Pollution Prevention Act (42 USC § 13101 et seq.)
- Resource Conservation and Recovery Act (RCRA) (42 USC § 6901 et seq.)
- Solid Waste Disposal Act (42 USC § 82)
- EO 11593, Protection and Enhancement of the Cultural Environment
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations.

## 1.4 Related Environmental Documentation

NEPA guidelines encourage federal agencies to use programmatic NEPA reviews and to tier off existing programmatic NEPA documentation, when appropriate. Tiering refers to the "coverage of general matters in broader NEPA documents with subsequent narrower statements or environmental analyses incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared" (40 CFR § 1508.28). This means that when a broad programmatic EA or EIS has been prepared, any subsequent EIS or EA on an action included within the entire program or policy (particularly a programmatically addressed site-specific action) need only summarize issues discussed in the broader statement and concentrate on the issues specific to the subsequent action. Tiering allows the agencies to summarize the overall scope and impacts based on the programmatic analysis and to focus on the key issues for a specific project or aspect of a new Proposed Action at each appropriate level of project review. This level of analysis eliminates repetitive discussions of the same issues.

As pertinent to this EA, the term "programmatic NEPA review" encompasses the review of broad actions undertaken previously by DTRA and WSMR in the 2007 PEIS, which comprehensively addressed proposed DTRA activities at WSMR. The PEIS addressed the broad issues of collateral effects testing at PHETS and the potential impacts to physical, biological, and cultural resources. The evaluation of impacts concluded that there would be no significant impacts as a result of collateral effects testing at PHETS.

The 2007 PEIS noted that unknown materials (i.e., chemical or biological simulants) not included in the PEIS could be used in future collateral effects testing. The 2007 PEIS stated that such materials would be evaluated under subsequent NEPA documentation prior to testing to ensure they are covered by approved environmental documents or new environmental documentation would be prepared. This EA is tiered off the 2007 PEIS and is being prepared to address the use of additional chemical and biological simulants.

In addition to the 2007 PEIS, previous NEPA documentation that address DTRA activities at PHETS includes the following:

- **EA for Long-Term High Explosive Testing at WSMR: PHETS** (1987). This document established PHETS as a test site for large scale high explosive testing.
- **Addendum to the EA for Long-Term High Explosive Testing at WSMR PHETS** (1995). This document evaluated the testing of air-delivered munitions and ground-based projectiles at PHETS.
- **Programmatic EA for PHETS and Bedrock Penetration Test Sites at WSMR** (DTRA 2002). This document linked PHETS, Seismic Hardrock In-Situ Test, and Alternate Seismic Hardrock In-Situ Test sites together to allow more flexibility to the test parameters than were covered in the previous NEPA documents. The Programmatic EA addressed current testing as well as predicted future testing.
- **Final EIS for Development and Implementation of Range-Wide Mission and Major Capabilities at WSMR** (WSMR 2010). This Final EIS provided range-wide information including land use and analysis of current environmental conditions.

## 1.5 Agency Coordination/Consultation and Public Participation

EO 12372, Intergovernmental Review of Federal Programs, as amended by EO 12416 with the same title, requires federal agencies to provide opportunities for consultation with officials of state and local governments that could be affected by a federal proposal. Through the interagency/intergovernmental coordination process, DTRA will coordinate with WSMR in notifying relevant federal, state, and local agencies, tribes, and officials of the Proposed Action and alternatives and provide them with sufficient time to make known their environmental concerns specific to the action. The process will also provide DTRA and WSMR with the opportunity to consult with and consider state and local views and processes in implementing the federal proposal. This EA will be distributed to the agencies to be identified in **Appendix A** as part of interagency/intergovernmental coordination. Agency coordination responses received from these agencies will also be included in **Appendix B**.

***Consultations for Cultural Resources.*** NEPA requires consideration of impacts on cultural resources (40 CFR § 1508.8). Section 106 of the National Historic Preservation Act defines the responsibility of federal agencies to protect historic properties and requires federal agencies to take into account the effects of their undertakings on historic properties in accordance with 36 CFR § 800. Cultural resources may also be covered by state, local, and territorial laws. To comply with legal mandates, DTRA and WSMR will consult with the New Mexico State Historic Preservation Office regarding the Proposed Action. Consultation will occur in accordance with the terms outlined in the DTRA/WSMR Agreement. Consultation materials will be included in **Appendix C**.

***Government-to-Government Tribal Consultation.*** In accordance with EO 13175, *Consultation and Coordination with Indian Tribal Governments*, DTRA and WSMR will consult with the federally recognized Native American tribes to be identified in **Appendix C.** DTRA and WSMR, in consultation with the Native American tribes, will determine whether the Proposed

Action would potentially affect Native American properties of cultural, historical, or religious significance, and consultation materials will be included in **Appendix C**.

***Consultations for Threatened and Endangered Species.*** NEPA also requires consideration of impacts on natural resources (40 CFR § 1508.8), which include protected wildlife and plant species and their habitats. The ESA aims to conserve, protect, and restore threatened and endangered plants and animals and their habitats. All federal agencies must ensure any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of an endangered or threatened species or result in the destruction of critical habitat for these species, unless the agency has been granted an exemption. Section 7 of the ESA establishes a consultation process with the U.S. Fish and Wildlife Service (USFWS) to determine the potential for effects a federal action might have on federally listed species and designated critical habitats. To comply with legal mandates, DTRA and WSMR will consult, as necessary, with USFWS to determine whether the proposed undertakings would potentially affect federally listed species and designated critical habitats. Consultation will occur in accordance with the terms outlined in the DTRA/WSMR Agreement. Appropriate consultation materials will be included in **Appendix C**.

***Public Involvement.*** In addition to government agency involvement, NEPA requirements help ensure that environmental information is made available to the general public during the decision making process and before actions are taken. The premise of NEPA is that the quality of federal decisions is enhanced if proponents provide information to the public and involve the public in the planning process.

The public will be provided with the opportunity for review and comment on the Draft EA during a 30-day comment period prior to a final decision being made on the action. The Draft EA and FONSI will be posted on the WSMR Garrison Publication website under Environmental Documents at https://www.wsmr.army.mil/gar/GarrisonPublications/Pages/default.aspx. A notice of availability of the Draft EA and FONSI will be published in the Albuquerque Journal at the start of the comment period. Public input will be taken in the form of written comments. Hard copies of the Draft EA and FONSI will be available by request. All public comments will be included in **Appendix B** of the Final EA, along with the response to each comment received. Once the Final EA is complete, a notice for the Final FONSI will be published in the Albuquerque Journal as appropriate.

# 2 Description of the Proposed Action and Alternatives

## 2.1 Proposed Action (Preferred Alternative)

Under the preferred alternative, DTRA would continue collateral effects testing at PHETS (see **Figure 2-1**) using five additional simulants to those analyzed and approved in the 2007 PEIS. The use of additional simulants would remain within the total volume, proposed test numbers, test site locations, and existing test bed infrastructure analyzed in the PEIS. Like the original simulants, all collateral effects tests using the five additional simulants would occur when meteorological conditions, such as precipitation and wind direction and speed, are suitable for testing so that the airborne plume and surface deposition areas would be minimized and directed in the desired direction. All testing would occur when no precipitation is predicted; the prevailing wind direction is to the southeast, which would direct the airborne plume and surface deposition areas away from any populations; and wind speeds are no greater than 15 miles per hour (mph). Up to 16 tests per year are permitted for each test material; historically DTRA has conducted tests on average four times a year (DTRA 2007b). Each test could include up to 500 mini-release events, ranging from use of micro-grams of materials up to 15 gallons for a total of 500 gallons per event for non-explosive events. Explosive events can contain up to 4,000 gallons. Simulant tests by DTRA on WSMR do not occur at regular intervals because different types of tests require different preparations.

DOD aims to minimize inadvertent harming of non-military personnel or property after the destruction of a WMD target, or collateral effects, by analyzing and using data on simulant plumes obtained during tests at WSMR. Collateral effects also includes impacts from the use of weapon systems on physical property such as military equipment, vehicles, telephone poles, signs, office equipment, and other infrastructure and facilities. During testing, these items are often placed near the intended impact point to obtain damage and durability information. The proposed simulants have been selected for evaluation in the EA because they have physical and chemical characteristics similar to those of chemical and biological agent materials, but are non-hazardous or less hazardous to humans and the environment. The dispersal patterns of the proposed simulants would be used to predict the behavior of WMD with similar properties.

The weapons and delivery systems used would be consistent with those described in the 2007 PEIS and would include munitions delivered by aircraft, unmanned aerial vehicles, surface-to-surface weapon systems, and statically detonated explosive testing for target lethality. Alternative means to disperse the simulant materials and create airborne plumes could include releases from airplanes and non-explosive air guns used to release simulant materials directly over test beds.

Targets could be either hardened or thin-skinned. Hardened targets include buried or partially buried concrete-and-earth reinforced bunkers, structures buried deep beneath the surface, and structures recessed within granite or other resilient bedrock. Thin-skinned targets simulate industrial facilities that could be converted to chemical/biological weapon production facilities. These targets are typically beam-sheet steel structures on a concrete slab.

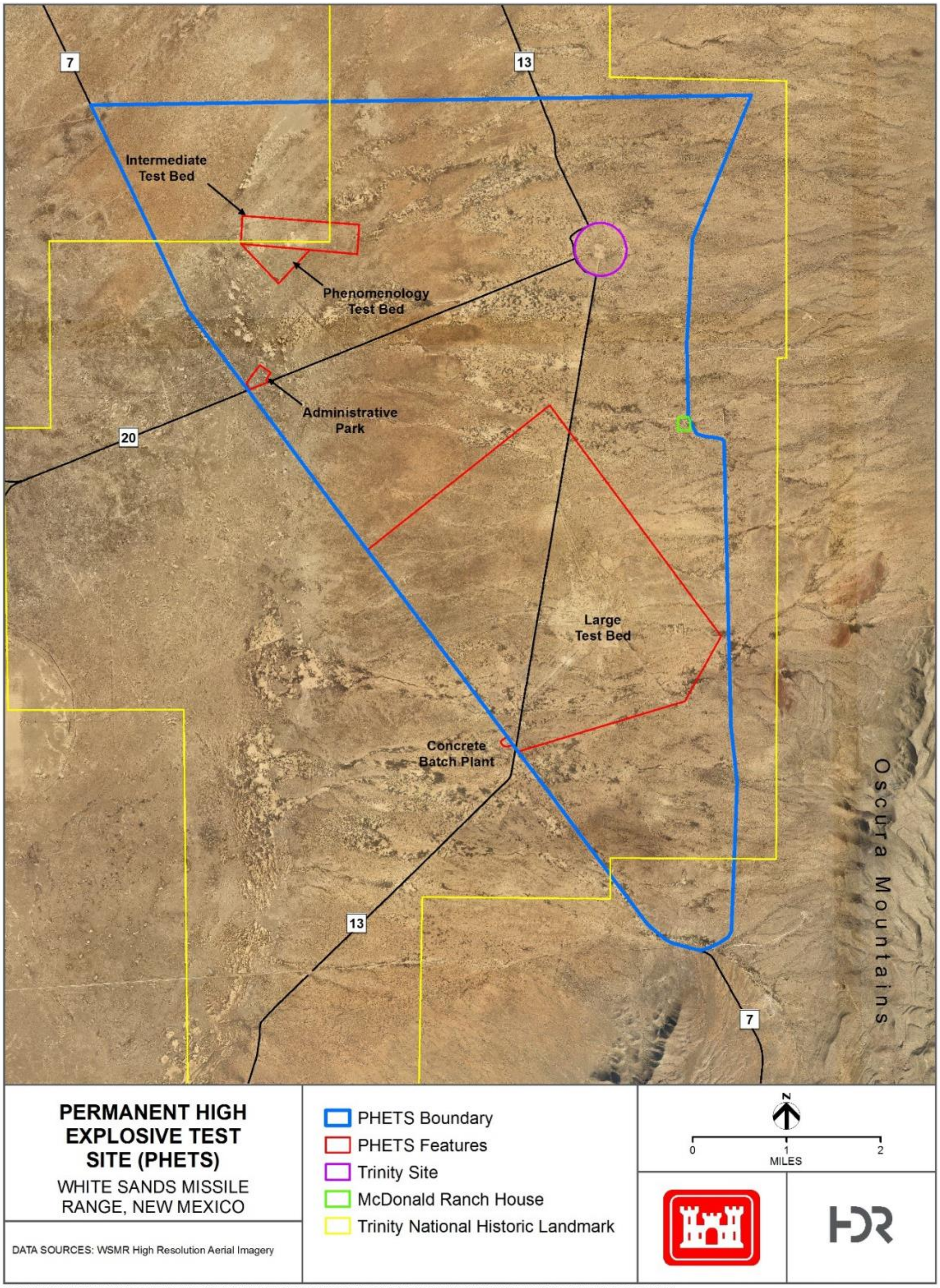


**Figure 2-1. Detailed Map of PHETS Site**

Mitigation and monitoring activities described in the 2007 PEIS are applicable to all tests that utilize the proposed additional simulants. These include ensuring personnel involved in collateral effects testing continue to be adequately trained, using spill containment measures for simulants used inside test structures and dispersed from unconfined containers, and considering wind direction and speed when conducting tests to ensure plume movement is toward approved areas within WSMR boundaries. Prediction modeling using the DTRA Hazard Prediction and Assessment Capability (HPAC) computer model would continue to be accomplished prior to each test event involving the use of simulants. These predictions assist in determining the fallout areas, or areas of high concentrations of material. Spill containment, such as plastic sheeting, would continue to be placed on the ground in the vicinity of the test area where heavy fallout or pooling is predicted to occur. Based on the area and size of the predicted fallout areas, blading of the area may be accomplished prior to the placement of spill containment. Depending on the type of collateral effects test being conducted, spill containment with residual material is collected at the end of the day or at the conclusion of each test event. This requirement would be included in the Record of Environmental Consideration for each test event/series. Modeling performed in conjunction with the development of this EA was used as the basis for any changes or additions to previously described mitigation and monitoring actions. Data provided in the HPAC computer model was used to assist in the development of air dispersion modeling used in this analysis.

The proposed list of simulants that DTRA would potentially release during testing at WSMR would be added to the list of materials already authorized on the WSMR simulant testing operations license issued by U.S. Army Developmental Test Command. The additional simulants include the following:

- Diisopropyl methylphosphonate (also known by the names DIMP, diisopropyl methane-phosphonate, phosphonic acid, and methyl-bis-(1-methyl-esthyl)-ester). DIMP is a colorless liquid that is a by-product resulting from the manufacture of Sarin gas (ATSDR 1999).
- Diethyl ethylphosphonate (also known by the name DEEP). DEEP is a colorless liquid with a mild odor (NOAA CAMEO undated).
- 2-chloroethyl phenyl sulfide (CEPS). Chemical simulant for bis (2-chloroethyl) sulfide (also known as mustard agent) (Millipore Sigma 2018a).
- *Bacillus thuringiensis* (strain Al Hakam) (BtAH). BtAH is a common soil bacteria used as a biological simulant. This particular strain is not commercially available and has had the enzyme removed so that it is ineffective as an insecticide (Ibrahim et al. 2010).
- Ethylene (also known as ethene). Ethylene is a colorless flammable gas that is one of the largest volume organic chemicals produced globally. Ethylene is the building block for many chemicals and is used to control ripening of fruit (Dow 2014).

Three sizes of tests based on the simulant quantities are being evaluated in this EA: 1) small tests would use up to 1 gallon of simulant; 2) mid-size tests would be up to 500 gallons; and 3) large scale tests would be above 500 gallons. The current simulant license limits DTRA to 4,000 gallons of simulant material. The largest amount of simulant released in a single test by DTRA was conducted using 3,000 gallons in the late 1990s.

The use of DIMP and *Bacillus thuringiensis* (Bt) were considered for use at WSMR in the 2007 PEIS. DIMP is being reconsidered in this EA because new testing has indicated it is not as toxic as previously believed (APHC 2018). The 2007 PEIS determined that Bt is generally not hazardous to humans. The particular strain of Bt being considered in this EA, BtAH, has had the enzyme removed making it ineffective as an insecticide.

As a conservative approach for impact analysis, maximum airborne plumes and surface deposition areas associated with three of the five additional simulants were modeled using the DTRA HPAC computer model. Two of the simulants under the Proposed Action, BtAH and ethylene, are not considered hazardous; therefore, these simulants did not undergo air dispersion modeling. HPAC computer models were developed using the following four scenarios: 1) confined (hardened) tests using 4,000 gallons of simulants, 2) confined tests using 500 gallons of simulants, 3) unconfined (thin-skinned) tests using 990 gallons of simulant, and 4) unconfined tests using 495 gallons of simulant. Each scenario was run at three different wind speeds (5, 15, and 25 miles per hour [mph]), in summer and winter conditions. Air dispersion modeling was conducted by extrapolating data provided in HPAC computer models and comparing them against Department of Energy Protection Action Criteria (PACs) to determine a threshold concentration to represent acute exposure levels of airborne chemicals that may affect a population or the environment. Based on air dispersion modeling and analysis, it was determined that the proposed simulants would not be used when wind speeds are greater than 15 mph and tests using DIMP would be limited to 1,000 gallons or less. Analysis in this EA is based on these scenarios. DTRA would continue to monitor groundwater and soils annually to ensure that the additional simulants have no effect on the environment. Samples would be taken of groundwater from monitoring wells in the area and soils would be sampled near test structures.

## 2.2 Alternatives Considered

### 2.2.1 No Action Alternative

The No Action Alternative is required pursuant to U.S. Army NEPA regulations and provides a baseline against which the Proposed Action can be compared. This comparison enables decision makers to examine the magnitude of environmental effects from implementing the action alternatives. In addition, CEQ NEPA regulations recommend inclusion of the No Action Alternative in an EA to assess any environmental consequences that may occur if the Proposed Action is not implemented. Therefore, the No Action Alternative is carried forward for detailed analysis in this EA.

Under the No Action Alternative, no new simulants would be added to the current approved list. Testing would continue at PHETS and other DTRA sites as described in the 2007 PEIS. The overall impact to the environment under the No Action Alternative would not change. Consequently, projected impacts of the Proposed Action and its alternatives are compared to impacts of the ongoing activities under the No Action Alternative. The No Action Alternative, however, would be detrimental to national security interests concerning the development of threat reduction technologies, including new WMD defeat capabilities, because no additional simulants could be tested. Therefore, the No Action Alternative would not meet the purpose of and need for the Proposed Action.

### 2.2.2 Reduced Simulant Quantity Alternative

The Reduced Simulant Quantity Alternative would consist of testing while using smaller quantities (500 gallons or less) of simulant material than documented in the PEIS, all other test parameters of the Proposed Action would remain unchanged. A reduced level of simulants used would lead to a corresponding reduction in potential impacts. The Reduced Testing Alternative would meet the purpose of and need for the Proposed Action and will be carried forward for detailed analysis in this EA.

### 2.2.3 Alternatives Considered But Not Carried Forward

***Use of Malathion and Parathion as a Simulants.*** DTRA initially proposed to include the use of malathion and parathion as simulants to be discussed in this EA. Malathion has been manufactured in the United States since the 1950s and is used as a pesticide for the agricultural industry, as well as for commercial (i.e., golf courses) and residential (i.e., home garden, landscaping) uses (ATSDR 2003). Parathion is an organosphosphorus insecticide no longer used in the United States; however, it continues to be used in other countries to control insects and mites (NIOSH 2016).

Based on air dispersion modeling, airborne plumes and surface deposition areas associated with the use of parathion and 4,000 gallons of malathion would have the potential to result in significant impacts on the state-threatened White Sands pupfish (*Cyprinidon Tularosa*) habitat, impacting the cooperating agreement to protect the habitat and species. Parathion is particularly toxic to birds and moderately toxic to fish and aquatic invertebrates (EXTOXNET 1993a). Although the use of 990 gallons or less of malathion does not appear to go over the mountain ridge into surface waters on the Tularosa Basin where the pupfish habitat exists, malathion is known to be highly toxic to honey bees and moderately toxic to birds and mammals (Gervais et al. 2009, EXTOXNET 1993b, ECHA 2018a). Several threatened, endangered, and sensitive faunal species are known to occur at PHETS. Therefore, the use of malathion and parathion as simulants has been eliminated from further detailed analysis in this EA.

***Use of Other Facilities.*** Apart from testing at WSMR as described under the Proposed Action in **Section 2.1**, the use of other facilities is a viable alternative for individual tests, but is a less desirable alternative on a programmatic level. The only potential site considered as an alternative location to WSMR for testing the additional simulants identified was the Nevada National Security Site, which supports chemical and biological testing. Program requirements for the proposed DTRA simulant testing include the need for a large, remote location and suitable infrastructure including test beds, hardened structures, communications, and administrative facilities.

Testing costs must be considered and minimized by using existing facilities with appropriate infrastructure, avoiding areas of environmental concern, and avoiding scheduling conflicts with other programs. Proximity of WSMR to Kirtland AFB in New Mexico would reduce travel costs and time for personnel to travel between their duty station and the test location. The Nevada Test Site is over 650 miles from Kirtland AFB as compared with WSMR, which is just over 120 miles to Kirtland AFB. While the Nevada Test Site has the infrastructure suitable to support collateral effects testing, the site is on a dry lakebed and cannot support construction of new test structures. In addition, the wind direction is not reliable enough to complete testing in a timely manner. Aerial delivery options available at WSMR would be insufficient at the Nevada Test

Site. Additionally, a substantial amount of historical data from previous tests at WSMR are valuable for current and future testing programs. For these reasons, this alternative has been eliminated from further detailed analysis in this EA. No other reasonable testing location alternatives have been identified.

# 3 Affected Environment and Environmental Consequences

This section of the EA describes the environmental setting and existing physical, social, and economic conditions that exist within the northern portion of WSMR and within the region of influence (ROI). The ROI defines the geographic extent of potential impacts from the alternatives on the important elements of that resource, and it varies due to the specific nature of the resources (e.g., air quality impacts could occur in a much wider ROI than noise, which would be more localized). Only those resources that have the potential to be affected by the alternatives considered are described, as per CEQ guidance (40 CFR § 1501.7[3]).

