Final
Record of Decision for
RVAAP-060-R-01 Block D Igloo Munitions Response Site
Version 1.0

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract No. W912DR-15-D-0016
Delivery Order No. 0001

Prepared for:

US Army Corps of Engineers®

U.S. Army Corps of Engineers
Baltimore District
2 Hopkins Plaza
Baltimore, Maryland 21201

Prepared by:
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August 5, 2019

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14. ABSTRACT

The U.S. Department of the Army (U.S. Army) is presenting this Record of Decision to document the determination for the former Ravenna Army Ammunition Plant, RVAAP-060-R-01 Block D Igloo Munitions Response Site, in Portage and Trumbull Counties, Ohio. This Record of Decision presents the U.S. Army's determination that Surface and Subsurface Removal is appropriate for addressing risk at the site. This Record of Decision presents the Ohio EPA Concurrence with this determination and summarizes the response from the public during the 30-day public comment period held for the MRS.

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			Kimberly Vaughn
U	U	U	SAR	70	19b. TELEPHONE NUMBER *(Include area code)* 512-658-6828

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Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

August 28, 2019

RE: US Army Ravenna Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859241

Mr. David Connolly
Army National Guard Directorate
Environmental Programs Division
ARNG-ILE-CR
111 South George Mason Drive
Arlington, VA 22204

Subject: Final Record of Decision for RVAAP-060-R-01 Block D Igloo MRS

Dear Mr. Connolly:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed the "Final Record of Decision for RVAAP-060-R-01 Block D Igloo Munitions Response Site [MRS], Version 1.0" dated August 5, 2019. It was prepared by HydroGeoLogic, Inc.

Ohio EPA has no comments on the Final Record of Decision (Final ROD). Based on the information contained in the Final ROD document, other investigation documents and reports, and Ohio EPA's oversight participation during the investigation, Ohio EPA concurs with the Final ROD document for the RVAAP-060-R-01 Block D Igloo MRS recommending surface and subsurface removal.

If you have any questions concerning this letter, please contact Nicholas Roope at (330) 963-1235.

Sincerely,

Melisa Witherspoon
Chief
Division of Environmental Response and Revitalization

NCR/MW/sc

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CONTRACTOR'S STATEMENT OF INDEPENDENT TECHNICAL REVIEW

HydroGeoLogic, Inc. has completed the *Final Record of Decision for RVAAP-060-R-01 Block D Igloo Munitions Response Site,* Version 1.0*,* at the former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives, technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets customer's needs consistent with law and existing United States Army Corps of Engineers policy.

Prepared/Approved by: _____ Date: August 6, 2019

Timothy Leahy, P.G., PMP
Project Manager
APTIM Federal Services

Reviewed/Approved by: _____ Date: August 6, 2019

Kimberly Vaughn
Project Manager
HydroGeoLogic, Inc.

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ARNG – Army National Guard
COR – Contracting Officer's Representative
IED – Installation and Environment Division
OHARNG – Ohio Army National Guard
RVAAP – Former Ravenna Army Ammunition Plant
USACE – United States Army Corps of Engineers

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ACRONYMS AND ABBREVIATIONS

amsl	above mean sea level
ARAR	applicable, relevant, and appropriate requirement
ARNG	Army National Guard
bgs	below ground surface
BIP	blow in place
CB&I	CB&I Federal Services, LLC
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act*
CJAG	Camp James A Garfield Joint Military Training Center
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
CTT	closed, transferring, or transferred
DERP	Defense Environmental Restoration Program
DFFO	*Director's Final Findings and Orders*
DMM	discarded military munitions
DoD	U.S. Department of Defense
e^2M	engineering-environmental Management, Inc.
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
FS	*Final Feasibility Study for RVAAP-060-R-01 Block D Igloo Munitions Response Site*
HA	hazard assessment
HGL	HydroGeoLogic, Inc.
HHRA	human health risk assessment
HRR	*Final Military Munitions Response Program Historical Records Review*
ISM	Incremental Sampling Methodology
lb	pound
LUC	land use control
MC	munitions constituents
MD	munitions debris
MEC	munitions and explosives of concern
MFD-H	maximum fragmentation distance-horizontal
mg/kg	milligrams per kilogram
MMRP	Military Munitions Response Program
MRS	Munitions Response Site
NCP	*National Oil and Hazardous Substances Pollution Contingency Plan*