This EA is being tiered from the 2007 PEIS, it adopts the findings of the PEIS and the subsequent Record of Decision and does not repeat the evaluations of those resources for which no new or additional impacts would result. In addition, the Proposed Action analyzed by this EA would result in no change to the locations, types, or frequency of DTRA testing activities within the PHETS as described in the PEIS. Therefore, the following bullets describe those resource areas not being carried forward for detailed analysis, along with the rationale for their elimination:

- ***Infrastructure.*** Infrastructure is not addressed in this EA because the use of additional simulants under the Proposed Action would not result in a change to utilities or infrastructure on the installation. As a result, DTRA anticipates no short- or long-term impacts at WSMR. Therefore, utilities and infrastructure will not be carried forward for detailed analysis.
- ***Land Use.*** Land use is not addressed in this EA because the use of additional simulants under the Proposed Action would not result in a change to current land use at WSMR or PHETS. As a result, DTRA anticipates no short- or long-term impacts on land use at WSMR. Therefore, land use will not be carried forward for detailed analysis.
- ***Airspace.*** Airspace is not addressed in this EA because the use of additional simulants under the Proposed Action would not result in a change to current airspace types, flight activities, or training and no changes to current aircraft operations. As a result, DTRA anticipates no new or additional short- or long-term impacts at WSMR. Therefore, airspace will not be carried forward for detailed analysis.
- ***Geology and Soils.*** Geology and soils are not addressed in this EA because the use of additional simulants under the Proposed Action would not result in a change to existing conditions. Test and support activities that could result in ground disturbance from construction, explosive detonations, excavations, Earth-penetrating weapons, demolition, and ground maneuvers, including vehicle traffic would not change from existing conditions. Spill containment measures would continue to be implemented for simulants used inside test structures and dispersed from unconfined containers and soil monitoring for simulant fallout would continue annually after collateral effects tests. Soil samples would be analyzed for the presence and concentration of particular simulants used in a given test year and soils found to have high simulant concentration levels would be removed, if necessary, to protect human health and the environment. As a

result, DTRA anticipates no new or additional short- or long-term impacts on geology and soils at WSMR. Therefore, Earth resources will not be carried forward for detailed analysis.

- ***Noise.*** Noise is not addressed in this EA because the use of additional simulants under the Proposed Action would not result in a change in the existing noise environment. The use of additional simulants at PHETS would remain within the total volume, proposed test numbers, test site locations, and existing test bed infrastructure. As a result, DTRA anticipates no new or additional short- or long-term impacts on the noise environment at or adjacent to WSMR. Therefore, noise will not be carried forward for detailed analysis.
- ***Cultural Resources.*** Cultural resources is not addressed in this EA because the use of additional simulants under the Proposed Action would not result in new or additional short- or long-term impacts on cultural resources or to the Trinity National Historic Landmark within the PHETS. Assuming continued pretreatment (i.e., washing) of samples prior to analysis and the minute concentrations of test materials expected to be deposited from the plumes, the effect on carbon-14 dates of surface artifact scatters from these test materials would be negligible. Therefore, cultural resources will not be carried forward for detailed analysis.
- ***Socioeconomics and Environmental Justice.*** Socioeconomics and environmental justice are not addressed in this EA because the use of additional simulants under the Proposed Action would not result in impacts on the socioeconomic environment or minority populations at WSMR or the surrounding area. Based on air dispersion modeling, airborne plumes and surface deposition areas from all of the simulants would remain well within the boundary of WSMR and no populations would be exposed. The Proposed Action would not disproportionately affect minority and low-income populations compared to the general population. Therefore, socioeconomics and environmental justice will not be carried forward for detailed analysis.

Specific criteria for evaluating the potential environmental impacts of the Proposed Action and alternatives are discussed by resource area. Environmental effects and proposed mitigation measures to avoid or minimize environmental harm are summarized in **Table 3-4**. Additional mitigation commitments are proposed to minimize, rectify, or compensate for unavoidable adverse environmental effects that could be significant without mitigation. Significance of an action is measured in terms of its context and intensity. The context and intensity of potential environmental impacts are described in terms of duration, the magnitude of the impact, and whether they are adverse or beneficial, as summarized below:

- ***Short-term or long-term.*** In general, short-term impacts are those that would occur only with respect to a particular activity, for a finite period, or only during the time required for construction or installation activities. Long-term impacts are those that are more likely to be persistent and chronic.
- ***Significant, moderate, minor, negligible, or no impact.*** These relative terms are used to characterize the magnitude or intensity of an impact. Significant impacts are those effects that would result in substantial changes to the environment (as defined by

40 CFR § 1508.27) and should receive the greatest attention in the decision-making process. Less than significant impacts are those that would be slight but detectable.

- ***Adverse or beneficial.*** An adverse impact is one having unfavorable or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. All impacts are considered adverse unless specifically stated otherwise.

Airborne dispersion models provide a predicted concentration of the chemical with distance away from the source. Because most of the simulants proposed for collateral effects testing can be acutely toxic to human, wildlife, or plants, Department of Energy PACs are being used in this analysis as a primary criteria against which potential impacts are assessed. PACs provide a threshold concentration representing the acute exposure level of airborne chemical that may affect a population, thus requiring mitigation action. PACs consist of Acute Exposure Guideline Levels (AEGLs) and Emergency Response Planning Guidelines (ERPGs) as the emergency exposure limits. However, because AEGLs and ERPGs exist for only a limited number of chemicals, Temporary Emergency Exposure Limits (TEELs) have been developed until AEGLs or ERPGs are developed. The highest concentrations of all materials would occur in the immediate vicinity, up to 200 feet from the test area, where spill containment, such as plastic sheeting, would be placed to collect residual material.

PAC values for TEELs are based on a 1-hour exposure duration. PAC values are concentrations in air at which it is predicted the general population could experience the following effects: TEEL-3 – life threatening adverse health effects or death; TEEL-2 – irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape; TEEL-1 – notable discomfort, irritation, or certain asymptomatic, nonsensory effects that are not disabling and are transient and reversible upon cessation of exposure; 1/2 TEEL-1 – one-half the concentration for the TEEL-1 value; and 1/10 TEEL-1 – one-tenth the concentration for the TEEL-1 value. Airborne plumes identified in the figures in this EA present the area encompassed by the airborne plume expanding out to the 1/10 TEEL-1 concentration level, which is equal to 0.27 milligram per cubic meter (mg/m$^3$) for DIMP, 0.1 mg/m$^3$ for DEEP, and 0.12 mg/m$^3$ for CEPS.

In order to determine surface deposition areas for each proposed simulant, modelers used data provided in the HPAC computer model to assist in the development of air dispersion modeling to estimate the amount of simulant released into the environment. Surface deposition values are based on a timeframe of 1 hour post-release. Surface deposition areas identified in the figures in this EA present the maximum surface deposition areas, or maximum extent of observable material hazard area, identified in air dispersion models, which are equal to 0.0791 milligram per square meter (mg/m$^2$) for DIMP and 0.1 mg/m$^2$ for DEEP and CEPS.

## 3.1 Air Quality

### 3.1.1 Affected Environment

Air quality is defined by the concentration of various pollutants in the atmosphere at a given location. The U.S. Environmental Protection Agency (USEPA) and the New Mexico

Environment Department, Air Quality Bureau regulate air quality in New Mexico to protect public health.

Under the Clean Air Act, the six pollutants defining air quality, called “criteria pollutants,” are carbon monoxide (CO), sulfur dioxide, nitrogen dioxide, ozone, suspended particulate matter (measured less than or equal to 10 microns in diameter and less than or equal to 2.5 microns in diameter), and lead. USEPA has established National Ambient Air Quality Standards (40 CFR § 50) for criteria pollutants. The state of New Mexico has established its own ambient air quality standards for the criteria pollutants, which in some cases are more stringent than the National Ambient Air Quality Standards. Areas that are and have historically been in compliance with ambient air quality standards or have not been evaluated for standard compliance are designated as attainment areas. Areas that violate air quality standards are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment. All of WSMR is an attainment area (USEPA 2018a).

As noted in the 2007 PEIS, the majority of manmade air pollution on WSMR is generated in the Main Post region, which is approximately 80 miles from PHETS. Stationary sources of air emissions on WSMR are permitted under the installation’s Title V Operating Air Permit (P085R2). A concrete batch plant and electrical generators used by DTRA at PHETS are included under this permit. Other sources of air emissions at PHETS include vehicle exhaust; airborne dust from vehicle travel on unimproved roads; and exhaust from missiles, aircraft, and ground targets used in mission-related testing.

The 2007 PEIS notes that airborne dust is a persistent problem throughout WSMR. Airborne dust is a form of suspended particulate matter, which impairs health, reduces visibility, and damages electronic equipment. Strong westerly winds are common during the spring (March through early May) and can produce dust storms prior to the onset of the rainy season. Moist, intact, and vegetated soils generally promote better air quality, while dry, disturbed, and non-vegetated soils can contribute substantial amounts of airborne dust during wind events. The arid to semi-arid climate of WSMR lends the region to little plant cover that exacerbates wind erosion and dust generation.

Ongoing global climate change has the potential to increase average temperatures and cause more frequent, intense, and prolonged droughts in the southwest United States including New Mexico (Garfin et al. 2014). These changes to regional climate patterns could result in regional changes to airborne dust generation, flooding frequency, vegetation types, vegetation growth rates, wildfire potential, groundwater depth, and potable water availability.

### 3.1.2 Environmental Consequences

#### 3.1.2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

Collateral effects testing using the five additional simulants would produce similar effects on air quality as described in the 2007 PEIS for the original simulants. Like the original simulants, testing each of the five additional simulants would produce an airborne chemical simulant plume (i.e., a cloud of aerosol droplets of the tested simulant) that would rapidly dissipate as it moves downwind and deposits on the surface. For DIMP, DEEP, and CEPS, the air quality within such an airborne plume would be acutely toxic to humans within the test site, where personnel would be wearing appropriate personal protective equipment (PPE), and gradually become less toxic with distance. Populations closer to the test site that are exposed to the airborne plume could experience immediate and potentially significant health effects, while populations farther from the test site that are exposed to the airborne plume could experience temporary and minor adverse health effects depending on the simulant tested. Populations outside of the airborne plume would experience no adverse health effects. BtAH and ethylene are not toxic to humans, so populations would experience no adverse health effects from airborne plumes produced during tests of these two additional simulants. See **Section 3.5** for further discussion of the five additional simulants impacts on human health.

Based on air dispersion modeling for DIMP, DEEP, and CEPS, the size of an airborne plume would vary based on the simulant tested, testing scenario, and meteorological conditions at the time of the test. These three additional simulants would produce an airborne plume that would stay relatively near the test site and extend no farther than 10 miles downwind under all testing scenarios and all meteorological conditions suitable for testing. The airborne plumes would remain well within the boundary of WSMR and no human populations would be exposed.

Like the original simulants, all collateral effects tests using the five additional simulants would occur when meteorological conditions are suitable for testing so that the airborne plume's range is minimized and is directed in the desired direction. All testing would occur when the prevailing wind direction is to the southeast, which would direct the airborne plume away from any human populations. In addition, no testing would occur when precipitation is predicted and wind speeds are greater than 15 mph. DTRA personnel would monitor meteorological conditions before a test to ensure that the desired simulant and testing scenario are appropriate for that day's weather.

Collateral effects testing using the five additional simulants would produce air emissions from vehicle travel to access the test sites, explosive detonations, and the construction and destruction of targets. Particulate matter (i.e., airborne dust) would be the primary air pollutant produced from vehicle travel because most roads on WSMR are unimproved; however, most criteria pollutants would also be produced from vehicle exhaust. Explosive detonations would continue to produce air pollutants such as airborne dust, water vapor, nitrogen, and CO. Tests involving the detonation of mid-size and large-scale simulant materials within thin-skinned or hardened targets would generate the greatest amounts of air pollutants from the larger amounts of simulant and target material involved. Construction of targets would continue to generate airborne dust and criteria pollutants from the use of heavy equipment. The additional simulants would not increase the number of vehicle miles driven, locations of the test sites, number of tests (i.e., explosive detonations), and number of targets needed beyond the levels authorized by the 2007 PEIS. Therefore, air emissions from vehicle travel, explosive detonations, and construction and destruction of targets from testing the additional simulants would remain at or below the levels identified in the 2007 PEIS.

Ongoing changes to climate patterns in the southwestern United States are described in **Section 3.1.1**. These climate changes are unlikely to affect DTRA's ability to test the five additional simulants. Collateral effects testing using the five additional simulants would continue to produce greenhouse gas emissions from vehicle travel to access the test sites, explosive detonations, and the construction and destruction of targets. However, greenhouse gas emissions from these activities would not change because the number of vehicle miles driven, locations of the test sites, number of tests, and number of targets would not exceed the levels authorized by the 2007 PEIS.

The 2007 PEIS identified three mitigation measures to be implemented to minimize the effects of chemical simulant testing on air quality. These mitigation measures include conducting HPAC prediction modeling and monitoring wind speed and direction to ensure chemical simulant airborne plumes do not extend beyond WSMR, and applying dust suppressant and retaining vegetation cover where possible to minimize airborne dust. These measures would continue to be implemented and would occur during collateral effects testing using the five additional simulants.

In summary, air emissions from the Proposed Action would not exceed federal or state air quality standards, and all activities would meet all applicable air quality regulations. Intermittent testing conducted by DTRA at PHETS is exempt from reporting requirements under the WSMR Title V permit.

#### 3.1.2.2 REDUCED SIMULANT QUANTITY ALTERNATIVE

The Reduced Simulant Quantity Alternative would be similar, but slightly less impactful on air quality than the Proposed Action. Testing reduced quantities of the five additional simulants under this alternative would result in smaller and/or less frequent airborne plumes than described for the Proposed Action. Airborne dust and criteria pollutant emissions from vehicle travel, explosive detonations, and the construction and destruction of targets under this alternative would also be less than those from similar activities under the Proposed Action. Similar mitigation measures as outlined in the 2007 PEIS and described for the Proposed Action would continue to be followed under this alternative. Therefore, this alternative would not exceed federal or state air quality standards, and all activities would meet all applicable air quality regulations.

#### 3.1.2.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, DTRA would not use the five additional simulants during collateral effects testing at PHETS. Air quality conditions would remain the same as described in **Section 3.1.1** and the environmental consequences section of the 2007 PEIS. No new impacts on air quality would occur.

## 3.2 Water Resources

### 3.2.1 Affected Environment

***Groundwater.*** Based on air dispersion modeling, the maximum extent of airborne plumes and surface deposition areas for all three modeled simulants would stay within the Jornada del Muerto Basin (see **Figure 3-1** and **Figure 3-2**). The Jornada del Muerto and Tularosa watersheds are closed basins, which have no drainage outlet for surface water flow and surface water is primarily lost to evaporation or percolates into underlying aquifers (WSMR 2009). A large quantity of groundwater is present in the unconsolidated basin-fill and alluvial deposits in the Jornada del Muerto and Tularosa Basins. In the Jornada del Muerto Basin, where PHETS is located, groundwater has been encountered in alluvial deposits at depths of 13 to 584 ft below

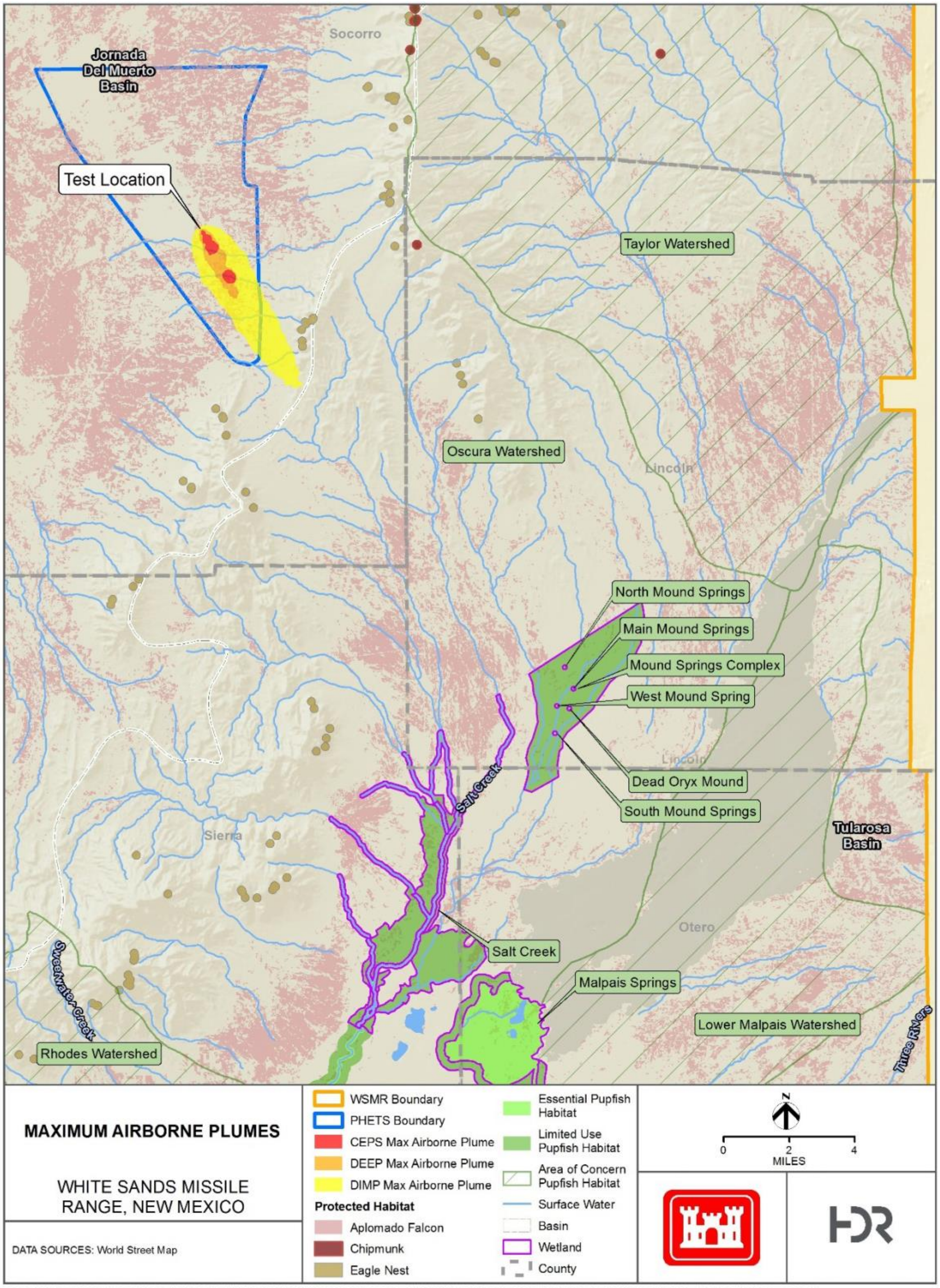


**Figure 3-1. Water Resources and Habitat within Maximum Airborne Plumes**

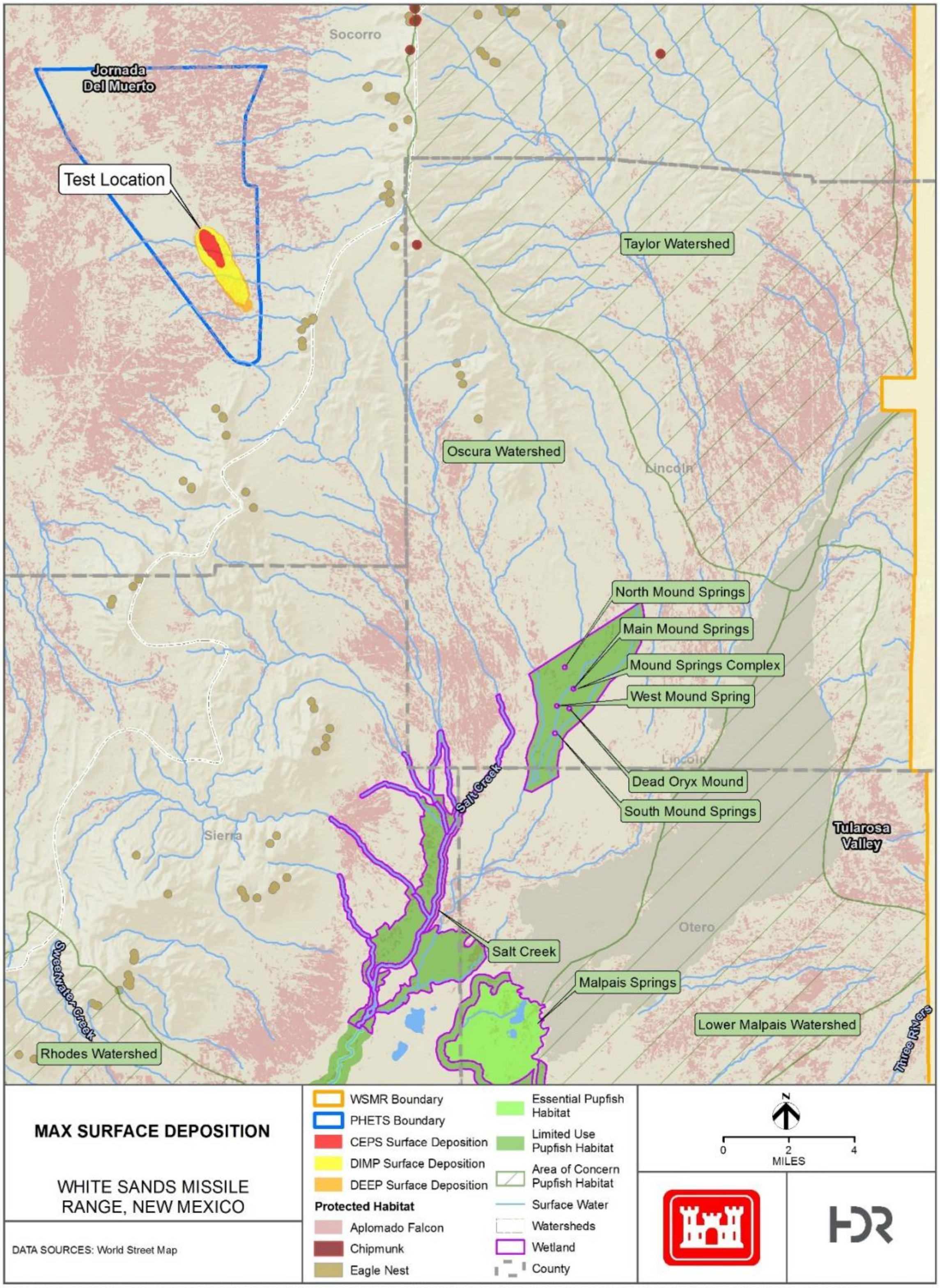


**Figure 3-2. Water Resources and Habitat within Maximum Surface Deposition Areas**

ground surface. Depth to water at PHETS generally increases from west to east, reflecting the increasing thickness of alluvium toward the Oscura Mountains. Depth to groundwater in the test area within PHETS varies between approximately 200 and 250 ft below ground surface. Much of the PHETS area is underlain with an extensive gypsic soil horizon, which impedes surface water movement toward the relatively deep groundwater. Groundwater recharge primarily occurs when runoff resulting from snowmelt or rainfall infiltrates the relatively permeable alluvial basin-fill deposits. The major source of recharge to the groundwater system occurs in areas adjacent to the mountain ranges, which are located east and south of PHETS (DTRA 2007b, Roybal 1991, WSMR 2015a).

Groundwater quality in the Jornada del Muerto and Tularosa Basins is generally poor due to high concentrations of dissolved minerals in the water, or total dissolved solids (TDS). Most groundwater within the Jornado del Muerto Basin contains TDS concentrations of 1,000 to 3,000 milligrams per liter (mg/L) and more than 85 percent of the groundwater in the Tularosa Basin may contain TDS concentrations exceeding 3,000 mg/L. In addition to TDS, there are high concentrations of sulfate in the groundwater throughout the region. The high concentrations of TDS and sulfate are a result of naturally occurring subsurface minerals. Chemical quality data reported in literature for water from historic wells indicated that groundwater throughout PHETS is non-potable and brackish. Sampling of the three groundwater monitoring wells on PHETS in 2001 found that sulfate, nitrate, and TDS content closely matched historic well data for the area (DTRA 2007b, WSMR 2015a, Roybal 1991, Weir 1965). The chemical simulant triethyl phosphate used in previous collateral effects tests was not detected in any of the samples. In addition, annual sampling and analysis of groundwater occurs to detect potentially adverse trends in groundwater quality (U.S. Army 2002, DTRA 2007b).