O&M	operation and maintenance
OHARNG	Ohio Army National Guard
Ohio EPA	Environmental Protection Agency
PTW	principle threat waste
RAO	remedial action objective
RDX	Research Department Explosives
RI	Remedial Investigation
RI Report	*Final Remedial Investigation Report*
ROD	Record of Decision
RVAAP	Ravenna Army Ammunition Plan
SI	Site Inspection
SI Report	*Final Site Investigation Report*
SRC	site-related chemical
TD	transferred
TNT	2,4,6-Trinitrotoluene
USACE	U.S. Army Corps of Engineers
USP&FO	U.S. Property and Fiscal Officer
UU/UE	unrestricted use/unlimited exposure
UXO	unexploded ordnance

PART I: DECLARATION

A. SITE NAME AND LOCATION

The Army National Guard (ARNG) developed this Record of Decision (ROD) for the RVAAP-060-R-01 Block D Igloo Munitions Response Site (MRS) located at the former Ravenna Army Ammunition Plant (RVAAP) in Portage and Trumbull Counties, Ohio (**Figure 1)**. The former RVAAP is now known as Camp James A Garfield (CJAG). The Block D Igloo MRS is located in the north-central portion of CJAG (**Figure 2)**. CJAG was previously known as Camp Ravenna Joint Military Training Center (Camp Ravenna) and that name will be used in some historical reports.

CJAG is 21,683 acres and is federally owned. The facility is located in Portage and Trumbull Counties, Ohio, approximately 3 miles east-northeast of the City of Ravenna (**Figure 1**). Administrative accountability for CJAG was transferred to the U.S. Property and Fiscal Officer (USP&FO) for Ohio in multiple transfers the last being in September 2013. The facility is licensed to the Ohio Army National Guard (OHARNG) for use as a military training facility (Federal Facility ID No. OH213820736).

To maintain a distinction between historical operations and current activities, the term "RVAAP" will be used for historical discussions and "CJAG" will be used when referring to the current facility activities.

B. STATEMENT OF BASIS AND PURPOSE

The ARNG is the lead federal agency for environmental response actions at CJAG. This ROD was prepared under the Military Munitions Response Program (MMRP) and presents the selected remedy for the Block D Igloo MRS. The selected remedy was chosen in accordance with the requirements of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) of 1980, as amended by the *Superfund Amendments and Reauthorization Act* of 1986, which requires the issuance of RODs for remedial action taken pursuant to Sections 104, 106, 120, and 122. The *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) establishes the regulatory requirements for this ROD in Chapter 40 of the *Code of Federal Regulations*, Section 300.430(f)(5).

The Ohio Environmental Protection Agency (Ohio EPA), the supporting state regulatory agency, reviewed and concurred with the *Final Proposed Plan for RVAAP-060-R-01 Block D Igloo Munitions Response Site Version 1.0* (HydroGeoLogic, Inc., [HGL], 2018b). ARNG's decision is based on information contained in the Administrative Record file for the Block D Igloo MRS. The Proposed Plan presented the ARNG's preferred remedy for addressing the Block D Igloo MRS and invited public involvement during the comment period (March 1, 2019 through April 8, 2019) and public meeting (March 6, 2019). The selected remedy under CERCLA at the Block D Igloo MRS satisfies the requirements of the *Director's Final Findings and Orders* (DFFO) (Ohio EPA, 2004), specifically by documenting the Ohio EPA's concurrence with the closeout of the MMRP investigation conducted for this MRS under Section XII, paragraph 26.