Groundwater resources on WSMR are monitored for quality and quantity. Water quality standards are regulated by the state of New Mexico and USEPA. Non-potable water for construction, project activities, or personnel use is trucked in from outside sources, typically from wells at Stallion Range Center. Potable water comes from the desalinization plant at the Stallion Range Center (WSMR 2015a, DTRA 2007b).

***Surface Water.*** Surface water resources within WSMR are limited due to low rainfall, high evaporation rates, and high soil infiltration properties. Most streams, lakes, and rainwater catchments are ephemeral (see **Figure 3-1** and **Figure 3-2**). The presence of these temporary surface water features is dependent upon runoff from infrequent precipitation events (DTRA 2007b, WSMR 2015a).

Perennial surface water bodies on WSMR are limited to the Tularosa Basin. Surface waters within the maximum airborne plume and surface deposition areas are characterized as intermittent, where flow ceases for weeks or months each year. The water in Salt Creek has high concentrations of TDS and is classified as saline, and water quality has been shown to depend on location and flow rate at time of collection. No perennial streams or surface water bodies occur at PHETS. Rainfall typically infiltrates rapidly into the ground in the region; however, heavy rainstorms can create short duration overland flows and occasional ponds within natural depressions. Stormwater runoff at PHETS drains westward across a broad alluvial plain and into ephemeral playa lakes in the central portion of the Jornada del Muerto Basin. In general, surface water quality on WSMR also depends on the amount of snow accumulation in mountainous areas, as well as the amount, intensity, and number of precipitation events. Surface water quality ranges from fresh to brine, and concentrations of TDS increases over time due to evaporation (DTRA 2007b, WSMR 2015a).

***Wetlands.*** Wetlands and riparian areas on WSMR include springs, seeps in mountainous areas, and extensive wetland marshes and creeks in the Tularosa Basin (WSMR 2001). Similar to surface waters, most wetlands on WSMR are ephemeral (WSMR 2015a). No wetlands are within the maximum extent airborne plume and surface deposition areas for all simulants (see **Figure 3-1** and **Figure 3-2**).

***Floodplains.*** No floodplains are present within the maximum extent airborne plume and surface deposition areas for all simulants (see **Figure 3-1** and **Figure 3-2**).

### 3.2.2 Environmental Consequences

#### 3.2.2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

The Proposed Action is not anticipated to result in short- or long-term impacts on wetlands or floodplains because none are present within or near the maximum extent airborne plume and surface deposition areas for all simulants; therefore, wetlands and floodplains are not discussed further.

***Groundwater.*** Intermittent, short-term, negligible, adverse impacts on groundwater resources would continue to occur from ground disturbance associated with the use of munitions delivered by aircraft, unmanned aerial vehicles, surface-to-surface weapon systems, and statically detonated explosive testing. Mitigation measures outlined in the 2007 PEIS would continue to be implemented and would occur during collateral effects testing using the five additional simulants.

Long-term, negligible to minor, adverse impacts on groundwater resources would occur from exposure to the five additional simulants under the Proposed Action. Because of low precipitation levels and high evaporation rates, the potential that surface water, and thus dissolved contaminants, would infiltrate to groundwater would be low. Previous sampling conducted to determine if ammonium nitrate-fuel oil tests resulted in groundwater contamination by nitrate and nitrite found that no leaching into groundwater occurred beneath the test sites (DTRA 2007b). The potential for contamination would be greater in areas of shallow groundwater. Additionally, chemical simulants that are moderately to highly soluble in water (DIMP and DEEP) would be more likely to contaminate groundwater than those that are not or only slightly soluble in water (CEPS and ethylene) (NPIC 2016). Additional information on each simulant is provided below and in **Appendix D** and potential impacts on aquatic species are discussed in **Section 3.3.2**.

Potential impacts on groundwater resources from the five additional simulants are discussed below. Mitigation measures outlined in the 2007 PEIS to avoid or minimize contamination would continue during collateral effects testing using the five additional simulants. These measures include annual analysis of groundwater for simulants tested; implementation of soil erosion control measures; and use of retention ponds, stabilization measures for disturbed areas, and sediment traps as applicable.

*DIMP*. DIMP was identified by one source as being highly soluble in water and as slightly soluble in water by other sources (DTRA 2007b, APHC 2018). DIMP does not adsorb to suspended solids and sediment in water. It is recommended that DIMP not be used in areas where groundwater contamination is likely or in agricultural areas. However, the extensive gypsic soil horizon that underlies the PHETS area impedes surface water movement toward the relatively deep groundwater. While DIMP is persistent in the environment, its bioconcentration factor of 1.2 for aquatic biota indicates low potential for bioaccumulation. DIMP does not undergo direct or indirect photolysis in aquatic systems (APHC 2018, DTRA 2007b, HSDB 2003a, Munro 1999). USEPA has issued a lifetime Health Advisory for DIMP of 600 micrograms per liter (µg/L) in groundwater (USEPA 1993).

*DEEP.* DEEP was identified by one source as being highly soluble in water and as slightly soluble in water by other sources (NOAA CAMEO undated, ChemIDplus undated, HSDB 2003b, PubChem 2005a). Persistence of DEEP in the environment is unlikely; however, it is toxic to aquatic life (Chemical Book 2017; Fisher 2015a, 2017, 2018; PubChem 2005a).

*CEPS.* CEPS has low solubility in water, and it is noted in a Safety Data Sheet (SDS) that it should not be allowed to contact ground or surface waters due to its corrosivity and acute toxicity (Fisher 2015b, Wagner and MacIver 1998). There is limited information regarding the potential effects of CEPS on aquatic and terrestrial species and whether or not it bioaccumulates.

*BtAH.* Neither the fate nor degradation of BtAH in the environment is well understood. This particular strain is not commercially available and has had the enzyme removed so that it is ineffective as an insecticide (Ibrahim et al. 2010). Biological aerosols may undergo physical and chemical transformations when released into the environment. Exposure to ozone, iodine, and higher levels of humidity can promote degradation of BtAH (Ratnesar-Shumate et al. 2015, Buhr et al. 2016). A review of selected studies on Bt indicated that adverse effects were limited to few species; therefore, it is unlikely that aquatic organisms would be appreciably impacted by BtAH. There is a general lack of information regarding the potential effects specifically of BtAH on aquatic and terrestrial species. Other Bt formulations are highly specific to the target insect for which the pesticide was developed (Clark et al. 2005). One study indicated that BtAH, at the highest dose rate used, exhibited no toxicity to various invertebrate species (Bishop and Robinson 2014). Given that BtAH contains a deactivated protein by design, which is why it is used as a simulant for other bacterial agents, it should generally have low, acute toxicity in wildlife and humans.

*Ethylene.* Ethylene is slightly soluble in water and does not persist in the environment. Ethylene exists naturally in the environment and is produced by plants. Although it is expected to move quickly through soil, it would not be expected to move from the soil surface to groundwater because it tends to migrate to the atmosphere and biodegrades quickly in the presence of oxygen (Dow 2014, HSDB 2018, IARC 1994). The toxicity of ethylene to aquatic organisms is low, and the potential for bioaccumulation in aquatic organisms is low (Dow 2014, HSDB 2018).

***Surface Water.*** Intermittent, short-term, negligible, adverse impacts on surface waters would continue to occur from ground disturbance associated with the use of munitions delivered by aircraft, unmanned aerial vehicles, surface-to-surface weapon systems, and statically detonated explosive testing. Potential impacts from increased soil erosion and surface runoff would continue to be reduced through implementation of sediment and erosion control measures and best management practices (BMPs) at impact sites outlined in the 2007 PEIS.

As discussed in **Section 3.2.1**, the only perennial surface water bodies on WSMR are limited to the Tularosa Basin. Ephemeral surface waters would partially coincide with the maximum extent surface deposition area for all three simulants. As previously stated, no perennial streams or surface water bodies occur at PHETS. Surface waters within the maximum airborne plume and surface deposition areas are characterized as intermittent, where flow eases for weeks or months each year. Because there are no perennial streams or surface water bodies at PHETS, no short- or long-term impacts on surface waters are anticipated from the proposed use of DIMP, DEEP, or CEPS.

A portion of the test materials released into the air at PHETS during collateral effects tests would eventually settle on the land surface. However, most of the material would evaporate, react, or rapidly degrade in the sunlight (photodegrade). Under rare conditions, such as heavy rainfall immediately following dispersion of test materials, part of the remainder may be dissolved in surface water runoff. However, with the exception of the immediate area around the material release point, it is expected that very low concentrations would be deposited over downwind areas. In addition, losses from evaporation, reactions, and photodegradation and the infrequency of heavy rains would minimize the concentration of substantial amounts of test materials in surface water runoff.

Mitigation measures and BMPs outlined in the 2007 PEIS to avoid or minimize impacts on surface waters would continue. Wind direction and speed would continue to be considered when conducting tests to ensure plume movement is toward approved areas within WSMR boundaries. Retention ponds, stabilization measures for disturbed areas, and sediment traps would continue to be used as applicable. Activities would be planned to minimize changes to existing drainage patterns. The use of culverts for road-crossings through arroyos, recontouring, and other BMPs would continue to be implemented to reduce adverse impacts.

#### 3.2.2.2 REDUCED SIMULANT QUANTITY ALTERNATIVE

The Reduced Simulant Quantity Alternative would be similar, but slightly less impactful on water resources than the Proposed Action. Testing smaller quantities of the five additional simulants under this alternative would result in smaller airborne plumes and surface deposition areas, reducing the potential for adverse impacts on water resources. Similar mitigation measures as outlined in the 2007 PEIS and described for the Proposed Action would continue to be followed under this alternative. Therefore, this alternative would not result in significant impacts on water resources.

#### 3.2.2.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, DTRA would not use the five additional simulants during collateral effects testing at PHETS. Conditions would remain the same as described in **Section**

**3.2.1** and the environmental consequences section of the 2007 PEIS. No new impacts on water resources would occur.

## 3.3 Biological Resources

The ROI for biological resources includes PHETS and the entire area within the maximum airborne plume and surface deposition area (see **Figure 3-1** and **Figure 3-2**). This includes the terrestrial and aquatic habitats, vegetation, fish and wildlife, threatened and endangered species, and species of interest (SOI) at WSMR that have the potential to occur there.

### 3.3.1 Affected Environment

***Terrestrial Habitat.*** WSMR lies within the Mexican Highland Section of the Basin and Range Physiographic Province. Two large basins occur on WSMR: the Jornada del Muerto Basin, which is west and northwest of the San Andres Mountains, and the Tularosa Basin, which is east of the San Andres Mountains. The ROI is within the Jornada del Muerto Basin of WSMR; which contains a wide diversity of terrestrial habitat types, ranging from desert shrublands of basin floors to ponderosa pine forests of mountaintops. Variations in vegetation types reflect the variations in elevation and topography on WSMR (see *Vegetation subsection below*).

***Aquatic Habitat.*** Most streams, lakes, and rainwater catchments are ephemeral (i.e., rain-dependent) or intermittent (i.e., seasonal) (WSMR 2015a). Perennial aquatic habitats, although rare on WSMR, can be categorized as streams (lotic habitats), *lagunas* or ponds (lentic habitats), and *cienegas* (wetlands). Surface waters within the ROI are characterized as intermittent, where flow ceases for weeks or months each year. No riparian habitat is associated with these surface waters.

***Vegetation.*** The ROI is dominated by three major vegetation types: creosote shrubland, lowland basin grassland, and mixed lowland desert scrub. These major vegetation types occur in extensive landscape patches throughout the maximum airborne plume and surface deposition areas (see **Figure 3-1** and **Figure 3-2**). There are also some patches of vegetated gypsum outcrop (104 acres) within the maximum surface deposition area for DEEP and mixed foothill piedmont desert grasslands (86 acres) and vegetated gypsum outcrop (269 acres) in the maximum airborne plume for DIMP. The ROI for the surface deposition area associated with all simulants is confined to PHETS and the ROI for the maximum airborne plume for DIMP extends southeast toward the Oscura Mountains. **Table 3-1** presents the dominant vegetation types within the ROI.

**Table 3-1. Dominant Vegetation Types within the ROI**

| Vegetation Types | Maximum Airborne Plume (acres) | Surface Deposition Area (acres) |
|---|---|---|
| Creosote Shrubland | 1,455 | 288 |
| Lowland Basin Grasslands | 712 | 279 |
| Mixed Lowland Desert Scrub | 912 | 256 |

The following descriptions of vegetation types were excerpted from Appendix 3.8 of the WSMR Integrated Natural and Cultural Resources Management Plan (WSMR 2015a). **Figure 3-3** and **Figure 3-4** present the vegetation types occurring within the ROI.

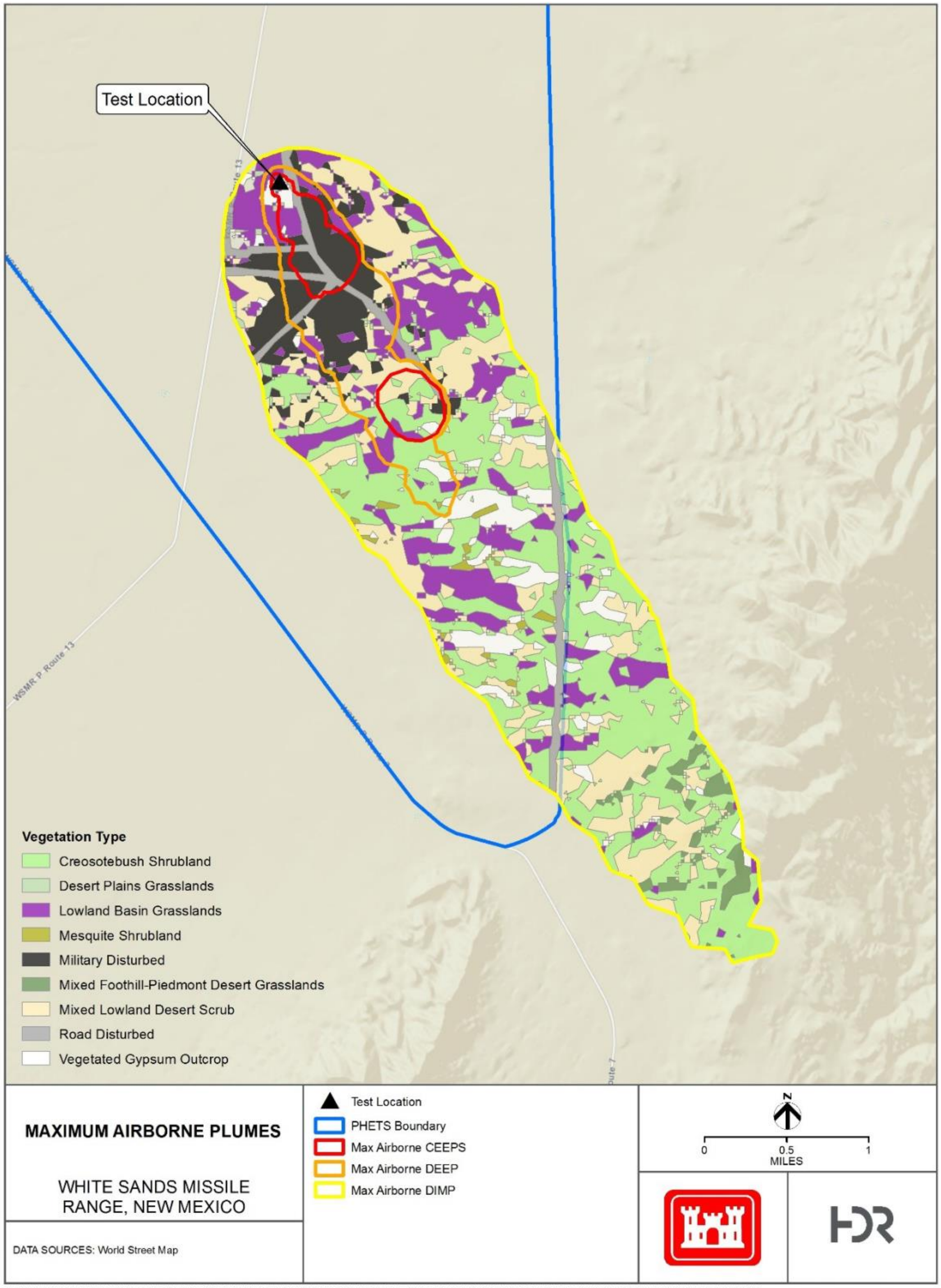


**Figure 3-3. Vegetation Types within Maximum Airborne Plumes**

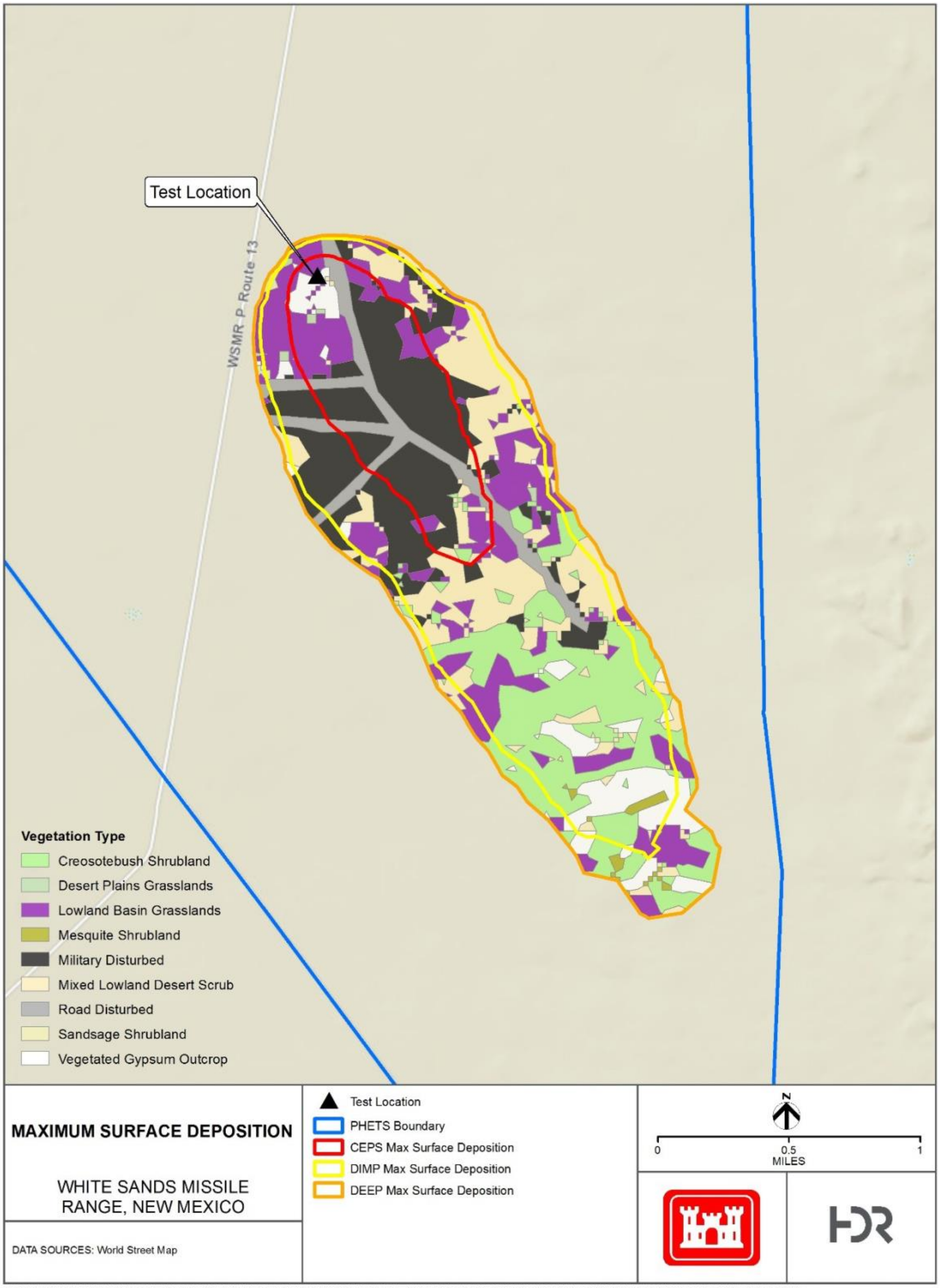


**Figure 3-4. Vegetation Types within Maximum Surface Deposition Areas**

*Creosotebush Shrubland.* Creosotebush Shrublands are the most widespread vegetation community on WSMR, occurring across a broad range of environments. This community extends from basin bottoms at 3,900 ft, up to piedmont bajadas, and into foothills to 5,700 ft. In basin bottoms, creosotebush (*Larrea tridentata*) communities occur on alluvial flats with relatively deep clay soils. They are most prevalent on gravelly, alluvial fan piedmonts with gentle to moderate slopes. In mountain foothills, they are most often found on warm, moderate to steep slopes with thin, rocky soils.

Creosotebush communities are diverse in character; 10 plant associations have been described. Canopies range from very open to dense, with extremely sparse to moderately grassy understories. In basin bottom sites, they are either barren or dominated by alkali sacaton (*Sporobolus airoides*) on clay soils or mesa dropseed (*Sporobolus flexuosus*) on sands. Dominants on erosional alluvial fans and in foothills are often black grama (*Bouteloua eriopoda*) and bush muhly (*Muhlenbergia porteri*), or sites are sparse with little or no herbaceous cover in the understory. Others, particularly on upper piedmonts and in foothills, have well-developed shrub layers that can include mariola (*Parthenium incanum*), ocotillo (*Foquieria splendens*), tarbush (*Flourensia cernua*), broom snakeweed (*Gutierrezia sarothrae*), honey mesquite (*Prosopis glandulosa*), and fourwing saltbush (*Atriplex canescens*).

*Lowland Basin Grassland.* Lowland Basin Grasslands are widespread in bottoms of the Tularosa and Jornada del Muerto Basins occurring on heavy clay soils of alluvial flats, swales, and drainages between alluvial fans. These are the lowest-elevation grasslands on WSMR, occurring at 3,800 to 5,800 ft. Climate conditions are generally arid, and precipitation is low, although during the summer rainy season, runoff from storms can inundate these poorly drained lowlands for days to several weeks. Alkali sacaton, tobosagrass (*Pleuraphis mutica*), and burrograss (*Scleropogon brevifolius*) are typical dominant flora; and sites with the best moisture conditions support inland saltgrass (*Distichlis spicata*). Most prevalent shrubs are honey mesquite and fourwing saltbush, which have become established in bare soil patches.

*Mixed Lowland Desert Scrub.* Mixed Lowland Desert Scrub occupies a large portion of the lowland basin landscape as a complex mixture of creosotebush, tarbush, and fourwing saltbush shrublands. It generally occupies low-elevation alluvial flats and playa bottoms of the northern Tularosa and Jornada del Muerto Basins at elevations of 3,800 to 5,600 ft with very little slope. Soils are typically composed of fine-textured clays with little rock content and consequently, poor drainage. During the summer rainy season, sites can become inundated with water for long periods. Within this complex are communities dominated or co-dominated by creosotebush, tarbush, or fourwing saltbush. The herbaceous layer ranges from very sparse to dense grasses dominated by alkali sacaton, bush muhly, mesa dropseed, or burrograss (WSMR 2015a).

***Fish and Wildlife.*** Complete lists of wildlife species present on WSMR can be found in the WSMR Integrated Natural and Cultural Resources Management Plan (WSMR 2015a). Below is a summary of the faunal diversity within the vegetation types present in the ROI.

*Creosotebush Shrubland*. Creosotebush shrublands are used by many fauna species. In large, monotypic stands that are low in forb and grass production, faunal diversity and use are relatively low. In contrast, use is relatively high in stands found adjacent to foothill and piedmont grasslands, which tend to have rich structural diversity and abundant grass and forb cover that enhance their potential use for forage and cover by many more species.

*Lowland Basin Grassland*. These grasslands, apart from scattered desert shrubs, tend to have little structural diversity and plant species richness, which likely lowers faunal diversity and use. Where the landscape is a mosaic of basin grasslands and shrublands, faunal diversity probably increases. Major herbivores associated with Lowland Basin Grasslands are oryx (*Oryx gazella*), black-tailed jackrabbit, and desert pronghorn (*Antilocapra americana*). Black-tailed jackrabbits and desert cottontails are common in grassland habitats.

*Mixed Lowland Desert Scrub.* Because Mixed Lowland Desert Scrub communities are extensive, but generally uniform, there is very limited structural and plant species diversity. Consequently, overall faunal diversity is low. Small mammals could include kangaroo rat (*Dipodomys* sp.) and pocket mouse (*Perognathus* sp.). Bats include pallid bat (*Antrozous pallidus*) and Mexican free-tailed bat (*Tadarida brasiliensis*). Medium and large mammals include the desert cottontail, black-tailed jackrabbit (*Lepus californicus*), and badger (*Taxidea taxus*).

***Threatened and Endangered Species and Species of Concern.*** The PHETS test beds were surveyed in the summer of 1994 to determine the presence or absence of federal- and state-listed threatened and endangered species. No systematic sampling of herpetofauna or large mammals took place as part of this inventory, although some of both taxa were incidentally observed. **Table 3-2** presents federally listed species and their potential to occur in the ROI based on the desktop review and field survey efforts.

**Table 3-2. Federal- and State-listed Species Known to Occur or Could Potentially Occur in the ROI**

| Common Name | Scientific Name | Federal Status | State Status | Habitat Association and Potential to Occur |
|---|---|---|---|---|
| **Mammals** | | | | |
| Mexican wolf | *Canis lupus baileyi* | E-EXPN | E | No; extirpated from WSMR |
| New Mexico Meadow Jumping Mouse | *Zapus hudsonius luteus* | E | E | No; no riparian habitat in ROI |
| Oscura Mountains Colorado Chipmunk | *Neotamias quadrivittatus oscuraensis* | -- | T | No; no suitable habitat in ROI; occurs at higher elevations |
| Spotted bat | *Euderma maculatum* | -- | T | Possible; in 1999, two spotted bats were captured northeast of PHETS. Suitability for roosting unknown. |
| **Birds** | | | | |
| Baird's Sparrow | *Centronyx bairdii* | -- | T | Possible; transient. Rare in winter months. |
| Bald Eagle | *Haliaeetus leucocephalus* | -- | T | Possible; transient species passing through on migration. |
| Bell's Vireo | *Vireo bellii* | -- | T | No; no riparian habitat in ROI |
| Brown Pelican | *Pelecanus occidentalis* | -- | E | No; no suitable habitat in ROI |
| Common Black Hawk | *Buteogallus anthracinus* | -- | T | No; uncommon summer resident. Prefers riparian habitat. |

**Table 3-2. Federal- and State-listed Species Known to Occur or Could Potentially Occur in the ROI**

| Common Name | Scientific Name | Federal Status | State Status | Habitat Association and Potential to Occur |
|---|---|---|---|---|
| **Birds (continued)** | | | | |
| Gray Vireo | *Vireo vicinior* | -- | T | No; no suitable habitat in ROI. Found in juniper/oak shrub. |
| Least Tern | *Sterna antillarum* | E | E | No; no suitable habitat in ROI. |
| Mexican Spotted Owl | *Strix occidentalis lucida* | T | -- | No; no suitable habitat in ROI |
| Neotropic Cormorant | *Phalacrocorax brasilianus* | -- | T | No; occur at WSMR only as migrants and then only as stopovers |
| Northern Aplomado Falcon | *Falco femoralis septentrionalis* | E-EXPN | E | Suitable habitat, but unlikely to occur. |
| Peregrine Falcon | *Falco peregrinus* | -- | T | Possible; transient, foraging. No suitable nesting habitat in ROI |
| Piping Plover | *Charadrius melodus* | T | T | No; no wetland habitat in ROI |
| Southwestern Willow Flycatcher | *Empidonax traillii extimus* | E | E | No; no riparian habitat in ROI |
| Varied Bunting | *Passerina versicolor* | -- | T | No; no dense scrub habitat in washes in ROI |
| Violet-crowned Hummingbird | *Amazilia violiceps* | -- | T | No; no riparian habitat in ROI |
| Yellow-billed Cuckoo | *Coccyzus americanus* | T | -- | No; no riparian habitat in ROI |
| **Reptiles and Amphibians** | | | | |
| Chiricahua Leopard Frog | *Rana chiricahuensis* | T | -- | No; no wetland/riparian habitat in ROI |
| Narrow-headed Gartersnake | *Thamnophis rufipunctatus* | T | -- | No; no stream/riparian habitat in ROI |
| Western River Cooter | *Pseudemys gorzugi* | -- | T | No; no suitable stream habitat in ROI |
| **Fishes** | | | | |
| Gila Trout | *Oncorhynchus gilae* | T | -- | No; no riverine habitat in ROI |
| Rio Grande Silvery Minnow | *Hybognathus amarus* | E | E | No; no riverine habitat in ROI |
| White Sands pupfish | *Cyprinidon Tularosa* | Under review | T | No; no riverine habitat in ROI |
| **Invertebrates** | | | | |
| Alamosa Springsnail | *Tryonia alamosae* | E | E | No; no wetland/spring habitat in ROI |
| Chupadera Springsnail | *Pyrgulopsis chupaderae* | E | E | No; no wetland/spring habitat in ROI |
| Socorro Springsnail | *Pyrgulopsis neomexicana* | E | E | No; no wetland/spring habitat in ROI |
| Socorro Isopod | *Thermosphaeroma thermophilus* | E | E | No; no wetland/spring habitat in ROI |
| **Flowering Plants** | | | | |
| Kuenzler Hedgehog Cactus | *Echinocereus fendleri var. kuenzleri* | T | -- | No; does not occur on WSMR |
| Pecos (=puzzle, =paradox) Sunflower | *Helianthus paradoxus* | T | -- | No; no wetland/riparian habitat in ROI |

**Table 3-2. Federal- and State-listed Species Known to Occur or Could Potentially Occur in the ROI**

| Common Name | Scientific Name | Federal Status | State Status | Habitat Association and Potential to Occur |
|---|---|---|---|---|
| Sacramento Mountains Thistle | *Cirsium vinaceum* | T | -- | No; no wetland/riparian habitat in ROI |
| **Flowering Plants (continued)** | | | | |
| Sacramento Prickly Poppy | *Argemone pleiacantha* ssp. *pinnatisecta* | E | -- | No; does not occur on WSMR |
| Todsen's Pennyroyal | *Hedeoma todsenii* | E | E | No; does not occur within or near test beds. |

Source: USFWS 2019; NMDGF 2019; NMRPTC 2005; NMRPTC 2017
E = Endangered; T = Threatened; EXPN = Nonessential Experimental Population

***Federally Listed Species.*** According to the USFWS Information for Planning and Consultation resource list, there are three mammals, six birds, one reptile, one amphibian, two fish, three snails, one crustacean, and five flowering plants that could potentially be affected by activities at PHETS (USFWS 2019). Of the 22 species listed by the Information for Planning and Consultation, only one of these, the northern aplomado falcon, has the potential to occur in the ROI.

*Northern Aplomado Falcon*. The northern aplomado falcon (*Falco femoralis septentrionalis*), a federally listed experimental population and state-listed endangered species, has been observed within the boundary of the installation. The first observation was in May 1991 with three observations since 1992 (WSMR 2007a, WSMR 2007b). In 2005, a single northern aplomado falcon was observed in the Stallion Range area. There has also been a single banded female (released in 2007) that has been seen at least three times on the eastern edge of Stallion Range (WSMR 2007b). As a result of the designation as a Nonessential-Experimental Population in New Mexico, a northern aplomado falcon reintroduction program was initiated in in 2006. As a non-essential experimental population, the falcon is protected as a threatened species within federal lands, but only as "proposed for listing" on private or state-owned lands. **Figure 3-1** and **Figure 3-2** present 'Suitable Habitat' for the falcon within the ROI.

***State-Listed Species.*** Of the state-listed species known to occur in Socorro County, five have the potential to occur within the ROI. One of these, the northern aplomado falcon is discussed under federally listed species. The other four species are discussed in more detail below.

*Spotted Bat.* The spotted bat (*Euderma maculatum*) has been collected on WSMR at Mound Springs, Borrego Spring, and audible calls of spotted bats were heard at additional sites on WSMR (Chung-MacCoubrey 2000). Additionally, three individual spotted bats were reported as being observed on buildings at Holloman AFB, which is adjacent to WSMR on its eastern boundary (Biological and Conservation Database 2000). The spotted bat is state-listed as threatened and is regarded as sensitive by the Bureau of Land Management (BLM) and U.S. Forest Service.

*Baird's Sparrow.* Baird's sparrow (*Ammodramus bairdii*) has been documented three times (five individuals total) on WSMR. All three sightings were on the Jornada Plain in Socorro County.

Four total individuals on two different occasions (August and October 1996) were observed in an open yucca grassland where dominant grasses were black grama, three-awn, and burro grass. In September 1995, one individual was seen in alkali sacaton (Biological and Conservation Database 2000). The Baird's sparrow is state-listed as threatened.

*Bald Eagle.* Bald eagles (*Haliaeetus leucocephalus*) have rarely been sighted on WSMR. There are no resident populations of bald eagles on WSMR; however, it is described as a species passing through WSMR on migration (Kamees and Burkett 1996). Habitat at WSMR is suboptimal for wintering bald eagles because of the lack of a large water body with appropriate prey and roosting or nesting trees nearby. One sighting occurred in March 1983 at the junction of Range Roads 7 and 287, just west of Lake Lucero; another sighting occurred in January 1984 on Highway 70, between the Small Missile Range and the Multi-Function Array Radar site turnoff (Biological and Conservation Database 2000).The most recent sighting occurred in February 2018 approximately 10 mile northeast of PHETS (Cutler 2019).

*Peregrine Falcon.* The peregrine falcon (*Falco peregrinus*), a state-listed threatened species, has been observed on WSMR and on lands adjacent to WSMR. Observations on WSMR occurred in the mouth of Texas Canyon in the Organ Mountains on 16 and 19 June 1995, and approximately 1.3 miles north of Malpais Springs on Range Road 9 on 11 May 1994. A breeding pair has also been observed in the Oscura Mountains. Because individuals that migrate through or forage on WSMR breed elsewhere in New Mexico and other parts of North America, threats beyond WSMR's boundaries or to the prey base within WSMR's boundaries are important.

*White Sands Pupfish.* The White Sands pupfish (*Cyprinidon Tularosa),* federally listed as 'under review' and state-listed as threatened, is a hardy fish restricted to shallow, calm, brackish-to-saline waters in the Tularosa Basin. The extremely limited distribution and geographic range of the species makes it vulnerable to extinction from natural and anthropogenic causes. Pupfish on WSMR are managed under the *Cooperative Agreement for the Protection and Maintenance of the White Sands Pupfish, 1 May 2006*. Populations of this species are many miles southeast of the DTRA test beds and would not be affected by the Proposed Action.

***Species of Interest.*** Based on New Mexico Natural Heritage Program data and information from the WSMR Environmental Division, four floral SOI may potentially occur within PHETS. These include Cory joint-fir (*Ephedra coryi*), dagger thorn cholla (*Opuntia clavata*), gramagrass cactus (*Pediocactus papyracanthus*), and pineapple cactus (*Neolloydia intertexta*). WSMR floral SOI are not afforded legal protection, but are monitored by WSMR Environmental Division.

*Golden Eagle.* The golden eagle (*Aquila chrysaetos*) is a raptor that occurs throughout WSMR. Eagles and their nests are specifically protected by the BGEPA and the MBTA. Golden eagles are best suited to hunt in open or semi-arid areas and nest on rock ledges and in cliffs that may be used seasonaly or year-round. The species local density may respond to indirect factors as cyclical prey populations. Species such as jackrabbits or hares are some of the primary prey for golden eagles and these prey are known to experience wide ranging abundance due to shifting habitat availability, drought cycles, or disturbance (Kochert and Steenhof 2002). Prey abundance and suitable nest sites determine eagle nesting density (Hunt et al. 1995). Changes in habitat characteristics that alter prey abundance affect the number of golden eagles that an area can support. With over 200 golden eagle nests and 32 potential breeding areas on the installation, WSMR has begun monitoring eagle nests and pairs to determine which territories are occupied and which pairs are breeding. The installation is also developing a Golden Eagle Management Plan to assist in avoiding the take of eagles or their nests due to military or non-military activities.

### 3.3.2 Environmental Consequences

#### 3.3.2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

Of the five proposed simulants, BtAH, is not considered hazardous to humans or other animals and, as a result, did not undergo air dispersion modeling. Ethylene is a gas that quickly dissipates and is unlikely to deposit on surface soil. It is expected that it would not present a hazard beyond the immediate confines of the test bed, where protective measures would be in place for both workers and the local environment; therefore, it did not undergo air dispersion modeling. Bt spores are commercially produced as insecticides that have been developed to specifically target moth, butterfly, and beetle larvae among other species; however, BtAH, which is proposed here, does not contain the enzyme responsible for the pesticide properties of Bt. Therefore, impacts of ethylene and BtAH on biological resources will not be discussed further. Impacts on biological resources associated with DIMP, DEEP, and CEPS follow.

***Terrestrial Habitat and Vegetation.*** Short- to long-term, negligible to minor, adverse impacts on terrestrial habitat and vegetation could occur. Vegetation occurring closest to the test area, where simulants are released, would have that greatest potential to be affected. Generally, effects could include impaired growth, reduced reproductive success, or plant mortality. With increasing distance from the point of initial release, plume concentrations would decrease rapidly. If in high enough quantities, test materials released into the air could potentially cause plant mortality, impair plant growth, or reduce reproductive success. Effects to plant life are contingent upon variables including chemical type, plant species, temperature, relative humidity, and wind speed. Plant species with higher profiles and larger canopies (e.g., shrubs and trees) would have greater capacity to intercept chemical plumes than plants with lower profiles such as forbs and grasses.

Mitigation measures and BMPs outlined in the 2007 PEIS to avoid or minimize impacts on biological resources would continue. HPAC prediction modeling and monitoring of wind speed and direction would continue. Prediction modeling would be used to determine fallout areas. Spill containment would be placed on the ground in the vicinity of the test area where heavy fallout or pooling is predicted. Based on the area and size of the predicted fallout areas, blading of the area may be accomplished prior to the placement of spill containment. Based on the type of collateral effects test being conducted, spill containment with residual material would be collected at the end of the day or at the conclusion of each test event. Vehicles would use existing roads whenever possible and off-road travel would continue to be limited to placement of testing infrastructure, plume tracking, and recovery activities, using a single path in and out.

*DIMP*. Short-term, minor, adverse impacts on terrestrial habitat and vegetation could occur with the use of DIMP. DIMP biodegradation in soil is quite slow, with a half-life in excess of 2 years. Little DIMP is lost to the atmosphere by vaporization from wet or dry soil. DIMP has high mobility if released in soils and is persistent in the environment; however, adverse effects on plants appear to be low. Plants can uptake DIMP, but bioaccumulation is low. In one study, sugar beet, carrot, wheat, and bean plants have shown some bioconcentration (APHC 2018, HSDB 2003a, Munro et al. 1999, Santa Cruz 2011).

In one study evaluating DIMP uptake from water, leaf burn or necrosis was seen in bean, radish, wheat, tomato, sugar beet, meadow fescue, and rose plants with concentrations of 10 and 100 parts per million (ppm). The same study indicated no effects on juniper, corn, and carrot plants using DIMP concentrations of 100 ppm. Irrigation water with a concentration of 20 ppm of DIMP had no effect for tested plants species (bean, radish, wheat, tomato, sugar beet, meadow fescue, and rose). An effect level for phytotoxicity was established at a concentration of 50 ppm. Bioconcentration from both soil and hydroponic solutions took place, with the highest concentrations in plant leaves (Munro et al. 1999).

DIMP has the farthest-reaching maximum airborne plume of all three simulants, with the plume extending outside the PHETS boundary toward the Oscura Mountains to the southeast. The maximum surface deposition area for DIMP reaches over approximately 1,105 acres of vegetation, which is significantly more than CEPS (298 acres) and and slightly less than DEEP (1,337 acres).

*DEEP.* Short-term, minor, adverse impacts on terrestrial habitat and vegetation could occur with the use of DEEP. DEEP has the farthest-reaching maximum surface deposition area of all three simulants, reaching over approximately 1,337 acres of vegetation. Exposure to DEEP has been shown to be toxic to ecological receptors at higher doses; however, bioaccumulation is low and persistence in the environment is unlikely. Based on its volatility, DEEP is likely to be mobile in the environment and mobile and soluble in water; however, as stated in **Section 3.2.1**, surface waters within the maximum airborne plume and surface deposition areas are characterized as intermittent, where flow ceases for weeks or months each year. No data is available regarding its persistence in air (Fisher 2018, Santa Cruz 2010).

*CEPS.* Short- to long-term, minor to moderate, adverse impacts on terrestrial habitat and vegetation could occur with the use of CEPS. CEPS is persistent in the environment in dry soil, but can hydrolyze, or break down, in the presence of moisture (Brevett et al. 2007). There is limited information regarding the potential effects of CEPS on vegetation.

***Fish and Wildlife.*** No impacts on fish and other aquatic organisms are expected. The effects of the additional simulants on fish and other aquatic organisms include toxic effects and the potential for bioaccumulation; however, the maximum airborne plume and surface deposition areas would only impact intermittent streams and creeks, which have no flow for weeks or months each year (see **Figure 3-1** and **Figure 3-2**). For this reason, impacts of the additional simulants on aquatic species will not be discussed further.

Potential short-term, acute effects on terrestrial wildlife would require animals to be within the plume near the point of dissemination or to travel through an airborne plume near an explosive test site during a test event. The highest concentrations of all materials would occur in the immediate vicinity (within 200 feet of the detonation) during large test events. The areas where the three simulants would reach acute levels would be much smaller and centered on PHETS. Wildlife that occur nearest the center of the release would be at the greatest risk and those further away would be less likely to receive acute exposure. Most releases are small tests (up to

1 gallon of simulant) and never reach potentially acute concentrations that the mid or large tests might. Acute concentrations would be limited to PHETS (less than 200 feet from the test area). Any injured or dead wildlife found in the project test beds would be reported to the WSMR Environmental Division.

Potential long-term effects on terrestrial wildlife, due to buildup of the additional simulants in the soil in surface deposition areas, have the potential to cascade up the food web to affect other organisms. The maximum surface deposition areas, or maximum extent of observable material hazard area, identified in air dispersion models and presented in **Figure 3-2**, are equal to 0.0791 mg/m$^2$ for DIMP and 0.1 mg/m$^2$ for DEEP and CEPS. The highest concentrations of all materials would occur in the immediate vicinity, up to 200 feet from the test area, where spill containment, such as plastic sheeting, would be placed to collect residual material. DTRA would continue annual soil monitoring for simulant fallout after collateral effects tests. Soil grab samples should be taken downwind and in close proximity to respective test beds. Soil samples would be analyzed for the presence and concentration of particular simulants used in a given test year and soils found to have high simulant concentration levels would be removed, if necessary, to protect human health and the environment. Continued implementation of these mitigation measures would reduce the potential for adverse impacts.

Biomagnification is an increase in concentration of a pollutant from one link in a food chain to another. It is possible that test materials may impact insect populations and the animals that depend on them such as birds and bats. The effects of the additional simulants on fish and wildlife are largely unknown; however, experiments have been performed on various model species. **Table 3-3** presents the results of these experiments for selected test materials and includes $LD_{50}$ (lethal dose 50), which is the dose of a chemical that kills 50 percent of a sample population. Based on air dispersion modeling, the predicted fallout of the additional simulants is well below the toxicity levels.

**Table 3-3. $LD_{50}$ for Proposed Simulants on Model Faunal Species**

| Test Material | $LD_{50}$ (mg/kg) | Range (mg/kg) |
|---|---|---|
| DIMP | 826 | 503 to 1,490 various species (oral) |
| DEEP | 2,330 | 785 to 2,500 rats and mice (oral) |
| CEPS | 252 | NI |

NI = no information, mg/kg = milligrams per kilogram

*DIMP*. Short-term, negligible, adverse impacts on terrestrial wildlife could occur with the use of DIMP. DIMP has the farthest-reaching maximum airborne plume of all of the additional simulants. A bioconcentration factor of 1.2 for aquatic biota indicates low potential for bioaccumulation. Other studies indicate little to no bioconcentration occurs in bluegill sunfish, ducks, and quail species exposed to DIMP. Exposure to DIMP appears to have low acute toxicity in terrestrial wildlife since it rapidly metabolizes in the body. There is also a low potential for bioaccumulation. Studies of the toxicity of DIMP in several wildlife species indicate that the $LD_{50}$ values for rats, adult mallard ducks, bobwhite quail, mink, and cattle as 826, 1,490, 1,000, 503, and 750 mg/kg, respectively. Acute exposure to DIMP by wildlife can result in adverse effects, such as neurotoxicity (rat, cow), decreased activity (rat, mouse), prostration (rat, mouse, cow, mink), salivation (mink, duck), and depression and engorgement of meningeal vessels along with excess fluid in cerebral ventricles (cow). DIMP is not considered a strong inhibitor of cholinesterase, an enzyme needed for proper functioning of the nervous system (ATSDR 1998, Munroe et al. 1999).

*DEEP.* Short-term, minor to moderate, adverse impacts on terrestrial wildlife could occur with the use of DEEP. DEEP has the farthest-reaching maximum surface deposition area of all of the additional simulants. Bioaccumulation of DEEP is low and persistence in the environment is unlikely. It has a $LD_{50}$ range of 785 to 2,500 mg/kg, based on oral exposure to a rat and was also associated with ataxia (a degenerative disease of the nervous system) and general depressed activity. Other adverse effects included dermal skin irritation and increased kidney weight. Irritation to the eyes of rabbits was severe and skin of rabbits was slight (ChemIDplus undated, Fisher 2018, Santa Cruz 2010).