C. DESCRIPTION OF THE SELECTED REMEDY

This ROD addresses U.S. Department of Defense (DoD) military munitions at the Block D Igloo MRS. Based on the information currently available, ARNG believes the selected remedy meets the threshold criteria and provides the best balance of tradeoffs among other alternatives with respect to the balancing and modifying criteria. ARNG expects the selected remedy to satisfy the requirements of CERCLA by protecting human health, complying with applicable or relevant and appropriate requirements (ARARs), being cost effective, and utilizing permanent solutions to the maximum extent practical. No unacceptable ecological risk was identified at the Block D Igloo MRS; therefore, the remedy does not address ecological receptors.

The selected remedy for the Block D Igloo MRS is Alternative 4 - Surface and Subsurface Removal. DoD military munitions confirmed to be munitions and explosives of concern (MEC) were identified in the top 6 inches of soil. The subsurface clearance will be completed to a maximum exposure depth of 4 feet below ground surface (bgs), as needed. As summarized in the Feasibility Study, the maximum depth that the Industrial Receptor is expected to access as part of their planned activities is 4 feet bgs (ARNG, 2014). Therefore, the maximum exposure depth in subsurface soil for the Industrial Receptor is 4 feet bgs, which is greater than the maximum depth that MEC was found (6 inches bgs) during the RI field work (HGL, 2018a). This remedy is also protective of the theoretical future Resident Receptor. This alternative is selected over the other alternatives because it provides the greatest protection of human health, results in significant reduction of explosive hazards at the MRS, and provides the greatest long-term effectiveness. There are no remedial action-operation or long-term monitoring costs and no Five-Year Reviews would be required. The selected remedy for the Block D Igloo-MRS includes the following activities:

- Detection of DoD military munitions on land and under water in wetland and surface water (stream) areas at the MRS
- Removal of DoD military munitions found, using manual digging methods
- Demolition and disposal of DoD military munitions confirmed to be MEC

D. STATUTORY DETERMINATION

The selected remedy for the Block D Igloo is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions to the maximum extent possible. The selected remedy achieves the statutory preference for treatment as a principle element of the remedy (i.e., reduces toxicity, mobility, and volume associated with DoD military munitions through treatment). The selected remedy was chosen since it reduces the volume of DoD military munitions to current and future receptors. Because this remedy will not result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use/unrestricted access (UU/UE), Five-Year Reviews will not be required for this remedial action.

E. DATA CERTIFICATION CHECKLIST

The Data Certification Checklist fulfills a commitment made by the U.S. Environmental Protection Agency (EPA) to the General Accounting Office to ensure that RODs contain certain remedy selection information. The following information is included in the Decision Summary (Section 2.0) of this ROD. Additional information can be found in the Administrative Record for the Block D Igloo MRS.

- DoD military munitions and site-related chemicals (SRCs) and their respective concentrations (*Part II, Section G*).
- Baseline risk and hazard represented by DoD military munitions and SRCs (*Part II, Section G*).
- Cleanup levels for DoD military munitions and the basis for levels (*Part II, Section D*).
- How source materials constituting principle threats are addressed (*Part II, Section J*).
- Current and future reasonably anticipated land use assumptions and current and future beneficial uses of groundwater (*Part II, Section F*).
- Potential land and groundwater uses that will be available at the MRS as a result of the selected remedy (*Part II, Section F*).
- Estimated capital, annual operation and maintenance (O&M), total present value costs, discount rate, and number of years over which the remedy cost estimates are projected (*Part II, Section H*).

- Key factors that led to selecting the remedy (i.e., description of how the selected remedy provides the best balance of trade-offs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (*Part II, Section I*).

F. AUTHORIZING SIGNATURE

Approved:

HALLET BRAZELTON, JR.
Acting Chief,
I&E, Army National Guard

11-7-19
Date

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PART II: DECISION SUMMARY

A. SITE NAME, LOCATION, AND DESCRIPTION

The former Ravenna Army Ammunition Plant (RVAAP), now known as the Camp James A. Garfield Joint Military Training Center (CJAG), located in northeastern Ohio within Portage and Trumbull counties, is approximately three (3) miles east/northeast of the City of Ravenna and one (1) mile north/northwest of the City of Newton Falls. The facility is approximately 11 miles long and 3.5 miles wide. The facility is bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad to the south; Garret, McCormick, and Berry Roads to the west; the Norfolk Southern Railroad to the north; and State Route 534 to the east. In addition, the facility is surrounded by the communities of Windham, Garrettsville, Charlestown, and Wayland (Figure 1). The facility is federal property which has had multiple accountability transfers amongst multiple Army agencies making the property ownership and transfer history complex. The most recent administrative accountability transfer occurred in September 2013 when the remaining acreage (not previously transferred) was transferred to the USP&FO for Ohio and subsequently licensed to the OHARNG for use as a military training site (Camp James A. Garfield).

Administrative accountability of the 21,683-acre facility has been transferred to the USP&FO for Ohio, which subsequently licensed CJAG to the OHARNG for use as a military training site. The restoration program for the facility involves the remediation of areas affected by military activities when the RVAAP was in operation.

The Block D Igloo MRS is a 101.6-acre area at the north-central portion of CJAG within Portage County (**Figure 2**). The MRS is between the intersection of Smalley Road and Road 7D in the "D" Block earth covered storage magazines (igloos) and Road 3E in the "E" Block igloos. **Figure 3** presents the current boundaries of the MRS.

The Block D Igloo MRS is being investigated under the MMRP which was established under the Defense Environmental Restoration Program (DERP) to address DoD military munitions located on current and former defense sites. Sites that are eligible under the MMRP are non-operational ranges where military munitions are known or suspected to be present. The Block D Igloo MRS was determined to be eligible under the MMRP.

B. SITE HISTORY AND ENFORCEMENT ACTIVITIES

The RVAAP was constructed in 1940 and 1941 for the assembly/loading and depot storage of ammunition. While serving as an ammunition plant, the RVAAP was a U.S. Government-owned and contractor-operated industrial facility. The ammunition plant consisted of 12 munitions assembly facilities, referred to as "load lines." Load Lines 1 through 4 were used to melt and load 2,4,6-Trinitrotoluene (TNT) and Composition B (a mixture of TNT and Research Department Explosive [RDX]) into large-caliber shells and bombs. Operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically, the floors and walls were cleaned with water and steam. After cleaning, the "pink water" wastewater, which contained TNT and Composition B, was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to earthen settling ponds. Load Lines 5 through 11 manufactured fuzes, primers, and boosters. From 1946 to 1949, Load Line 12 produced ammonium nitrate for explosives and fertilizers; subsequently, it was used as a weapons demilitarization facility.

In 1950, the facility was placed on standby status, and operations were limited to renovation, demilitarization, normal maintenance of equipment, and munitions storage. Production activities resumed from July 1954 to October 1957 and again from May 1968 to August 1972. Demilitarization and production activities were conducted at Load Lines 1, 2, 3, and 12. Demilitarization activities included disassembling

munitions and melting out and recovering explosives using hot water and steam processes. These activities continued through 1992.

In addition to production and demilitarization activities at the load lines, other activities conducted at the RVAAP included the burning, demolition, and testing of munitions. The locations used as burning and demolition grounds consisted of large, open areas and abandoned quarries. Other areas of concern associated with the RVAAP include a landfill, an aircraft fuel tank testing area, and various industrial support and maintenance facilities (CB&I Federal Services LLC [CB&I], 2015).

The Block D earth-covered magazines (igloos) are located in the north-central portion of CJAG within Portage County. On March 24, 1943, 2,516 clusters of M-41 20-pound (lb) fragmentation bombs exploded in Igloo 7-D-15 during loading into the earth-covered magazines for storage. The explosion was reported to have been caused by rough handling and the faulty design of the M-110 fuze. At the time of the incident, Igloo 7-D-15 was 95 percent full.

The 60-foot-long igloo was constructed of reinforced concrete with a steel door. The igloo was primarily earthen covered with the exception of the front of it where the door was located. The igloo-shaped configuration of the magazine was designed to protect the personnel at the former RVAAP and the nearby residential communities from external force in the event of an internal explosion. The directional configuration of former Igloo 7-D-15 and the door location was toward the east.