DEEP is toxic to aquatic organisms and may cause long-term adverse effects in the aquatic environment; however, references provide no further information or identify the experimental study as a basis for this conclusion (Santa Cruz 2010). Although aquatic habitat within the ROI includes only intermittent streams with little to no flow, DEEP would only be a concern if carried to other waterbodies during storm events or heavy rainfall. Surface waters within PHETS are characterized as intermittent, where flow ceases for weeks or months each year. The maximum airborne plume and surface deposition areas for DEEP are confined to the PHETS (less than 200 feet from the test site).

*CEPS.* Short- to long-term, minor to moderate, adverse impacts on terrestrial wildlife could occur with the use of CEPS. There is limited information regarding the potential effects of CEPS on terrestrial species and whether or not it bioaccumulates. The corrosive and acutely toxic nature of CEPS makes the completion of chronic studies difficult. CEPS exposure can result in acute and long-lasting toxicity in humans. CEPS has low solubility in water and is slow to biodegrade in dry soil. CEPS has a $LD_{50}$ of 252 mg/kg, based on oral exposure to a rat. Irritation to the skin and eyes of rabbits was severe (Santa Cruz 2010).

CEPS has the lowest $LD_{50}$ of all proposed simulants; however, the footprint of the maximum airborne plume and surface deposition area for CEPS is the smallest. Both areas are confined to PHETS (less than 200 feet from the test site).

***Threatened and Endangered Species and Species of Concern.*** Short-term, negligible, adverse impacts on threatened and endangered species and species of concern could occur with the use of the additional simulants. The maximum surface deposition areas for the proposed additional simulants occur within established test beds where vegetation communities are considered unsuitable as aplomado falcon habitat, thus minimizing the potential to affect falcons. The maximum airborne plume for DIMP would extend slightly farther and could include suitable habitat for the aplomado falcon; however, the potential for the species to occur within these areas is minimal because the habitat in these areas is not contiguous. Mitigation measures outlined in the 2007 PEIS to avoid or minimize impacts on the northern aplomado falcon would continue. Should DTRA plan to conduct activities in areas with suitable aplomado falcon habitat, they would coordinate with the WSMR Environmental Division to ensure compliance with the ESA.

There are no resident populations of bald eagles on WSMR; however, it is described as a species passing through WSMR on migration. Golden eagles, Baird's sparrows, and peregrine falcons could occur within the maximum airborne plume and surface deposition areas (see

**Figure 3-1** and **Figure 3-2**). Golden eagles are known to reside at WSMR and are protected by the BGEPA and MBTA. Baird's sparrow is listed as a possible, rare species, occurring mainly in winter months, from October to February. The peregrine falcon is listed as rare on WSMR, occurring mainly during the breeding months of March to August (Kamees and Burkett 1996). Although eagles or other sensitive species may occur within PHETS during a test event, human activity and the small area containing acute concentrations of simulants would diminish the likelihood of injury or death to these species. In compliance with the BGEPA and MBTA, DTRA personnel would continue to verify that no active bird nests are located within or adjacent to test structures, where the highest concentrations of all materials would result, prior to collateral effects testing. Should an active nest be observed within or adjacent to test structures where activities are planned, the WSMR Environmental Division would be consulted to determine further action. In addition, WSMR could require hunters to remove oryx carcasses to avoid attracting scavengers to the test area prior to collateral effects tests, where carcasses could be an issue. The proposed additional simulants may affect the insect population in DTRA test beds, thereby indirectly affecting the food source for the spotted bat and other insectivorous fauna. DTRA and WSMR would coordinate the need for wildlife and carcass surveys based on predictions from individual test activities. It is expected this primarily would affect large test events, which typically require more monitoring than small test events.

#### 3.3.2.2 REDUCED SIMULANT QUANTITY ALTERNATIVE

The Reduced Simulant Quantity Alternative would be similar, but slightly less impactful on biological resources than the Proposed Action. Testing smaller quantities of the five additional simulants under this alternative would result in reduced and/or less frequent exposure to simulants than described for the Proposed Action. Similar mitigation measures as outlined in the 2007 PEIS and described for the Proposed Action would continue to be followed under this alternative. Therefore, this alternative would not result in significant impacts on biological resources.

#### 3.3.2.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, DTRA would not use the five additional simulants during collateral effects testing at PHETS. Conditions would remain the same as described in **Section 3.3.1** and the environmental consequences section of the 2007 PEIS. No new impacts on biological resources would occur.

## 3.4 Hazardous Materials and Wastes

### 3.4.1 Affected Environment

A hazardous material is any substance or chemical that exhibits either a physical or health hazard (29 CFR § 1910.1200). A physically hazardous materials is one that has shown to be a combustible liquid, compressed gas, explosive, flammable substance, organic peroxide, oxidizer, pyrophoric, or is unstable (reactive). The term "health hazard" includes chemicals that are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, and mucous membranes. Hazardous materials used by DTRA at PHETS include chemical and biological materials, construction products, and petroleum, oils, and lubricants (POL). In accordance with RCRA guildines, hazardous materials are stored in appropriate storage containers in areas that provide spill protection and environmental controls to protect on-site personnel. The type and degree of hazard for these materials can be found in Appendix E of the 2007 PEIS.

Hazardous waste is any material listed in 40 CFR § 261 Subpart D, or any material possessing any of the hazardous characteristics of toxicity, corrosivity, ignitability, or reactivity as defined in 40 CRF § 261 Subpart C, or any material contaminated by or mixed with any of the materials described in 40 CFR § 261.3. Waste products generated by DTRA include a variety of liquid, solid, and gaseous wastes. All waste that could potentially be defined as hazardous (e.g., spent or excess test materials, paints, glues, and POL products) is analyzed for proper disposal. If a product is deemed hazardous, it is handled in accordance with WSMR Regulation 200-1. A satellite accumulation point for the collection of small amounts of POL wastes is in the PHETS Administrative Park. Nonhazardous waste is handled as solid or nonregulated waste (DTRA 2007b).

### 3.4.2 Environmental Consequences

#### 3.4.2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

Collateral effects testing using the five additional simulants would produce similar effects on hazardous materials and wastes as described in the 2007 PEIS for the original simulants. Intermittent, short-term, negligible, adverse impacts from construction activities associated with test activities as analyzed in the 2007 PEIS would continue. Construction equipment would use small quantities of hazardous materials and POL products such as solvents, hydraulic fluid, oil, antifreeze, and other hazardous materials. The severity of a potential impact from an accidental release would vary based on the extent of a release and the substance(s) involved. Petroleum products are the most common wastes likely to be produced by personnel during construction. Mitigation measures and BMPs outlined in the 2007 PEIS would continue to be implemented reducing adverse impacts.

Long-term, negligible to minor, adverse impacts would occur during handling of the five additional simulants and collection of hazardous wastes following collateral effects testing. Collection, accumulation, and packaging of hazardous wastes would be performed in accordance with WSMR Regulation 200-1, *Environmental Hazardous Waste Management*. Potentially hazardous and toxic substances would be segregated and stored in approved containers in designated areas for disposal. Continued implementation of WSMR regulations, standard operating procedures (SOPs) addressing procedures for tracking hazardous materials and managing hazardous waste requirements at WSMR, and RCRA guidelines would reduce the potential for adverse impacts.

Mitigation measures and BMPs outlined in the 2007 PEIS to avoid or minimize impacts on hazardous materials and wastes would continue. These include using spill containment (e.g., drip pans) for vehicles, construction equipment, generators, and fuel storage units in accordance with the WSMR Spill Prevention Plan and other regulations. Waste POL products would continue to be tested for hazardous constituents that may have been picked up during use. Appropriate SOPs to prevent, control, and clean up any spills and releases that might occur would be followed. Simulants and other test materials would be used in the smallest amounts practicable in order to reduce the accumulation of hazardous wastes. Continued implementation of these measures would reduce the potential for adverse impacts from the Proposed Action.

#### 3.4.2.2 REDUCED SIMULANT QUANTITY ALTERNATIVE

The Reduced Simulant Quantity Alternative would be similar, but slightly less impactful on the storage and use of hazardous materials and generation and disposal of hazardous wastes than the Proposed Action. Testing smaller quantities of the five additional simulants under this alternative would result in a reduced generation of hazardous wastes than described for the Proposed Action. Similar mitigation measures as outlined in the 2007 PEIS and described for the Proposed Action would continue to be followed under this alternative. Therefore, this alternative would not result in significant impacts on hazardous materials and wastes.

#### 3.4.2.3 NO ACTION ALTERNATIVE.

Under the No Action Alternative, DTRA would not use the five additional simulants during collateral effects testing at PHETS. Conditions would remain the same as described in **Section 3.4.1** and the environmental consequences section of the 2007 PEIS. No new impacts on hazardous materials and wastes would occur.

## 3.5 Occupational Health and Safety

### 3.5.1 Affected Environment

General health and safety protocols for DTRA areas and facilities are addressed in various federal, state, and local guidelines, rules, and regulations. Detailed DTRA SOPs have been established to fulfill health and safety requirements at WSMR (DTRA 2007b). Additionally, safety procedures and training are available on the WSMR Safety Office web page (WSMR 2018). In accordance with SOPs, hazardous materials such as chemical and biological materials, construction products, and POL products are stored in appropriate storage containers in areas that provide spill protection and environmental controls to protect on-site personnel. Safety includes airspace management to ensure there are adequate safety buffer zones for hazardous activities involved with military testing and training, such as missile and rocket firings.

Additional potential health and safety concerns for workers on WSMR and in DTRA areas include exposure to hazardous materials, explosive devices, and unexploded ordnance (UXO). Although, all target sites undergo UXO clearance prior to use, all personnel involved in test activities at WSMR are required to receive UXO training (WSMR 2015b). Public access to the test site or surrounding surface danger zone is not allowed during test activities and the public would not be exposed to explosive activities, airborne plumes, or surface deposition areas. Although the area is open to the public during sanctioned hunts, the area would be closed off with gates should a hazard exist on the test bed.

DTRA activities pose little hazard to people living in areas adjacent to WSMR. Airborne dust has the potential to be generated off-range from high explosive tests; however, the site's location within a basin surrounded by mountains captures most dust locally.

### 3.5.2 Environmental Consequences

#### 3.5.2.1 PROPOSED ACTION (PREFERRED ALTERNATIVE)

Intermittent, short- and long-term, adverse impacts on safety would occur. Intermittent, short-term, negligible, adverse impacts would continue during test bed and site improvements. Collateral effects testing using the five additional simulants would produce similar effects on safety as described in the 2007 PEIS for the original simulants. Mitigation measures, BMPs, and precautions outlined in the 2007 PEIS, such as proper ventilation of work areas and the use of proper PPE would continue to reduce adverse impacts to personnel. Hazardous materials would continue to be stored in appropriate storage containers in areas that provide spill protection and environmental controls to protect on-site personnel. Precautions would continue to be taken to avoid possible health concerns, such as exposure to hantavirus and West Nile virus; minimize health risks from extreme desert conditions, such as heat stroke and heat exhaustion; and personnel being bitten by venomous reptiles and spiders, or being stung by scorpions.

Long-term, negligible to minor, adverse impacts would result from the use of the five additional simulants during collateral effects testing. Access to PHETS would be restricted during and after collateral effects testing in accordance with DTRA SOPs. The Test Director would have real-time weather information prior to conducting any simulant testing in order to define personnel exclusion zones. As stated in **Section 2.1**, air dispersion modeling was conducted for DIMP, DEEP, and CEPS, and the size of the resulting airborne plume and surface deposition areas would vary based on the simulant tested, testing scenario, and prevailing meteorological conditions at the time of the test. Access to range roads and hazard areas as predicted by HPAC modeling would be controlled. Non-DTRA personnel would not be within the area of these plumes, and DTRA personnel within these areas would be required to follow strict SOPs and use appropriate PPE to ensure their safety. In addition, the nearest community, San Antonito, is approximately 22 miles northwest of PHETS.

Two of the simulants under the Proposed Action, BtAH and ethylene, are not considered hazardous and did not undergo air dispersion modeling. Bt is a biosafety level 1 material. The Centers for Disease Control (CDC) defines biosafety level 1 in terms of the presence of microbes not known to cause disease in healthy adults with no or low risk to the community. The risk of infection in personnel in close proximity to a release is low, and it is not expected to pose any risk to the general public. CDC's biosafety manual notes the risk is minimal. Implementing standard microbiological safety practices (e.g., hand washing, no eating in areas where microbes are present) and using proper PPE would protect personnel from risk of an allergic reaction or infection.

Ethylene is a gas that quickly dissipates and is unlikely to deposit on surface soil. It is not expected to present a hazard to human health beyond the immediate confines of the test bed, where protective measures will be in place for both workers and the local environment. Ethylene would degrade to ethylene oxide, which is both highly volatile and mobile; however, it also degrades quickly and does not persist. Testing with ethylene is not expected to pose any risk to the general public. Using proper PPE would protect personnel from any potential impact.

DIMP is not classified as a carcinogen, because there is inadequate experimental or occupational data to make this determination. Once in the body, DIMP is rapidly metabolized to isopropyl methylphosphonic acid (IMA). Greater than 90 percent is metabolized in 24 hours and eliminated with urine. Because of this rapid metabolism, it is unlikely that DIMP would bioaccumulate (ATSDR 1998, Munro 1999). During acute exposure, DIMP can cause effects on the blood and nervous systems based on animal studies; however, as noted above, DIMP metabolizes rapidly to IMA and is eliminated with urine, which supports evidence of DIMP's chronic toxicity to humans as being low (ATSDR 1998, PubChem 2005b). No adverse health effects associated with DIMP were found in numerous studies; therefore, no lowest observed adverse effect level has been determined.

The U.S. Army Public Health Center (APHC) established a preliminary occupational exposure limit of 33 milligrams per cubic meter (4.5 ppm) as an 8-hour time-weighted average to be used until further data becomes available. Although the toxicity of DIMP via inhalation has not been tested, DIMP demonstrates low toxicity via the oral route and when compared to structurally similar compounds, indications are that inhalation toxicity of DIMP would be similarly low. Therefore, the APHC granted a toxicity clearance for DIMP for use as a vapor/aerosol chemical simulant (APHC 2018).

Exposure to DIMP appears to have low acute toxicity in terrestrial wildlife and humans, as it rapidly metabolizes in the body. If released into the environment, DIMP is mobile and highly soluble in water; it is slow to biodegrade in soil. Volatilization to air is low. Risk of exposure to personnel during collateral effects testing using DIMP would be minimized with the use of proper PPE in accordance with SDS and Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (HCS) recommendations.

Exposure to DEEP can result in skin, eye, mucous membranes, and upper respiratory tract irritation. The combustion products (i.e., CO, carbon dioxide, phosphorus oxides, and phosphine) of this highly flammable compound may cause pulmonary edema (NTP 2018). No classification on carcinogenicity is available, because there are inadequate experimental or occupational data available (Fisher 2015a). DEEP is rapidly absorbed from the gastrointestinal tract and rapidly eliminated with urine in rats, both as the parent compound and as metabolites (Blumbach 2000). DEEP is mobile and soluble in water; however, it is not persistent in the environment. Risk of exposure to military personnel during collateral effects testing using DEEP would be minimized with the use of proper PPE in accordance with SDS and OSHA HCS recommendations.

CEPS is classified by the European Chemicals Agency as a carcinogen, Category 1A via the dermal pathway; however, U.S. agencies have not assessed its carcinogenicity. Acute toxicity can occur if humans are exposed to CEPS; it is corrosive and a severe skin and eye irritant. Acute toxicity symptoms include burns and blisters, breathing difficulties, headache, dizziness, nausea, and vomiting (ECHA 2018b, Fisher 2015b). CEPS exposure can result in acute and long-lasting toxicity in humans. This results from its corrosive properties and ability to cause irritation to skin and oral tissues. Tests indicate it may be both mutagenic and carcinogenic. CEPS has low solubility in water and is slow to biodegrade in dry soil. Volatilization to air is evident, as DOE PAC values have been developed and it is known to be toxic if inhaled.

Workers are to obtain special instructions before use of CEPS. Exposure can result in acute injury and/or chronic effects, including a potential for cancer. Breathing in of dusts and vapors should be avoided. The Poison Control Center should be called or other emergency response taken if contact with CEPS occurs (Millipore Sigma 2018b). Risk of exposure to personnel during collateral effects testing using CEPS would be minimized with the use of proper PPE in accordance with SDS and OSHA HCS recommendations.

Mitigation measures and BMPs outlined in the 2007 PEIS to avoid or minimize impacts on human health and safety would continue. These include personnel working at PHETS being trained in hazard communication, SDS usage, and hazardous material spill response procedures. WSMR facilities have existing or planned procedures addressing regulated materials that require proper handling, storage, and disposal. Potential risk to the public resulting from transportation of hazardous materials are minimized by following Department of Transportation regulations regarding packaging, labeling, and transport. Personnel handling and in contact with test material occurs during test preparations, post-test evaluation, and site cleanup. Concentrated test materials are generally eye, skin, and respiratory irritants. In accordance with SDS and OSHA HCS recommendations, proper PPE would be used by all personnel handling any of the test materials listed in **Appendix D**, **Appendix E**, **Appendix F**, and **Appendix G**.

#### 3.5.2.2 REDUCED SIMULANT QUANTITY ALTERNATIVE

The Reduced Simulant Quantity Alternative would be similar, but slightly less impactful on occupational health and safety than the Proposed Action. Testing smaller quantities of the five additional simulants under this alternative would result in reduced and/or less frequent exposure to simulants than described for the Proposed Action. Similar mitigation measures as outlined in the 2007 PEIS and described for the Proposed Action would continue to be followed under this alternative. Therefore, this alternative would not result in significant impacts on occupational health and safety.

#### 3.5.2.3 NO ACTION ALTERNATIVE

Under the No Action Alternative, DTRA would not use the five additional simulants during collateral effects testing at PHETS. Conditions would remain the same as described in **Section 3.5.1** and the environmental consequences section of the 2007 PEIS. No new impacts on occupational health and safety would occur.

## 3.6 Environmental Mitigation and Minimization Measures

Environmental mitigation and minimization measures would be implemented to reduce adverse impacts from the Proposed Action. **Table 3-4** provides a quick reference to mitigation and minimization measures outlined in this EA by resource area.

**Table 3-4. Mitigation and Minimization Measures for the Proposed Action**

| Resource Area | Mitigation/Minimization Measure |
|---|---|
| Air Quality | • Consider wind direction and speed when conducting tests to ensure plume movement is toward approved areas within WSMR boundaries.<br>• DTRA personnel would conduct HPAC prediction modeling and monitor meteorological conditions before a test to ensure that the desired simulant and testing scenario are appropriate for that day's weather.<br>  ○ Collateral effects testing would occur when the prevailing wind direction is to the southeast, which would direct the airborne plume away from any populations.<br>  ○ No testing would occur when precipitation is predicted or wind speeds are greater than 15 mph.<br>• Apply dust suppressants when practical to minimize excessive vehicle-generated dust levels, and retain vegetation cover on sites wherever possible. |
| Water Resources | • Use spill containment measures on the ground for simulants used inside test structures and dispersed from unconfined containers.<br>• DTRA personnel would conduct HPAC prediction modeling and monitor meteorological conditions before a test to ensure that the desired simulant and testing scenario are appropriate for that day's weather.<br>  ○ Collateral effects testing would occur when the prevailing wind direction is to the southeast, which would direct the airborne plume away from any surface waters.<br>  ○ No testing would occur when precipitation is predicted or wind speeds are greater than 15 mph.<br>Analyze groundwater annually for particular simulants tested at PHETS. |
| Biological Resources | • DTRA personnel would conduct HPAC prediction modeling and monitor meteorological conditions before a test to ensure that the desired simulant and testing scenario are appropriate for that day's weather.<br>  ○ Collateral effects testing would occur when the prevailing wind direction is to the southeast, which would direct the airborne plume away from any populations.<br>  ○ No testing would occur when precipitation is predicted or wind speeds are greater than 15 mph.<br>• DTRA personnel would verify that no active nests are located within or adjacent to test structures prior to collateral effects testing.<br>• Use HPAC prediction modeling to determine fallout areas. Spill containment would be placed on the ground in the vicinity of the test area where heavy fallout or pooling is predicted.<br>  ○ Based on the area and size of the predicted fallout areas, blading of the area may be accomplished prior to the placement of spill containment.<br>  ○ Depending on the type of collateral effects test being conducted, spill containment with residual material would be collected at the end of the day or at the conclusion of each test event.<br>• Vehicles would use existing roads whenever possible and off-road travel would be limited to placement of testing infrastructure, plume tracking, and recovery activities, using a single path in and out.<br>• DTRA would conduct soil monitoring for simulant fallout annually after collateral effects tests.<br>  ○ Soil grab samples should be taken downwind and in close proximity to respective test beds.<br>  ○ Analyze samples for the presence and concentration of particular simulants used in a given year and soils found to have high simulant concentration levels would be removed, if necessary, to protect human health and the environment.<br>• Should an active bird nest be observed within or adjacent to test structures where activities are planned, the WSMR Environmental Division would be consulted to determine further action.<br>• WSMR could require hunters to remove oryx carcasses to avoid attracting scavengers to the test area prior to collateral effects tests, where carcasses could be an issue.<br>  ○ DTRA and WSMR would coordinate the need for wildlife and carcass surveys based on predictions from individual test activities. It is expected this primarily would affect large test events, which typically require more monitoring than small test events. |

**Table 3-4. Mitigation and Minimization Measures for the Proposed Action**

| Resource Area | Mitigation/Minimization Measure |
|---|---|
| Hazardous Materials and Wastes | • Ensure personnel involved in collateral effects testing continue to be adequately trained.<br>  ○ Train personnel working at PHETS in hazard communication, SDS usage, and hazardous material spill response procedures.<br>• Store hazardous materials in appropriate storage containers in areas that provide spill protection and environmental controls to protect on-site personnel.<br>• Minimize risks associated with transportation of hazardous materials by following Department of Transportation regulations regarding packaging, labeling, and transport.<br>• In accordance with SDS and OSHA HCS recommendations, proper PPE would be used by all personnel handling any test materials.<br>• Use spill containment measure on the ground for simulants used inside test structures and dispersed from unconfined containers.<br>• Implement appropriate SOPs to prevent, control, and clean up any spills and releases that might occur.<br>• Test waste POL products for hazardous constituents that may have been picked up during use.<br>• Use simulants and other test materials in the smallest amounts practicable in order to reduce the accumulation of hazardous wastes. |
| Occupational Health and Safety | • Consider wind direction and speed when conducting tests to ensure plume movement is toward approved areas within WSMR boundaries.<br>• DTRA personnel would conduct HPAC prediction modeling and monitor meteorological conditions before a test to ensure that the desired simulant and testing scenario are appropriate for that day's weather.<br>  ○ Collateral effects testing would occur when the prevailing wind direction is to the southeast, which would direct the airborne plume away from any populations.<br>  ○ No testing would occur when precipitation is predicted or wind speeds are greater than 15 mph.<br>• Ensure personnel involved in collateral effects testing continue to be adequately trained.<br>  ○ Train personnel working at PHETS in hazard communication, SDS usage, and hazardous material spill response procedures.<br>• Store hazardous materials in appropriate storage containers in areas that provide spill protection and environmental controls to protect on-site personnel<br>• Minimize risks associated with transportation of hazardous materials by following Department of Transportation regulations regarding packaging, labeling, and transport.<br>• In accordance with SDS and OSHA HCS recommendations, proper PPE would be used by all personnel handling any test materials.<br>• Ensure proper ventilation of work areas.<br>• Take precautions to avoid possible health concerns, such as exposure to hantavirus and West Nile virus; minimize health risks from extreme desert conditions, such as heat stroke and heat exhaustion; and personnel being bitten by venomous reptiles and spiders, or being stung by scorpions.<br>• Restrict access to PHETS during and after collateral effects testing in accordance with DTRA SOPs.<br>  ○ Test Director would have real-time weather information prior to conducting any simulant testing in order to define personnel exclusion zones.<br>  ○ Access to range roads and hazard areas as predicted by HPAC modeling would be controlled.<br>• Non-DTRA personnel would not be within the area of the plumes, and DTRA personnel within these areas would be required to follow strict SOPs and use appropriate PPE to ensure their safety. |

# 4 Cumulative Impacts

CEQ defines cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR § 1508.7). Cumulative impacts can result from individually minor but collectively significant actions taking place over time by various agencies (i.e., federal, state, and local) or individuals. Informed decision-making is served by consideration of cumulative impacts resulting from projects that are proposed, under construction, recently completed, or anticipated to be implemented in the reasonably foreseeable future. Reasonably foreseeable future actions consist of activities that have been approved and can be evaluated with regard to their impacts.