The Block D Igloo MRS extends from the location of former Igloo 7-D-15 to the east toward the "E" Block igloos, a distance of nearly 2,500 feet (**Figure 5**), derived from the furthest distance (2,389 feet) that the 20-lb bombs could have traveled as a result of the 1943 explosion, with a 100-foot buffer zone. This area also encompasses all of the munitions debris [MD] found during the site investigations.

The MRS is mostly heavily wooded with thick vegetation and ground cover. Roads, fields, and wetlands are also located within the boundaries of the MRS. (CB&I, 2015). The MRS is shown in **Figure 5**.

There have been no CERCLA enforcement actions related to the Block D Igloo MRS.

C. COMMUNITY PARTICIPATION

Using the RVAAP restoration community relations program, ARNG and the Ohio EPA have interacted with the public through news releases, public meetings, reading materials, and a website. Specific items of the community relations program include the following:

- **Restoration Advisory Board:** A Restoration Advisory Board was established in 1996 to promote community involvement in environmental cleanup activities and to review and discuss the progress with decision makers and the public. Board meetings are generally held two to three times per year and are open to the public.
- **RVAAP Restoration Program Community Relations Plan:** The Final *Community Relations Plan for the Ravenna Army Ammunition Plant Restoration Program in Portage and Trumbull Counties, Ohio* (U.S. Army Corps of Engineers [USACE], 2019) was prepared to establish processes to keep the public informed of activities being conducted as part of the RVAAP restoration program.
- **RVAAP Restoration Program Website:** A website was established in 2004 dedicated to the RVAAP Restoration Program. The website provides information on the history of the RVAAP, areas of potential contamination, the cleanup program being implemented, current activities, and a schedule of upcoming events. This website is accessible to the public at www.rvaap.org.

In accordance with Section 117(a) of CERCLA, Section 300.430(f)(2) of the NCP and the *Final U.S. Army Military Munitions Response Program Munitions Response, Remedial Investigation/Feasibility Study*

Guidance (U.S. Army, 2009) the ARNG released the Proposed Plan for the Block D Igloo MRS (HGL, 2018b) in March 2019. The Proposed Plan and other project-related documents were made available to the public as part of the Administrative Record maintained at CJAG and in the two Information Repositories at Reed Memorial Library in Ravenna, Ohio and Newton Falls Public Library in Newton Falls, Ohio. The notice of availability for the Proposed Plan was sent to the Tribune Chronicle and Record Courier, as specified in the Community Relations Plan (USACE, 2017). The notice of availability initiated the 30-day public comment period which began on March 1, 2019 and ended on April 8, 2019 (Appendix A).

The ARNG held a public meeting on March 6, 2019, at the Charlestown Town Hall, 6368 Rock Spring Road, Ravenna, Ohio 44266, to present the Proposed Plan to the public. At this meeting, representatives of the ARNG provided information about the history of the Block D Igloo MRS, the investigations, and current site conditions. ARNG/OHARNG also proposed the selected remedy of Surface and Subsurface Removal and answered questions about the results of the investigations. Responses to the comments received at this meeting and during the public comment period are included in the Responsiveness Summary in Part III of this ROD.

The ARNG considered the community input received on the Proposed Plan (HGL, 2018b) and determined that Surface and Subsurface Removal is the appropriate remedy for DoD military munitions for the Block D Igloo MRS.

D. SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

The overall goal of the MMRP at RVAAP is to address risks to human health and the environment posed by DoD military munitions (i.e., unexploded ordnance (UXO) and discarded military munitions (DMM)) and munitions constituents (MC)-related contamination. Investigations conducted by the ARNG have determined that unacceptable risk is posed by DoD military munitions at the Block D Igloo MRS. The overall remedial strategy for the Block D Igloo MRS reflects the interests of both the ARNG and the Ohio EPA in mitigating risk and protecting potential human receptors (both the Industrial Receptor and the theoretical future Residential Receptor) where residual explosive hazards associated with DoD military munitions remain. In keeping with this strategy, a selected remedy was determined for the MRS that constitutes the final response action for the Block D Igloo MRS. The ARNG's overall strategy will permanently reduce the toxicity, mobility, and volume of DoD military munitions presenting an explosive hazard at the MRS. Following the completion of the response action, conditions will allow for UU/UE.

E. SITE CHARACTERISTICS

This section provides a brief overview of the Block D Igloo MRS that includes the physical characteristics, previous investigations completed under the MMRP, the nature and extent of contamination, and the most current conceptual site model (CSM).

E.1 Physical Characteristics

The physical characteristics such as topography, geology, hydrogeology, and ecological characteristics that contributed to identifying potential transport pathways, receptors and exposure scenarios used to evaluate health and ecological risks are presented in this section.

E.1.1 Topography/Physiography

CJAG is located within the Southern New York section of the Appalachian Plateaus physiographic province characterized by rolling hills, incised streams, and dendritic drainage patterns. Past glacial activity created bogs, lakes, and other wetland areas. Topography across the Block D Igloo MRS is relatively flat with low hillocks and "pit and mound" features typical of forested sites. The overall drainage direction for the MRS

is east to southeast. The highest elevation at the MRS is approximately 1,110 feet above mean sea level (amsl) near the location of former Igloo 7-D-15 (CB&I, 2015).

E.1.2 Geology and Soils

The Block D Igloo MRS is situated over two bedrock types, the Mercer Member and the Sharon Member. The location of former Igloo 7-D-15 and the western portion of the MRS are over the Mercer Member. The eastern portion of the MRS is located over the Sharon Member. Bedrock elevations across the MRS are consistent at approximately 1,050 feet amsl. Based on the ground surface topography for the MRS, the depth to bedrock can range between 5 to 40 feet bgs (CB&I, 2015).

Soils across the Block D Igloo MRS include various soil types that consist primarily of the Mahoning silt loam with 2 to 6 percent slopes and the undulating Mahoning-Urban land complex. Other soil types found with the MRS include the Trumbull silt loam with 0 to 2 percent slopes and the Holly silt loam along the surface water drainage paths that are frequently flooded. The frost line for northeast Ohio extends to approximately 30 inches bgs (CB&I, 2015).

E.1.3 Surface Water

CJAG is located within the Ohio River Basin with a major surface stream running adjacent to the western portion of the facility flowing to the Mahoning River before joining the Michael J. Kirwan Reservoir. After leaving the reservoir, the west branch joins the Mahoning River east of the facility.

Surface water drainage for the Block D Igloo MRS and surrounding area follows the topography toward the southeast. An unnamed tributary to Sand Creek begins approximately 1,000 feet southeast of the former Igloo 7-D-15 footprint and flows east to southeast. Sand Creek ultimately enters the downstream perennial headwater stream to the Michael J. Kirwan reservoir located directly south of CJAG (CB&I, 2015).

E.1.4 Hydrogeology

Although groundwater recharge and discharge areas have not been delineated at CJAG, it is assumed that the extensive uplands areas at the facility, primarily located at the western portion of the facility, are regional recharge zones. Sand Creek, Hinkley Creek, and Eagle Creek are presumed to be major groundwater discharge areas. The Block D Igloo MRS is not situated in the upland areas that are considered to be regional recharge zones.

No groundwater monitoring wells have been specifically installed for the Block D Igloo MRS. Based on the data collected at CJAG under the Facility-Wide Groundwater Monitoring Program, the groundwater elevation at the MRS and the immediate vicinity is approximated at a potentiometric high of 1,100 feet amsl. Groundwater flow direction is towards the southeast. The approximate depth to groundwater in the unconsolidated aquifer at the Block D Igloo MRS is 10 feet bgs (CB&I, 2015).