This section briefly summarizes past, present, and reasonably foreseeable future actions within the same general geographic and time scope as the Proposed Action. The geographic scope of the analysis varies by resource area. For example, the geographic scope of the cumulative impacts on safety is narrow and focused on the location of the resource. The geographic scope of air quality is much broader and considers more county- or region-wide activities.

The cumulative impacts analysis in this EA evaluates potential impacts associated with the Proposed Action in combination with other activities occurring in the northern portion of WSMR where PHETS is located. DTRA and its legacy organization has been operating and maintaining test sites and associated infrastructure at WSMR since 1975.

The present effects of past actions are now part of the existing environment described in **Section 3**. In accordance with CEQ guidance, the current impacts of past actions are considered in aggregate as appropriate for each resource area without delving into the historical details of individual past actions. Identification of projects occurring at and near the project area during the same time as the Proposed Action ensures that all current and reasonably foreseeable future projects that have the potential to result in cumulative effects are taken into account. The cumulative impact scenario, present, and reasonably foreseeable future actions, is then added to the Proposed Action.

## 4.1 Impact Analysis

### 4.1.1 Past Actions

Past actions are those actions, and their associated impacts, which occurred within the geographical extent of cumulative impacts that have shaped the current environmental condition of the ROI and surrounding areas. Prior to the U.S. military establishment of the Alamogordo Bombing Range in 1942 and the consolidation of the White Sands Proving Ground in 1948 (named WSMR in 1958), the land around DTRA test beds was used mainly for ranching and mining. The ranching and mining period began in the 1860s and continued until 1942. A variety of metallic and non-metallic minerals deposits were mined in the area. WSMR has become a sophisticated testing facility for a range of developers, both military and private sector. PHETS was created to provide a location for conducting high explosives tests consisting of igniting above- and below-ground static charges. The area has historically been used for high explosive tests, bombing, and missile impacts since the creation of WSMR in the 1940s. The Trinity Site was the location of the first atomic bomb test conducted in July 1945. WSMR has continuously been developed as DOD missions, organizations, needs, and strategies have evolved. Activities that have contributed to cumulative effects in the northern portion of WSMR in the area surrounding PHETS include past mining and ranching, past military uses, aircraft overflights, and BLM actions on adjoining lands.

### 4.1.2 Present and Reasonably Foreseeable Future Actions

WSMR is a very large military installation that is continually evolving. Several remote launch areas exist in northern WSMR to facilitate missile and rocket firings for various surface-to-surface and surface-to-air missile test programs. Warhead Impact Targets (WITs) near PHETS include Stallion WIT, approximately 2.5 miles west of the western boundary of PHETS and 649 WIT, approximately 2.5 miles west, just north of Stallion WIT. North WIT is approximately 4 miles north of the northern boundary of PHETS. Various air-to-surface and surface-to-surface test programs use these areas. The Aerial Cable Range is approximately 7 miles east of the eastern boundary of PHETS. Approximately 400 missions occur at the Aerial Cable Range per year. Approximately 20 percent of the missions involve a missile-firing operation from a ground-based launcher and 80 percent involve items dropped from a trolley, simulating airborne delivery systems for ordnance or other materials. The Stallion Range Center is approximately 8.5 miles northwest of the northwestern boundary of PHETS. Stallion Range Center contains infrastructure to support test mission activities, including an airstrip, maintenance shops, and meeting rooms. Zumwalt Test Track, which is approximately 8 miles southwest of the southernmost boundary of PHETS, was established in 1991 as the primary test bed on WSMR to test munitions/submunitions against moving armored tactical vehicles.

PHETS is used for high explosive events and tests to evaluate the effectiveness of various weapons systems against hardened targets. Hardened targets are well-protected, often deeply buried structures that include reinforced concrete bunkers and tunnels excavated into mountains. Weapons tested are mainly air-delivered bombs and missiles in the current U.S. arsenal, as well as developmental weapons. Anti-terrorism tests are conducted at PHETS using mock-up government buildings to obtain survivability data after the detonation of simulated terrorist explosive devices or for examining the characteristic of various improvement explosive devices. Large-scale static high explosive tests are conducted to evaluate the survivability of military assets against simulated enemy nuclear blasts and to calibrate equipment used to verify compliance with the Threshold Test Ban Treaty of 1974. Small-scale tests obtain explosive characteristics of various system components and requires smaller quantities of explosives.

Collateral effects testing at PHETS is conducted using chemical, biological, taggants, and other substances to simulate and track the release of materials into the atmosphere and to support the development of new detection equipment. Dispersal patterns of simulants and taggants are used to predict the behavior of WMD with similar properties. Chemical simulants are compounds that have certain properties similar to those of WMD agents such as nerve gas and mustard gas, but they have a reduced physiological effect. Biological simulants are biological substances or microorganisms that share at least one physical or biological characteristic of a biological agent, has been shown to be nonpathogenic, and can be used for biological defense testing to replace the agent under study. Biological simulants are typically common soil bacteria such as Bt or *Bascillus subtilus* var. *niger*, and killed viruses such as noninfectious influenza A. Radiological simulants are nonradioactive, but contain some of the same chemical elements that can be used in radiological dispersion devices.

Collateral effects also include impacts of weapon systems on physical property such as military equipment, vehicles, telephone poles, signs, office equipment, etc. These items are not usually placed on the target directly, but are near the intended impact point to obtain damage and durability information. Vehicles and other equipment used to assess collateral effects are typically drained of fuel and have tires removed, unless otherwise required for certain tests. Some test scenarios are designed to simulate the defeat of enemy chemical or biological weapons facilities and the resultant release of an airborne plume. These tests are typically conducted using hardened or thin-skinned targets. Thin-skinned targets simulate industrial facilities (e.g., pesticide production plants) that could be converted to chemical or biological weapon production facilities. These targets are usually beam-sheet steel structures on concrete pads.

BLM manages large tracts of land west of PHETS, beyond the WSMR boundary. These lands are used primarily for livestock grazing and recreational activities. There are no major construction activities planned on BLM lands in the area. BLM is in the process of preparing the TriCounty Resource Management Plan (RMP) and EIS, which would provide the framework for managing BLM public lands for the next 15 to 20 years. The TriCounty RMP will replace the White Sands RMP and supersede the Mimbres RMP for Doña Ana County. The Mimbres RMP will continue to guide the management of public lands within Luna, Grant, and Hidalgo Counties as well as the remainder of the Las Cruces District. The RMP will provide a land use plan consistent with current laws, regulations and policies, and allow the Las Cruces District to meet nationwide BLM goals and objectives to ensure actions taken are consistent with current policy. Long-term goals of the plan include restoring watershed health, protecting special landscapes, reclaiming legacy lands (lands that have been damaged by historic use or extraction of resources), helping local communities meet future needs, enhancing habitat for special status species, consolidating land ownership patterns, and resolving mineral conflicts.

## 4.2 Cumulative Impact Analysis by Resource Area

### 4.2.1 Air Quality

It is expected that past, present, and reasonably foreseeable future actions would result in a cumulative impact on air quality in the ROI and surrounding areas. The arid to semi-arid climate of WSMR lends the region to little plant cover that exacerbates wind erosion and dust generation. Past ranching has permanently degraded some of the vegetation and created dust problems, particularly during period of high winds. Present grazing on BLM lands adjacent to BLM also contribute to particulate emissions. Continued construction activities by DTRA and other agencies also contributes to an increase in particulate emissions. Explosive detonations continue to produce air pollutants such as airborne dust, water vapor, nitrogen, and CO. Established impact areas have little to no vegetative cover and vehicle traffic on unimproved roads contribute to particulate emissions in the area. Other emissions expected to cumulatively impact air quality include aircraft overflights below 3,000 ft (914 m), explosive testing, and the use of obscurant countermeasures. The use of the additional simulants during collateral effects testing would not increase the number of vehicle miles driven, locations of test sites, number of tests, and number of targets needed beyond the levels analyzed in the 2007 PEIS. Potential impacts on air quality from the Proposed Action would be reduced with the continued implementation of BMPs and mitigation measures outlined in the 2007 PEIS. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable future action would not result in significant cumulative impacts on air quality at WSMR or regionally.

### 4.2.2 Water Resources

It is expected that past, present, and reasonably foreseeable future actions would result in a cumulative impact on water resources in the ROI and surrounding areas. Adverse impacts on water resources would continue to occur from ground disturbance associated with vehicle traffic, construction activities, and high explosives tests, bombing, and missile impacts. Because of low precipitation levels and high evaporation rates in the area, it would be unlikely that surface water, and thus dissolved contaminants, would infiltrate to groundwater. A portion of the test materials released into the air at PHETS during collateral effects testing would eventually settle on the land surface. However, most of the material would evaporate, react, or rapidly degrade in the sunlight (photodegrade). Potential impacts on water resources from the Proposed Action would be reduced with the continued implementation of BMPs and mitigation measures outlined in the 2007 PEIS. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable future actions would not result in significant cumulative impacts on water resources at WSMR or regionally.

### 4.2.3 Biological Resources

It is expected that past, present, and reasonably foreseeable future actions would result in a cumulative impact on biological resources in the ROI and surrounding areas. Adverse impacts on biological resources would continue to occur from vehicle traffic, construction activities, and high explosives tests, bombing, and missile impacts. Vegetation may be negatively affected from collateral effects testing using the five additional simulants. Vegetation occurring closest to the test area, where simulants are released, would have the greatest potential to be affected. With increasing distance from the point of initial release, plume concentrations would decrease rapidly. Continued HPAC prediction modeling and monitoring of meteorological conditions before collateral effects testing is conducted would ensure that no impacts on fish and other aquatic organisms would occur. Potential buildup of test materials in the soil around test structures and in the maximum airborne plume and surface deposition areas have the potential to cascade up the food web to affect other organisms. Potential impacts on biological resources from the Proposed Action would be reduced with the continued implementation of BMPs and mitigation measures outlined in the 2007 PEIS. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable future actions would not result in significant cumulative impacts on biological resources at WSMR or regionally.

### 4.2.4 Hazardous Materials and Wastes

It is expected that past, present, and reasonably foreseeable future actions cumulatively would result in an increase in the use of hazardous materials and petroleum products and generation of hazardous wastes. Collateral effects testing using the five additional simulants would produce similar effects on hazardous materials and wastes as described in the 2007 PEIS for the original simulants. Collection, accumulation, and packaging of hazardous wastes would be performed in accordance with WSMR Regulation 200-1. Potentially hazardous and toxic substances would be segregated and stored in approved containers in designated areas for disposal. Continued implementation of WSMR regulations, SOPs, and guidelines would reduce the potential for adverse impacts. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable future actions would not result in significant cumulative impacts on hazardous materials and wastes at WSMR or regionally.

### 4.2.5 Occupational Health and Safety

It is expected that past, present, and reasonably foreseeable future actions cumulatively would result in an increase in health and safety impacts. Collateral effects testing using the five additional simulants would produce similar effects on health and safety as described in the 2007 PEIS for the original simulants. The potential for increased exposure to hazardous materials could result; however, continued adherence to OSHA regulations and SOPs would minimize the potential for work-related injuries and protect workers exposed to hazardous materials. Continued implementation of precautions, BMPs, and mitigation measures outlined in the 2007 PEIS would reduce the potential for adverse impacts. Therefore, the Proposed Action, when combined with other past, present, and reasonably foreseeable future actions would not result in significant cumulative impacts on occupational health and safety at WSMR or regionally.

## 4.3 Unavoidable Adverse Impacts

Unavoidable adverse impacts would result from the Proposed Action. None of these impacts would be significant.

***Hazardous Materials and Wastes.*** The use and generation of hazardous materials and wastes during collateral effects testing using the five additional simulants would be unavoidable; however, the materials and wastes would be handled in accordance with federal, state, and local policies and would not be expected to result in significant impacts.

***Biological Resources.*** Potential buildup of test materials in the soil around test structures and in the maximum airborne plume and surface deposition areas have the potential to cascade up the food web to affect other organisms. However, HPAC prediction modeling and spill containment measures would continue to be implemented. Soil monitoring for simulant fallout would continue annually after collateral effects tests. Soil samples would be analyzed for the presence and concentration of particular simulants used in a given test year and soils found to have high simulant concentration levels would be removed, if necessary, to protect human health and the environment.

## 4.4 Compatibility of the Proposed Action with the Objectives of Federal, Regional, and Local Land Use Plans, Policies, and Controls

The Proposed Action would occur entirely within WSMR. Activities would not be incompatible with any current land uses on or adjacent to PHETS. The Proposed Action would not conflict with any applicable off-installation land use ordinances and would follow all applicable permitting and safety requirements.

## 4.5 Relationship between Short-Term Uses and Long-Term Productivity

The relationship between short-term uses and enhancement of long-term productivity from implementation of the Proposed Action is evaluated from the standpoint of short-term effects and long-term effects. Short-term uses of the biophysical components of the human environment include direct construction-related disturbances and direct impacts associated with an increase in population and activity that occurs over a period of less than 5 years. Long-term uses of the human environment include those impacts occurring over a period of more than 5 years, including permanent resource loss.

The Proposed Action would not require short-term resource uses that would result in long-term compromises of productivity. The Proposed Action would not result in intensification of land use at WSMR or within the surrounding area. Implementation of the Proposed Action would not represent a loss of open space. Therefore, it is anticipated that the Proposed Action would not result in any adverse cumulative impacts on land use or aesthetics.

## 4.6 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the impacts that the use of these resources would have on future generations. Irreversible impacts primarily result from use or destruction of a specific resource that cannot be replaced within a reasonable timeframe (e.g., energy and minerals). The irreversible and irretrievable commitment of resources that would result from the Proposed Action involve the consumption of material resources used for construction and test activities, energy resources, biological resources, and human labor resources. The use of these resources is considered to be permanent.

***Material Resources.*** Material resources used for the Proposed Action would potentially include concrete and various construction materials and test supplies (e.g., various metallic materials, chemicals, and minerals). The materials that would be consumed are not in short supply, would not limit other unrelated construction or test activities, and would not be considered significant.

***Energy Resources***. Energy resources used for the Proposed Action would be irretrievably lost. This includes petroleum-based products (e.g., fuel and explosive components). During construction and test activities, gasoline, diesel, and explosive components would be used for the operation of vehicles, construction equipment, and explosive tests. Consumption of these energy resources would not place a significant demand on their availability in the region; therefore, less than significant impacts would be expected.

***Biological Resources.*** The Proposed Action would result in a negligible, long-term loss of habitat for plants or animals and an insignificant loss or impact on threatened or endangered species. Vegetation and terrestrial species occurring closest to the test area, where simulants are released, would have the greatest potential to be affected. Potential long-term effects on terrestrial wildlife, due to buildup of the additional simulants in the soil in surface deposition areas, have the potential to cascade up the food web to affect other organisms. However, with implementation of BMPs and mitigation measures outlined in this EA and the 2007 PEIS, adverse impacts on biological resources would be minimized or avoided. Potential direct effects of the proposed chemicals would be short-term and not expected to have long-term effects on wildlife populations.

***Human Resources.*** The use of human resources for construction and test activities is considered an irretrievable loss only in that it would preclude such personnel from engaging in other work activities. However, the use of human resources for the Proposed Action represents employment opportunities and is considered beneficial.

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# **Appendix A.** Interagency and Intergovernmental Distribution and Coordination

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# DISTRIBUTION LIST

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## Example Agency Letter

**DEPARTMENT OF THE ARMY**
**U.S. ARMY GARRISON WHITE SANDS MISSILE RANGE**
**100 Headquarters Avenue**
**WHITE SANDS MISSILE RANGE, NEW MEXICO 88002-5000**

September 17, 2020

Dear Sir or Madam:

The Defense Threat Reduction Agency has prepared a draft Environmental Assessment to evaluate the proposal to assess the environmental impacts of the use of five additional simulants at the Permanent High Explosive Test Site on the White Sands Missile Range (WSMR), New Mexico. The additional simulants proposed in the draft EA would be in addition to those analyzed and approved in the 2007 Defense Threat Reduction Agency Programmatic Environmental Impact Statement (PEIS). The use of the additional simulants requires further analysis, but would remain within the total volume, proposed test numbers, test site locations, and existing test bed infrastructure analyzed in the PEIS.

The Draft EA and Draft Finding of No Significant Impact (FONSI) can be viewed on the WSMR Garrison Publication website under Environmental Documents at: https://www.wsmr.army.mil/gar/GarrisonPublications/Pages/default.aspx. Hard copies of the Draft FONSI are available upon request. Your expertise is highly valued, and comments are appreciated. Please submit all correspondence to the address below no later than 20 October 2020.

Department of the Army
US Army Garrison White Sands
Environmental Division (Bldg. 163/DPW)
ATTN: Ms. Nethers
White Sands Missile Range, New Mexico 88002-5000
E-mail to usarmy.wsmr.imcom-central.mbx.dpw-nepa-support@mail.mil

Sincerely,

KNIGHT.BRIAN.DANIEL.1271283330
Digitally signed by KNIGHT.BRIAN.DANIEL.1271283330
Date: 2020.09.16 14:34:19 -06'00'

Brian Knight
Chief, Environmental Division

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# **Appendix B.** Interagency, Intergovernmental, and Public Comments

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| Comment | Name | Date | Comment | Comment Response |
|---|---|---|---|---|
| 1 | Kelly Mulvey | 10/19/2020 | Were synergistic interactions evaluated between the new simulants and those approved in the 2007 Programmatic Environmental Impact Statement? | DTRA considered this issue from an operational perspective. DTRA intends to prevent potential synergistic reactions by performing actions that may include (1) protecting the area from fall-out immediately around the test site and (2) sampling between tests. |

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# **Appendix C.**
Section 7 and
Section 106
Consultation

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To be populated following Section 7 and Section 106 consultations.

**Section 7 Consultation**

A review of the program determined the activities do not require a section 7 consultation.

## Section 106 Consultation

A review of the program determined the activities do not require a section 106 consultation.

# **Appendix D.**
Characteristics and Properties of Proposed Chemical Simulants

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# Contents

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# 1. Introduction

The potential threat posed by weapons of mass destruction (WMD), including highly toxic chemical agents and pathogenic biological agents, is cause for concern for the United States and its allies. As a result, the United States (U.S.) military conducts research on the human and environmental toxicity of these agents and methods of destruction of these agents. Because of the obvious hazards inherent in handling and releasing WMD, less toxic and pathogenic agents known as simulants, are used in some tests in place of the actual biological and chemical agents. A detailed review of various simulants is provided in the 2007 Programmatic Environmental Impact Statement (PEIS) for Defense Threat Reduction Agency (DTRA) Activities on White Sands Missile Range (WSMR), New Mexico.

**Appendix D** focuses on additional chemical and biological simulants that were not included in the 2007 PEIS. The exception is Diisopropyl methylphosphonate (DIMP), which was evaluated in the 2007 PEIS and is included here. These simulants have been selected for evaluation because they have physical and chemical characteristics similar to those of specific WMD agents, but are less hazardous to humans and the environment. **Appendix D** and **Appendix G** contain a detailed literature review on the environmental fate and specific environmental and human hazards of each of the simulants being considered.

## 1.1. List of Simulants

The proposed list of simulants that DTRA would use during testing at WSMR would be added to the list of materials already authorized on the WSMR simulant testing operations license issued by U.S. Army Developmental Test Command. The proposed simulants include the following:

- DIMP, also known as diisopropyl methane-phosphonate, phosphonic acid, and methyl-bis-(1-methyl-esthyl)-ester (CAS No. 1445-75-6)
- Diethyl ethylphosphonate (DEEP) (CAS No. 78-38-6)
- 2-chloroethyl phenyl sulfide (CEPS) (CAS No. 5535-49-9)
- Malathion also known as S-[1, 2-bis (ethoxycarbonyl) ethyl] O, O-dimethyl phosphorodithioate (CAS No. 121-75-5)
- Parathion also known as O, O-diethyl-O-p-nitrophenylthiophosphate (CAS No. 56-38-2)
- Ethylene: also known as ethene (CAS No. 74-85-1)
- *Bacillus thuringiensis* (strain Al Hakam) (BtAH)

# 2. Chemical Simulants Under the Proposed Action

A chemical weapon (CW) utilizes a manufactured chemical to incapacitate, injure, terrorize, or kill people, relying on the deleterious physiological effects of the chemical to achieve this objective. In addition to having potentially adverse health and environmental effects, CWs are of great concern as a potential WMD threat because they are often cheaper and easier to manufacture and deliver than nuclear or biological weapons.

## 2.1. Diisopropyl methylphosphonate (DIMP)

### 2.1.1. General Information

DIMP (CAS No. 1445-75-6) is a clear, colorless liquid that is a byproduct in the production of the chemical agent sarin, which was manufactured by the U.S. Army in the 1950s (ATSDR 1998). It is a diisopropyl ester of methyl phosphonic acid and is used as a simulant for G-type chemical nerve agents (DTRA 2007b, ATSDR 1998). DIMP is not produced commercially, has no known industrial or consumer application, and is not known to occur naturally in the environment (DTRA 2007b, ATSDR 1998).

### 2.1.2. Environmental Fate and Hazards

<u>Fate and Transport</u>

DIMP is highly soluble and has been identified as a groundwater contaminant on or near sites of former CW production facilities. In water, DIMP does not adsorb to suspended solids and sediment. Volatilization from surface water is low. DIMP does not undergo direct or indirect photolysis in aquatic systems. The flow of water during irrigation can carry DIMP through the soil (DTRA 2007b).

DIMP has high mobility if released in soils. Volatilization in dry soil surfaces is slow; DIMP volatilized in 10 days when applied to soil. Biodegradation in soil is slow, taking 1 year in acclimated (where bacteria that can degrade DIMP is present) soil and 3 years in unacclimated soil. DIMP is persistent in the environment (DTRA 2007b, HSDB 2003, Munro 1999).

<u>Ecological Effects</u>

Plants can uptake DIMP, but bioaccumulation is low (HSDB 2003, Santa Cruz 2011). The results of several studies vary. In one study, sugar beet, carrot, wheat, and bean plants have shown some bioconcentration; soil-grown wheat leaves had a bioconcentration factor (BCF) of 11, which was the highest of all the plants (HSDB 2003). Other studies of plants have indicated BCFs of less than 20 (Munroe 1999).

In one study evaluating DIMP uptake from water, leaf burn or necrosis was seen in bean, radish, wheat, tomato, sugar beet, meadow fescue, and rose plants with concentrations of 10 and 100 parts per million (ppm), which supports DIMP's uptake into these plants. The same study indicated no effects in juniper, corn, and carrot plants using DIMP concentrations of 100 ppm (Munroe 1999).

A bioconcentration factor of 1.2 for aquatic biota indicates low potential for bioaccumulation. Other studies indicate little to no bioconcentration occurs in bluegill sunfish, ducks, and quail species (HSDB 2003).

Studies of the toxicity of DIMP in several wildlife species indicate that the lethal dose to kill 50 percent of the test population (LD50) values for rats, adult mallard ducks, bobwhite quail, mink, and cattle as 826, 1,490, 1,000, 503, and 750 mg/kg, respectively. Acute exposure to DIMP by wildlife can result in adverse effects, such as neurotoxicity (rat, cow), decreased activity (rat, mouse), prostration (rat, mouse, cow, mink), salivation (mink, duck), and depression and engorgement of meningeal vessels along with excess fluid in cerebral ventricles (cow) (ATSDR 1998, Munroe 1999).

DIMP is not considered a strong inhibitor of cholinesterase, an enzyme needed for the proper functioning of the nervous system (ATSDR 1998, Munroe 1999).

### 2.1.3. Human Health Hazards

Occupational exposure to DIMP may occur in military workplaces during manufacturing, testing, and training. Human exposure might also occur by consumption of produce irrigated by DIMP-contaminated soil; however, this and other exposure to the general population is unlikely due to the tightly controlled use of this material (ATSDR 1998).

DIMP is not classifiable as a human carcinogen as there is inadequate experimental or occupational data to make this determination (USEPA 1989, HSDB 2003). Regarding mutagenicity, Ames assay results were negative (APHC 2018). In comparison, the Annex III Inventory of the European Chemicals Agency (ECHA) indicates that DIMP is a suspected carcinogen and mutagen, based on predictive modeling and using the ISS Carcinogenicity model and OASIS (ECHA 2016).

Once in the body, DIMP is rapidly metabolized to isopropyl methylphosphonic acid (IMA). Greater than 90 percent is metabolized in 24 hours and is excreted in the urine. Due to this rapid metabolism, it is unlikely that DIMP would bioaccumulate (ATSDR 1998, Munroe 1999).

During acute exposure, DIMP can cause effects on the blood and nervous systems based on animal studies; however, as noted above, DIMP metabolizes rapidly to IMA and is excreted in the urine, which supports evidence of DIMP's chronic toxicity to humans as being low (ATSDR 1998, PubChem 2005). It is classified as hazardous in the 2012 Occupational Safety and Health Administration (OSHA) Hazard Communication Standard (Fisher 2015, Fisher 2018). No adverse health effects associated with DIMP were found in numerous studies; no lowest observed adverse effect level has been determined (APHC 2018). The LD50 values identified for wildlife would be considered "slightly toxic" based on the Hodge and Sterner Scale (CCOHS 2018).

<u>Toxicity Values</u>

The Agency for Toxic Substances and Disease Registry's (ATSDR's) minimal risk level (MRL) for oral route of exposure, for intermediate duration (15 to 264 days) is 0.8 mg/kg-day; it is 0.6 mg/kg-day for chronic (1 year or longer) exposure. Both are based on hematological endpoints (ATSDR 2018).

The U.S. Environmental Protection Agency's (USEPA's) Integrated Risk Information System (IRIS) identifies a noncancer oral reference dose (RfD) of 0.08 mg/kg-day for chronic exposure, based on a subchronic 1980 study with beagle dogs (USEPA 1989, USEPA 2018).

<u>Standards/Screening Levels for Environmental Media</u>

USEPA has issued a lifetime Health Advisory of 600 ug/L in groundwater based on the 1980 beagle dog study. In comparison, Colorado established a more conservative groundwater quality standard of 8 ug/L, based on a reproductive toxicity screening study with minks; the results of the study were questioned, as it was thought the health effects were associated with nursing or stress syndrome (USEPA 1993, Colorado 2016, Munroe 1999, NRC 2000, Bucci 2003).

USEPA regional screening levels (RSLs) are used as a measure of potentially significant concentrations of chemicals in environmental media for the protection of human health. The DIMP RSLs (at a target risk of 1E-06 and hazard quotient of 0.1) are 630 mg/kg for a resident's exposure to contaminated soil, 9,300 mg/kg for a worker's exposure to soil, and 160 ug/L for a resident's exposure to DIMP in drinking water (USEPA 2018b).

There are no occupational monitoring studies for DIMP and no occupational exposure levels (OEL) for humans. However, a study in April 2018 by the U.S. Army Public Health Center evaluated the toxicity of DIMP and provided a preliminary OEL of 33 mg/m$^3$ (4.5 ppm) in air. The use of the preliminary value is recommended until further data becomes available. The OEL is expressed as an 8-hour time-weighted average (TWA) based on a 40-hour week (APHC 2018).

The U.S. Department of Energy (DOE) provides Protective Action Criteria (PACs) for exposure to DIMP via the inhalation route. The PACs assume a minimum 1 hour exposure in which 2.7 mg/m$^3$ (PAC-1) of DIMP can cause discomfort, irritation, or other effects that are reversible; 30 mg/m$^3$ can cause irreversible or other serious, long-lasting health effects; and 180 mg/m$^3$ is life-threatening and can cause death (DOE 2018).

### 2.1.4. Discussion

Exposure to DIMP appears to have low acute toxicity in terrestrial wildlife and humans, as it rapidly metabolizes in the body. Adverse effects on aquatic biota and plants also appear to be low. If released into the environment, DIMP is mobile and highly soluble in water; it is slow to biodegrade in soil. Volatilization to air is low. Risk of exposure to military workers during manufacturing, testing, and training with DIMP should be minimized by the use of proper personal protective equipment (PPE), corrective actions (e.g., containment or confinement), and decontamination procedures.

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## 2.2. Diethyl ethylphosphonate (DEEP)

### 2.2.1. General Information

DEEP (CAS No. 78-38-6) is a colorless, organophosphate liquid with a mild odor (NOAA CAMEO undated). It is a G-series nerve agent simulant that closely mimics these CW agents. This series includes GA (tabun), GB (sarin), and GD (soman) (Bartelt-Hunt SL 2008, ATSDR 2014). DEEP is used commercially for heavy-metal extraction and solvent separation as well as a flame retardant, gasoline additive, antifoam agent, plasticizer, and textile conditioner (HSDB 2003, Fisher 2015). It is also used in adhesives, sealants, and in construction materials (PubChem 2015).

### 2.2.2. Environmental Fate and Hazards

<u>Fate and Transport</u>

DEEP is identified as highly soluble in water in one source (ChemID undated) with a solubility of 17,500 mg/L at 25 degrees Celsius. While it is noted as being slightly soluble in water, and miscible in several solvents in other sources, the sources do not provide a numeric solubility value. These sources refer to a 1992 National Toxicology Program (NTP) reference, which was last updated in August 2018. The updated NTP data sheet is available at <*https://ntp.niehs.nih.gov/testing/status/agents/ts-10412-w.html*>. DEEP may hydrolyze, or break down, under acid or basic conditions (NOAA CAMEO undated, HSDB 2003). Although DEEP is noted as being colorless in many sources, it can also be a light, transparent yellow color (IRO 2017). It can smell sweet (HSDB 2003). DEEP is likely to be mobile in the environment based on its volatility (Fisher 2018). Bioaccumulation is low and persistence of DEEP in the environment is unlikely (Fisher 2018, Santa Cruz 2010).

<u>Ecological Effects</u>

DEEP is toxic to aquatic life with long lasting effects; however, references located provide no further information or identify the experimental study as basis for this conclusion (PubChem 2015, Fisher 2015 and 2017, Chemical Book 2017).

### 2.2.3. Human Health Hazards

Exposure to DEEP can result in skin, eye, mucous membranes, and upper respiratory tract irritation. The combustion products (i.e., carbon monoxide, carbon dioxide, phosphorus oxides, and phosphine) of this highly flammable compound may cause pulmonary edema (NTP 2018).

No classification information on carcinogenicity is available from USEPA, the International Agency for Research on Cancer (IARC), NTP, OSHA, or American Conference of

Governmental Industrial Hygienists (ACGIH) (Fisher 2015, NOAA CAMEO undated). There is inadequate experimental or occupational data available (Fisher 2015). ECHA indicates that DEEP is a suspected carcinogen and mutagen based on the ISS Carcinogenicity model and OASIS (ECHA 2016).

DEEP is rapidly absorbed from the gastrointestinal tract and rapidly eliminated with urine in rats, both as the parent compound and as metabolites (Blumbach 2000). An Ames bacterial test provided no evidence of mutagenicity for DEEP (TOXLINE undated). DEEP also tested negative for mutagenicity using the AMES test with rat and hamster liver enzymes (PubChem 2015). Although DEEP has not been studied on chronic basis, it may induce renal tumor formation in male rats when given at high doses for a prolonged time, based on its capability to bind to a protein in kidney nephrons (Blumbach 2000).

Toxicity Values

DEEP has a LD50 of 2,330 mg/kg, based on oral exposure to a rat and was also associated with ataxia and general depressed activity (ChemIDplus undated, Fisher 2018). Based on oral exposure of a mouse to DEEP, a LD50 of 2,500 mg/kg was identified in the same study, also associated with general depressed activity (ChemIDplus undated, Fisher 2015). Another study identified a LD50 of greater than 2,000 mg/kg, with dermal skin irritation (Fisher 2015). These LD50 values would be considered “slightly toxic” based on the Hodge and Sterner Scale (CCOHS 2018). A study conducted in 2000 that administered one dose of 500 mg/kg of DEEP resulted in high mortality, which resulted in the dose being lowered to 50 and 100 mg/kg during the 5-day acute study; increased kidney weight was identified as resulting from exposure to DEEP (Blumbach 2000).

Standards/Screening Levels

For inhalation exposure to DEEP, the DOE PACs assume a minimum 1 hour exposure, during which 1 mg/m$^3$ (PAC-1) can cause discomfort, irritation, or other reversible effects. Exposure to 11 mg/m$^3$ can cause irreversible, or other serious, long-lasting health effects; whereas exposure to 460 mg/m$^3$ is considered life threatening and can cause death (NOAA CAMEO undated, DOE 2018).

### 2.2.4. Discussion

Exposure to DEEP has been shown to be toxic to ecological and human receptors at higher doses. It has long-term toxic effects on aquatic life. DEEP is mobile and soluble in water; however, is not persistent in the environment. Precautions related to potential inhalation, including the need to evacuate the area of any release immediately and recommending transporting anyone exposed to DEEP to a hospital immediately indicate the potential for volatilization to air is high.

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## 2.3. 2-chloroethyl phenyl sulfide (CEPS)

### 2.3.1. General Information

CEPS (CAS No. 5535-49-9) is a clear, colorless liquid that is used as a simulant for sulfur mustard agent and chemical warfare agent sulfur mustard, bis(2-chloroethyl) sulfide (Sigma-Aldrich 2018).

### 2.3.2. Environmental Fate and Hazards

Fate and Transport

CEPS is stable under normal temperature and pressure; its odor has been described as a “stench” (MOLBASE 2016). One safety data sheet (SDS) states that CEPS should not be allowed to reach groundwater, a watercourse or sewage system (Fisher 2015). This is likely due to its noted acute corrosivity and toxicity on direct contact, as CEPS has low water solubility (Wagner 1998).

CEPS is persistent in the environment in dry soil, but can hydrolyze in the presence of moisture. One study indicates CEPS degraded from 1-year-old concrete with a first-order half-life of 19 weeks; it took 9 months for 50 percent of CEPS to degrade on wet, aged concrete (Brevett 2007).

When a nanocomposite adsorbent (Pb-MCM-41/ZnNiO2) was applied on CEPS, CEPS degraded in under an hour (Sadeghi 2017).

Ecological Effects

There is limited information regarding the potential effects of CEPS on aquatic and terrestrial species and whether or not it bioaccumulates. The corrosive and acutely toxic nature of this chemical makes the completion of chronic studies difficult.

### 2.3.3. Human Health Hazards

CEPS is classified as a carcinogen, Category 1A via the dermal pathway (ECHA 2018). The ECHA Annex III Inventory also indicates that CEPS is a suspected carcinogen and mutagen based on the ISS Carcinogenicity model, CAESAR Mutagenicity model, and SARPY Mutagenicity model (ECHA 2016). In comparison, U.S. agencies have not assessed its carcinogenicity (Fisher 2015, MOLBASE 2016, NCBI n.d.).

Acute toxicity can occur if humans are exposed to CEPS; it is corrosive and a severe skin and eye irritant. Acute toxicity symptoms include burns and blisters, breathing difficulties, headache, dizziness, nausea and vomiting (Fisher 2015).

Toxicity Values

No data were available related to the quantitative toxicity values of CEPS; the DOE PACS noted below and known symptoms of exposure do indicate it is highly toxic.

Standards / Screening Levels

For inhalation exposure to CEPS, the DOE PACs assume a minimum 1-hour exposure in which 1.2 $mg/m^3$ (PAC-1) can cause discomfort, irritation or other effects that are reversible. Exposure to 13 $mg/m^3$ (PAC-2) can cause irreversible or other serious, long-lasting health effects whereas exposure to 79 $mg/m^3$ (PAC-3) is life threatening and can cause death (DOE 2018).

### 2.3.4. Discussion

CEPS exposure can result in acute and long-lasting toxicity in humans. This results from its corrosive properties and ability to cause irritation to skin and oral tissues. Tests indicate it may be both mutagenic and carcinogenic. CEPS has low solubility in water and is slow to biodegrade in dry soil. Volatilization to air is evident, as Department of Energy protective action criteria values have been developed and it is known to be toxic if inhaled. Workers are to obtain special instructions before use of CEPS. Exposure can result in acute injury and/or chronic effects, including a potential for cancer. Breathing in of dusts and vapors is to be avoided and protective gloves, clothing, eye and face protection should be used (Millipore 2018).

A Poison Control Center should be called or other emergency response taken if contact with CEPS occurs (Chemical Book 2017).

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## 2.4. Ethylene

### 2.4.1. General information

Ethylene (CAS No. 74-85-1) is a colorless, flammable gas with a slight sweet odor produced by the petrochemical industry and is important in the production of polyethylene, the most common plastic (DOW 2014). It is one of the largest volume organic chemicals produced globally (Dow 2014). Ethylene is also used as a refrigerant, in welding and cutting of metals, an anesthetic, and in agriculture for fruit ripening and growth retardation (HSDB 2018). It will be used in testing as a generic gas.

### 2.4.2. Environmental Fate and Hazards

<u>Fate and Transport</u>

Ethylene is a naturally occurring, gaseous hormone in plants. It is ubiquitous in the atmosphere, with concentrations reaching 5 ug/m$^3$ at remote sites and up to 1,000 ug/m$^3$ in urban centers. Ethylene is released into the environment from burning vegetation, petroleum refining, incomplete combustion of fossil fuels, exhaust from automobiles and diesel engines, and from sewage treatment plants (USACHPPM 2006).

Ethylene tends to migrate to the atmosphere because of its high vapor pressure. In the presence of oxygen, it biodegrades quickly, with an estimated half-life of 1.9 days. It degrades even faster in sunlight. It does not persist and is expected to move quickly through soil (DOW 2014, HSDB 2018). Ethylene is slightly soluble in water (HSDB 2018, IARC 1994).

<u>Ecological Effects</u>

Ethylene exists naturally in the environment and is produced by plants. It acts as a plant hormone in regulation of plant growth and development (DOW 2014, HSDB 2018, PubChem 2004, USACHPPM 2006). Plants exposed to ethylene after they are harvested will ripen, resulting in browning, yellowing, and/or wilting during transport and in the consumer environment (Erisfilter 2018).

An estimated BCF of 2.6 in fish suggests the potential for bioconcentration in aquatic organisms is low (HSDB 2018, DOW 2014).

The 48-hour LC50 of ethylene was 62.5 mg/L using Daphnia. In another study based on exposure to *Raphidocelis subcapitata* (microalgae) in freshwater, the 72-hour Effect Concentration (EC) 50 ranged from 13.9 to 72.2 mg/L (ECHA undated). One subchronic 14-day study indicated a LC50 of 60.037 mg/L for exposure of earthworms to ethylene (ECHA n.d.).

Given the volatility of ethylene, it is unlikely that it would persist in the environment long enough to allow for significant exposure to terrestrial wildlife (USACHPPM 2006).

However, ethylene is readily converted to ethylene oxide, which is more stable and could pose some risk to wildlife (USACHPPM 2006). Animal tests of ethylene oxide have shown high acute toxicity from inhalation, similar to humans that have been exposed (USEPA 2017).

### 2.4.3. Human Health Hazards

Ethylene is an extremely flammable gas that can form explosive mixtures in ambient air. It may explode if heated (Airgas 2018).

There is inadequate data to determine the carcinogenicity of ethylene and it is not classifiable as to its carcinogenicity to humans (Group 3) (HSDB 2018, IARC 1994). Mutagenicity studies were negative (DOW 2014, HSDB 2018). Ethylene is metabolized to ethylene oxide, which is known to be acutely toxic and have carcinogenic and mutagenic effects (DOW 2014, USACHPPM 2006).

Acute exposure to ethylene may cause headache, dizziness, drowsiness, or other central nervous system effects. In confined or poorly ventilated areas, ethylene vapor can accumulate, displacing oxygen and resulting in unconsciousness or asphyxiation. Eye or skin contact with liquefied ethylene can cause frostbite. The primary route of exposure is via the inhalation pathway (DOW 2014). The biological half-life of ethylene in humans is 0.65 hour (HSDB 2018, PubChem 2004).

Ethylene is easily transformed to ethylene oxide, a chemical that is acutely toxic if inhaled or ingested, can cause eye, skin, and mucus membrane irritation and malfunction of the nervous system. Higher levels of exposure to ethylene oxide are more severe and harmful. Reproductive effects, including miscarriage have been noted in animal and epidemiological studies (ATSDR 1990).

Workers exposed to ethylene oxide have had an increased rate of leukemia, stomach, and pancreatic cancer and Hodgkin's disease; it has been shown to cause cancer in animal studies, including leukemia, brain, lung, and other cancers (ATSDR 1990).

Standards/Screening Levels

Ethylene is considered to be hazardous by OSHA, having a narcotic effect (Airgas 2018). For inhalation exposure to ethylene, the ACGIH Threshold Limit Value (TLV) is 200 ppm as an eight-hour time-weighted average (TWA) (DOW 2014, PubChem 2004). The DOE PACs are 600 ppm (PAC-1, 688.44 mg/m$^3$), 6,600 ppm (PAC-2, 7572.86 mg/m$^3$) and 40,000 ppm (PAC-3, 45,896 mg/m$^3$) (DOE 2018,).

### 2.4.4. Discussion

Exposure to ethylene itself appears to have low toxicity in wildlife and humans, as it readily evaporates and does not bioaccumulate. These characteristics also limit the extent to which it is transported and affects the environment. Risk of exposure or injury to military workers during manufacturing, testing, and training with ethylene should be minimized with by the use of proper PPE, keeping ethylene away from heat and ignition sources, there should be no smoking allowed where ethylene is stored or in use. Persons exposed should be removed to fresh air and their breathing monitored, providing medical support if symptoms are uncomfortable.

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# 3. Biological Simulants Under the Proposed Action

## 3.1. Bacillus thuringiensis var. Al Hakam

### 3.1.1. General Information

*Bacillus thuringiensis Al Hakam* (BtAH) is a common firmicutes soil bacteria used as a biological simulant for *B. anthracis* (UniProt 2018, McCartt 2011, NCBI, n.d.). This particular strain has had an enzyme removed so that it is ineffective as an insecticide and it is not commercially available (Ibrahim et al. 2010).

### 3.1.2. Environmental Fate and Hazards

<u>Fate and Transport</u>

Neither the fate nor degradation of *Bacillus thuringiensis* (Bt) in the environment is well understood. Studies completed indicate there is great variability in the results, even within the same study (Clark, B. et al 2005). In comparison to other *B.* strains, Bt endospores are larger, possess a thin cell coat, and have a flexible exosporium. The exosporium likely shields the bacterium from various agents and environmental factors and slows the uptake of water because of its hydrophobicity (McCartt 2011, Ratnesar-Shumate 2015).

Biological aerosols may undergo physical and chemical transformations when released into the environment. Exposure to ozone, iodine, and higher levels of humidity can promote degradation of BtAH (Ratnesar-Shumate 2015, Buhr 2016).

There are very limited studies available on changes in the expression of Bt proteins in general during a growing season, and how this may change due to various stressors. The highest concentration of Bt in plants is at the seedling stage. The largest amount of bacterial protein occurs when plants are in full flower, when plant biomass is greatest. Bt proteins are incorporated into soil with plant tissue after harvest. Note: this research is not BtAH specific (Clark 2005).

One of the few published quantitative estimates of Bt protein loads to soil concluded that approximately 486 g/acre (1174 g/ha) or 1.6 ug/g of soil of Bt protein would be incorporated in soil from a mature cotton crop (Clark 2005). Persistence in soil appears to be variable (Clark 2005).

Inoculation of 1x2 or 2x2 cm BtAH substrates inside of a cargo hold of a C-130 military transport aircraft indicated dispersal throughout the entire cargo hold (Buhr 2016).

<u>Ecological Effects</u>

There is a general lack of information regarding the potential effects specifically of BtAH on aquatic and terrestrial species. Other Bt formulations are highly specific to the target insect for which the pesticide was developed. A review of selected studies on Bt indicated that adverse effects to insects, butterflies, and other higher, non-target species varied, with such impacts limited to few species overall (Clark 2005).

One study indicated that BtAH, at the highest dose rate used, exhibited no toxicity to various other invertebrate species, including the greater wax moth, diamondback moth, beet armyworm moth, mealworm, springtail arthropod, housefly, and roundworm (Bishop 2014).

### 3.1.3. Human Health Hazards

There is a lack of information specifically regarding the potential effects of BtAH on the health and safety of humans (GMOSCIENCE 2015, USEPA 2001). Data on genetically modified biological pesticide formulations, similar to BtAH vary in terms of conclusions related to potential adverse health impacts (EXTOXNET 1994).

### 3.1.4. Discussion

There is very little information available of BtAH; however, given that BtAH contains a deactivated protein by design, which is why it is used as a simulant for other bacterial agents, it should generally have low, acute toxicity in wildlife and humans. However, the results of studies performed on similar bacteria do vary, depending on the species. Fate and transport-related properties are not well studied. Due to general lack of data specific to BtAH, risk of exposure would be minimized by the use of proper PPE.

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# 4. Chemical Simulants Considered but Dismissed

## 4.1. Malathion

### 4.1.1. General Information

Malathion (CAS No. 121-75-5) is a non-systemic, synthetic, organophosphate insecticide that is a simulant for the nerve agent VX (James 2018). It has been manufactured in the United States since 1950 to control mosquitoes, flies, and parasites. It is used as a pesticide in agricultural commercial (i.e., golf courses) and residential (i.e., home garden, landscaping) settings. Malathion has a strong, garlic-like odor; it is colorless when pure and dark brown to yellow when in a technical-grade solution (ATSDR 2003).

### 4.1.2. Environmental Fate and Hazards

<u>Fate and Transport</u>

If malathion is released into the air, it will break down rapidly in sunlight. Its half-life is 1.5 days (EXTOXNET 1993). Another source indicates malathion's half-life is 5 hours in air (HSDB 2016).

Malathion is usually broken down within a few weeks by water, sunlight, and bacteria found in soil and water. Malathion does not tend to stick to soil; the half-life in soil ranges from 1.33 to 4.14 days. Given its Koc value (range of 927 to 17,620) and quick degradation in soil, it is unlikely that malathion will reach groundwater in significant amounts (HSDB 2016).

In water, the half-life of malathion is 1.65 days at a pH of 8.16 and 17.4 days at a pH of 6. The breakdown products in water are mono- and di-carboxylic acids. In sediment, the half-life is 0.8 to 1.4 days under aerobic conditions and 1.6 to 2.3 days under anaerobic conditions (Gervais 2009).

<u>Ecological Effects</u>

Based on the rapid metabolism and short half-life, bioconcentration of malathion in aquatic organisms is expected to be low, with BCFs of less than 10 (HSDB 2016, EXTOXNET 1993).

Malathion is highly toxic to aquatic organisms for both acute and chronic exposures. This includes being toxic in the aquatic stages of the amphibian life cycle. Due to its short half-life, malathion is not expected to bioconcentrate in aquatic organisms. It is known to be highly toxic to honey bees. It has low to moderate toxicity for birds and mammals (Gervais et al. 2009, EXTOXNET 1993, ECHA 2018).

Experimental studies have identified LD50 values of less than 15 mg/L for the fathead minnow and daphnia (ECHA 2016).

The acute oral LD50 in rats range from 290 to 12,500 mg/kg and in mice from 190 to 4,000 mg/kg. A study using guinea pigs identified an oral LD50 of 570 mg/kg. The acute dermal LD50 in rats is greater than 2000 mg/kg and in rabbits between 4,100 and 8,800 mg/kg. The acute inhalation LC50 in rats is greater than 5.2 mg/L (Gervais 2009, NIOSH 2016).

### 4.1.3. Human Health Hazards

Symptoms following acute exposure may include vomiting, diarrhea, pinpoint pupils, blurred vision, sweating, salivation, crying, wheezing, production of phlegm, agitation, cardiac arrhythmias, muscle weakness, and/or incontinence. Death can result from coma, adverse respiratory effects, and cardiac arrhythmias. The toxicity of malathion requires metabolic activation; adverse effects may become apparent minutes to hours after exposure (ATSDR 2014).

Historically, there has been inadequate data to determine the carcinogenicity of malathion (USEPA 1987, IARC 2016). Recently, IARC has determined there is limited evidence of carcinogenicity in humans, with malathion being positively associated with non-Hodgkin's lymphoma (NHL) and prostate cancer. There is sufficient evidence in experimental animals for the carcinogenicity of malathion (IARC 2016). Therefore, IARC has classified it as probably carcinogenic to humans (Group 2A) (IARC 2016, ECHA 2018b, HSDB 2016). Malathion is also a suspected mutagen based on predictive modeling (ECHA 2016).

For noncancer effects, malathion is classified as slightly toxic to humans. Acute symptoms include nausea, headache, tightness in the chest, and other symptoms typical of acetyl-cholinesterase inhibition. Human exposure can occur through ingestion, inhalation, and absorption through the skin, where it is rapidly passes into the bloodstream. Most malathion is broken down in the liver into its active metabolite, malaoxon, which is an active anticholinesterase agent, with adverse effects on the nervous system. Malathion has low chronic toxicity, as it does not tend to bioaccumulate in the body. It is expelled in the urine within a few days after exposure (ATSDR 2003, EXTOXNET 1993).

<u>Toxicity Values</u>

An ATSDR MRL of 0.2 mg/m$^3$ has been derived for acute duration inhalation exposure (14 days or less), based on a neurological endpoint. An MRL of 0.02 mg/m$^3$ was also derived for intermediate duration inhalation exposure based on a respiratory endpoint. Both the intermediate and chronic duration oral exposure MRL is 0.02 mg/kg-day, based on a neurological endpoint (ATSDR 2018).

USEPA IRIS identifies a noncancer oral RfD of 0.02 mg/kg-day for chronic exposure, the critical effect was reduced plasma and red blood cell cholinesterase activity (USEPA 1987, 2018).

<u>Standards/Screening Levels</u>

USEPA has established a health advisory of 0.1 mg/L (100 ug/L) in drinking water for lifetime exposure of adults. This level is not expected to cause effects that are harmful to health (ATSDR 2003).

Current USEPA RSLs (at a target risk of 1E-06 and target hazard quotient of 0.1) for screening malathion in environmental media are 130 mg/kg for a resident's exposure to contaminated soil, 1,600 mg/kg for a worker's exposure to soil, and 39 ug/L for a resident's exposure to malathion in drinking water (USEPA 2018b).

The Food and Drug Administration (FDA) and USEPA allow a maximum of 8 ppm of malathion to be present as a residue on specific crops used as foods (ATSDR 2003).

For inhalation exposure to malathion, OSHA has set a Permissible Exposure Limit (PEL) of 15 mg/m$^3$ in air for an 8-hour work shift during a 40-hour week. NIOSH has set a Recommended Exposure Limit (REL) of 10 mg/m$^3$ in air for a 10-hour work shift during a 40-hour week (NIOSH 2016). The DOE PACs assume a minimum 1 hour exposure in which exposure to 15 mg/m$^3$ in air (PAC-1) can cause discomfort, irritation, or other reversible effects, 120 mg/m$^3$ (PAC-2) can cause irreversible or other serious, long-lasting health effects, and 390 mg/m$^3$ in air (PAC-3) is life-threatening and can cause death (DOE 2018).

### 4.1.4. Discussion

Exposure to malathion is highly toxic to aquatic organisms and honey bees, less so to other species, such as birds. It is also acutely toxic to humans, with evidence that it can cause cancer. In the environment, malathion breaks down fairly quickly in soil and in water also. Due to its low vapor pressure, volatilization to air is not significant; however, a typical commercial formulation for use as a pesticide includes malathion that has been dissolved in organic solvents, which may be volatile and toxic in their own right. Exposure or injury to military workers can be minimized by the use of proper PPE, decontamination, and treatment for malathion poisoning (e.g., providing cardiorespiratory support and use of antidotes such as atropine and pralidoxime). Do not induce vomiting. In severe poisoning, diazepam should be administered as well. Antidotes should be administered as a countermeasure, even when the diagnosis of malathion poisoning is unsure (ATSDR 2014).

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## 4.2. Parathion

### 4.2.1. General Information

Parathion (CAS No. 56-38-2) is a liquid organophosphate pesticide that is a simulant for the nerve agent VX (Halder 2011). Parathion is no longer used or produced in the United States. USEPA terminated most production in December 2002, and terminated the registration of remaining parathion products in December 2006. However, this organophosphorus insecticide is currently used in other countries to control insects and mites. Pure parathion is pale-yellow in color with a faint phenol-like odor, while technical parathion is a pale-yellow to dark brown liquid. The odor threshold is 5 times the OSHA PEL of 0.1 mg/m$^3$, which does not provide adequate warning of hazardous concentrations (NIOSH 2016). Because parathion has a low vapor pressure, significant inhalation is unlikely unless heated. Parathion is often dissolved in hydrocarbon solvents in commercial preparations, which can be inhaled (ATSDR 2017).

### 4.2.2. Environmental Fate and Hazards

<u>Fate and Transport</u>

Parathion is expected to have limited mobility in soil, as it is highly adsorbed by soils. If released into water, parathion is expected to adsorb to suspended solids and sediment in the water column. Parathion biodegrades in natural waters having acclimated bacteria within several weeks. Volatilization of parathion from soil and water is low (HSDB 2003, ATSDR 2017). As noted above, parathion has a low vapor pressure, limiting its volatility and inhalation potential (ATSDR 2017).

Parathion in the environment is degraded by photolysis, hydrolysis, and biodegradation. The measured photolysis half-life in water is approximately 2 to 3 weeks. Hydrolysis takes place more slowly, with a half-life of 1 to 4 months depending upon temperature and the degree of acidity of the water. The mobility of parathion in soils is expected to be low; it is not expected to move from the soil surface to groundwater. It has low solubility in water (ATSDR 2017).

Ecological Effects

Parathion bioaccumulation data for aquatic organisms varies, as indicated by BCF values ranging from 63 to 462 for various freshwater fish (e.g., bluegill sunfish, brook trout, and killifish) (ATSDR 2017, HSDB 2005). There is no evidence of bioaccumulation in snails, algae, daphnia, mosquito larvae, or fish in a 38-day experiment (HSDB 2005), nor in cattle, sheep, and rabbits (HSDB 2005, EXTOXNET 1993). It does persist in the environment (ECHA 2016).

The oral LD50 range is 0.93 to 32 mg/kg in various species, including rats, mice, guinea pigs, rabbits, cats, and dogs. Parathion is particularly toxic to birds; the oral LD50 for parathion is 6 mg/kg in bobwhite quail, 3 mg/kg in pigeons, and 2.1 mg/kg in ducks. The dermal LD50 range is 6.8 to 50 mg/kg in various species, including rats, mice, guinea pigs, and rabbits. The oral LC50 is 84 $mg/m^3$ based on rats. Parathion is considered moderately toxic to fish and aquatic invertebrates based on LC50 values with a range of 0.02 to 2.7 mg/L (EXTOXNET 1993).

### 4.2.3. Human Health Hazards

USEPA IRIS identifies parathion as a possible human carcinogen (Group C) based on adrenal cortical tumors and association with cancer in the thyroid and pancreas (USEPA 1988, HSDB 2005). IARC also identifies parathion as possibly carcinogenic to humans (Group 2B) (IARC 2017, HSDB 2005). Parathion is rapidly absorbed via ingestion and skin and eye contact, with acute systemic toxic effects (ATSDR 2014). ECHA lists parathion as being fatal if swallowed or inhaled and toxic via contact with skin. It is also listed as a suspected carcinogen and mutagen (ECHA 2016).

Parathion is rapidly absorbed in the bloodstream and can result in acute adverse health effects to the nervous system. It can cause excessive eye watering and salivation, blurred vision, stomach cramps, tremors, and seizures. Parathion is broken down by the liver into metabolites, such as paraoxon, which can take several days to eliminate from the body through the excretion of urine (ATSDR 2017).

Toxicity Values

The ATSDR MRL for intermediate-duration inhalation exposure of parathion is 20 $ng/m^3$ based on a neurological endpoint. The MRL for intermediate-duration oral exposure of parathion is 0.009 mg/kg-day, also based on a neurological endpoint (ATSDR 2018).

The noncancer oral RfD is 0.006 mg/kg-day for chronic exposure based on decreased cholinesterase activity (USEPA 2018).

Standards / Screening Levels

The current RSLs (at a target risk of 1E-06 and target hazard quotient of 0.1) are 38 mg/kg for a resident’s exposure to contaminated soil, 490 mg/kg for a worker’s exposure to soil, and 8.6 ug/L for a resident’s exposure to parathion in drinking water (USEPA 2018).

For inhalation exposure to parathion, OSHA has set a PEL of 0.1 $mg/m^3$ based on an 8-hour work shift during 40-hour week. In comparison, NIOSH has set a REL of 0.05 $mg/m^3$ based on a 10-hour work shift during a 40-hour week (NIOSH 2016).

The DOE PACs assume a minimum 1-hour exposure in which 0.15 $mg/m^3$ (PAC-1) can cause discomfort, irritation, or other effects that are reversible. Exposure to 1.5 $mg/m^3$ (PAC-2) can cause irreversible or other serious, long-lasting health effects; whereas exposure to 2 $mg/m^3$ (PAC-3) is life threatening and can cause death (DOE 2018).

#### 4.2.4. Discussion

Parathion is acutely toxic to humans, birds, and in particular, to aquatic species; it is persistent in the environment. It metabolizes in a few days and then eliminated in the urine. It binds to both soil and particles in water and sediment and biodegrades in environments having acclimated bacteria. There is low volatilization potential to air. Risk of exposure or injury to workers can be minimized through the use of proper PPE, corrective actions (e.g., containment or confinement), decontamination, supportive measures, up to and including advanced life support, as needed and the administration of an antidote (i.e., atropine) in symptomatic persons.

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## **Appendix E.**
## Hazard Ratings for Proposed Chemical Simulants

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| Test Material | CAS Number | NFPA[4] | | | Listed as Hazardous by: | | | | Discussion of Material |
|---|---|---|---|---|---|---|---|---|---|
| | | Health | Flammability | Reactivity | DOT | EPA | OSHA | Other | |
| Diisopropylmethyl phosphonate (DIMP) | 1445-75-6 | 2 | 1 | 0 | No | No | Acute toxicity, oral (Category 4) - H302,<br>Skin corrosion (Category 2) - H315,<br>Serious eye damage/irritation (Category 2) - H318/H319,<br>Specific target organ, single exposure (Category 3, respiratory) - H335 | No | Appendix D, Section 2.1 |
| Diethylethyl phosphonate (DEEP)[1] | 78-38-6 | 2 | 0 | 0 | No | No | Skin corrosion (Category 2) - H302,<br>Serious eye damage (Category 2) - H318,<br>Specific target organ, single exposure (Category 3, respiratory) - H335<br>Aquatic toxicity, chronic - H411 | No | Appendix D, Section 2.2 |
| 2-chloroethyl phenyl sulfide (CEPS) | 5535-49-9 | 3 | 1 | 0 | Class 6.1 | No | Acute toxicity, inhalation (Category 3) - H331,<br>Acute toxicity, dermal (Category 3) - H311,<br>Skin corrosion (Category 1B) - H314,<br>Serious eye damage (Category 1) - H318,<br>Carcinogenicity (Category 1A) - H350 | IATA, IMDG | Appendix D, Section 2.3 |
| Malathion | 121-75-5 | 2 | 0 | 0 | Class 9 | SARA 311/312 - Acute hazard | Acute toxicity, oral (Category 3) - H301,<br>Acute toxicity, inhalation (Category 3) - H331,<br>Skin sensitization (Category 1) - H317,<br>Carcinogenicity (Category 1B) - H350 | IATA, IMDG | Appendix D, Section 2.4 |
| Parathion[2] | 56-38-2 | 4 | 0 / 1 | 0 / 2 | Class 6.1 | CWA; SARA 311/312 - Acute hazard or delayed hazard | Acute toxicity, oral/dermal/inhalation (Category 1) - H300/H310/H330,<br>Serious eye damage/irritation (Category 2B) - H318/H320,<br>Carcinogenicity (Category 2) - H351,<br>Specific target organ, repeated exposure (Category 1) - H372,<br>Aquatic toxicity, acute (Category 1) - H400,<br>Aquatic toxicity, chronic (Category 1) - H410 | IATA, IMDG, California P65 | Appendix D, Section 2.5 |
| Ethylene[3] | 74-85-1 | 2 | 4 | 2 | Class 2.1 | TSCA; SARA 311/312 - Acute hazard, sudden release of pressure hazard, fire hazard | Extremely flammable gas - H220,<br>Contains gas under pressure/may explode if heated - H280,<br>May cause drowsiness or dizziness - H336<br>May displace oxygen and cause rapid suffocation - OSHA-H01 | IATA, IMDG, EU regulations | Appendix D, Section 2.6 |
| *Bacillus thuringiensis* var. Al Hakam (BtAH) | -- | -- | -- | -- | -- | -- | -- | -- | Appendix D, Section 3.1 |

**Notes**

-- = Data was not available or not applicable

(1) DEEP can form highly toxic and flammable phosphine gas in the presence of strong reducing agents (Chemical Book 2017).

(2) Parathion has varying NFPA ratings based on its SDS and OSHA (Chem Service 2018, OSHA 2018). It can result in a violent reaction when used as a solvent to dissolve endrin. When heated, parathion emits very toxic fumes of sulfur, phosphorus and nitrogen oxides (Chemical Book 2017).

(3) Ethylene has a wide range of explosion limits, it's incompatible with strong oxidizing agents and readily forms explosive mixtures with air (ozone) and in the presence of aluminum chloride.

(4) The NFPA hazard rating system consists of values 0 to 4 for each category: 0 indicates minimal hazard, 1 is slight hazard, 2 is moderate hazard, 3 is serious hazard and 4 is severe hazard.

**Abbreviations**

CWA = Clean Water Act
DOT = U.S. Department of Transportation
EU = European Union
IMDG = International Maritime Dangerous Goods
IATA = International Air Transport Association
NFPA = National Fire Protection Association
OSHA = Occupational Safety and Health Administration
SARA = Superfund Amendments and Reauthorization Act
TSCA = Toxic Substances Control Act
USEPA = U.S. Environmental Protection Agency

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# Appendix F.
Exposure Data for Proposed Chemical Simulants

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| Test Material | CAS Number | Agent Simulated | Lethal Oral Dose (LD50) mg/kg | Route | Range | Carcinogenicity / Human Toxicity | Discussion of Material |
|---|---|---|---|---|---|---|---|
| Diisopropylmethyl phosphonate (DIMP) | 1445-75-6 | G-type nerve agent simulant | 826 | Oral (rat) | Oral LD50 range of 503 to 1,490 mg/kg for various species. | Not classifiable as to human carcinogenicity (Group D, IRIS 1986) / Acute toxicity: Slight eye and respiratory irritant, headache dizziness and nausea. | Appendix D, Section 2.1 |
| Diethylethyl phosphonate (DEEP) | 78-38-6 | G-type nerve agent simulant | 2,330 | Oral (rat) | Oral LD50 range of 2,000 to 2,500 mg/kg for rats and mice. | Inadequate data to determine carcingencity / Acute toxicity: Skin, eye, and respiratory irritant | Appendix D, Section 2.2 |
| 2-chloroethyl phenyl sulfide (CEPS) | 5535-49-9 | Mustard agent simulant | -- | -- | -- | Inadequate data to determine carcinogencity in the U.S, but classified as carcinogen (Category 1A) via dermal pathway in the ECHA / Acute toxicity: Skin and eye, and respiratory irritant | Appendix D, Section 2.3 |
| Malathion | 121-75-5 | VX simulant | 190 | Oral (mouse) | Oral LD50 range of 190 to 12,500 mg/kg for various species. Dermal LD50 range of 2,000 to 8,800 for rats and rabbits. Inhalation LC50 of 5.2 mg/L in rats. | Probably carcinogenic to humans (Group 2A, IARC 2016) / Acute toxicity: Nervous system, slight eye irritation | Appendix D, Section 2.4 |
| Parathion | 56-38-2 | VX simulant | 0.93 | Oral (cat) | Oral LD50 range of 0.93 to 32 mg/kg for various species. Dermal LD50 range is 6.8 to 50 mg/kg for various species. Inhalation LC50 is 84 $mg/m^3$ for rats. | Possibly carcinogenic to humans.(Group 2B, IARC 2017), Possible human carcinogen (Group C, IRIS 1986) / Acute toxicity: Severe nervous system and gastrointestinal irritant | Appendix D, Section 2.5 |
| Ethylene | 74-85-1 | Generic gas | -- | -- | -- | Not classifiable as to its carcinogenicity to humans (Group 3, IARC 1994) / Acute toxicity: Can induce hypoxia at high concentrations | Appendix D, Section 2.6 |
| *Bacillus thuringiensis* var. Al Hakam (BtAH) | -- | *Bacillus anthracis* | -- | -- | -- | -- | Appendix D, Section 3.1 |

**Notes**

-- = Data was not available or not applicable

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**Appendix G.**
Environmental Fate Data for Proposed Chemical Simulants

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| Test Material | CAS Number | Test Use | Vapor Pressure / Solubility in Water | Soil Adsorption Tendency | Expected tendency for leaching | Degradation Rates | Hazardous Decomposition Products and By-Products |
|---|---|---|---|---|---|---|---|
| Diisopropylmethyl phosphonate (DIMP) | 1445-75-6 | G-type nerve agent simulant | 0.28 mmHg at 25 degC / High solubility, 1,500 mg/L at 25 degC | Low, Koc of 87 | -- | Half-life: Soil: 1 year (acclimated soil), 3 years (unacclimated soil) Air: 5 hours | Carbon monoxide, carbon dioxide, phosphorus oxides |
| Diethylethyl phosphonate (DEEP) | 78-38-6 | G-type nerve agent simulant | 0.316 mmHg at 25 degC / High solubility, 17,500 mg/L at 25 degC | -- | -- | -- | Carbon monoxide, carbon dioxide, phosphorus oxides |
| 2-chloroethyl phenyl sulfide (CEPS) | 5535-49-9 | Mustard agent simulant | Based on sulfur mustard: 0.11 mmHg at 25 degC / Low solubilty, 0.11%, 609 mg/L at 25 degC | Based on sulfur mustard: Moderate, log Koc of 2.43, Koc of 240 | Based on sulfur mustard: Low (based on HSDB) | -- | Carbon monoxide, carbon dioxide, sulfur oxides, hydrogen chloride |
| Malathion | 121-75-5 | VX simulant | 3.9E-06 mmHg at 25degC / Low solubility, 0.02%, 143 mg/L at 20 degC | Low (based on ATSDR), log Koc of 3.25, Koc range of 927 to 17,620 | High (based on ATSDR) | Half-life: Air: 1.5 to 5 hours, Soil: 1.33 to 4.14 days, Water: 1.65 to 17.4 days | Carbon oxides, nitrogen oxides, phosphorus oxides, sulfur oxides |
| Parathion | 56-38-2 | VX simulant | 6.68x10-6 mmHg at 20 degC / Low solubility, 0.001%, 11 mg/L at 20 degC | High (based on ATSDR), log Koc range of 2.48 to 4.019, Koc range of 314 to 15,860 | Low (based on ATSDR) | Air: 4.2 hours, Soil: up to 3 weeks, Water: 2 to 3 weeks | Carbon oxides, nitrogen oxides, phosphorus oxides, sulfur oxides |
| Ethylene | 74-85-1 | Generic gas | 5.21x10+4 mmHg at 25 degC / Low to no solubility, 131 mg/L at 25 degC | Low, Koc of 13 | -- | Air: 2 days | Carbon oxides |
| *Bacillus thuringiensis* var. Al Hakam (BtAH) | -- | *Bacillus anthracis* | -- | -- | -- | -- | -- |

**Notes**
-- = Data was not available or not applicable

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