E.1.5 Ecology

CJAG is home to a range of vegetation and habitat resources. The plant communities at the Block D Igloo MRS primarily fall within the Red Maple Woods Community, the Oak Maple Tulip Forest Community, and the White Ash Wild Black Cherry Red Maple Woods Community. These communities are characterized by a high abundance of red maple, which sometimes occur in nearly pure stands. Green ash, white ash, black cherry, and sugar maple often are present as well, but not as dominant species

A planning-level survey (i.e., desktop review of wetlands data and resources [National Wetlands Inventory maps, aerials, etc.]) for wetlands was conducted for the entire facility, including the investigation area. A small wetlands area was identified during the planning-level survey of wetlands

at the northwest corner of the investigation area. Approximately 0.8 acres of the planning-level wetland is located within the boundaries of the investigation area. Additionally, a jurisdictional wetlands delineation has been conducted within the investigation area and a small 0.25-acre jurisdictional wetland was been identified at the central portion of the investigation area (CB&I, 2015).

The area along the unnamed tributary to Sand Creek is classified as a Mixed Swamp Forest. The vegetation within this alliance consists primarily of green ash, American elm, hackberry, and red maple. Black walnut, white ash, swamp white oak, cottonwood, and black willow are also present. This vegetation is associated with flood plains near streams and rivers and other temporarily flooded areas (CB&I, 2015).

Biological inventories have occurred within the Block D Igloo MRS and a state-listed species of concern consisting of the sharp-shinned hawk has been observed (CB&I, 2015). The CJAG Integrated Natural Resources Management Plan and U.S. Fish and Wildlife Service Threatened and Endangered Species List indicate that one federally-listed threatened species, the Northern Long-eared Bat, is known to reside within CJAG (OHARNG, 2014) (U.S. Fish and Wildlife Service, 2018). Additionally, the Ohio Department of Natural Resources has identified several state-listed threatened and endangered plant and animal species. Twelve state listed endangered species (1 mammal, 1 fish, 1 insect, 8 bird, and 1 plant species) and ten state listed threatened species (5 bird, 1 insect, 4 plants species) are included on the Camp Ravenna Rare Species List. No confirmed sightings of these species within the Block D Igloo MRS have been reported and no critical habitats are present within the MRS (CB&I, 2015) (OHARNG, 2014). No federally-listed endangered species have been identified within CJAG.

E.2 Site Investigations

This section summarizes the CERCLA investigations that were completed at the Block D Igloo MRS under the MMRP.

E.2.1 2004 Archives Search Report

In 2004, the USACE conducted a literature search of the national archives to determine the potential for DoD military munitions that could present an explosives hazard at the former RVAAP. The search identified 12 MRSs as well as four additional locations with the potential for DoD military munitions. The four additional locations included former Igloo 7-D-15 that was referred to as "Block D Igloo". The *Archives Search Report for the Ravenna Army Ammunition Plant* (USACE, 2004) indicated that the area surrounding former Igloo 7-D-15 potentially contained explosives ordnance and recommended further investigation under the MMRP.

E.2.2 2007 Historical Records Review Summary

In 2007, a historical records review was conducted under the MMRP at CJAG that included the Block D Igloo MRS. The *Final Military Munitions Response Program Historical Records Review* (HRR; environment-management Inc. [e^{2}M], 2007) summarized the investigation following the accidental explosion of Igloo 7-D-15 ("D" Block) on March 24, 1943, and the development of the initial MRS boundary by the USACE, Huntsville District. According to the Army's inventory of closed, transferring, and transferred military and defense sites (Army CTT Range/Site Inventory), the detonation of bombs in Igloo 7-D-15 caused multiple fatalities and sent shrapnel and demolished material up to 2.9 miles away, off installation property. However, a majority of the demolished material was reported to have landed 1.3 to 2 miles to the northeast of the igloo, within installation boundaries. The material consisted of concrete fragments, parts of clothing, and an oil filter from a vehicle. The report further noted that cluster bombs may have been propelled from the igloo.

The USACE, Huntsville District utilized the information in the Army CTT Range/Site Inventory to establish the MRS boundary. The MRS captured the probable debris field resulting from the explosion and consisted of a 3,000-foot diameter circle ("for high explosive bombs") centered on and surrounding Igloo 7-D-15. This resulted in a total MRS acreage of approximately 622.24 acres. A portion of the circle extended beyond the installation boundary and was considered separately because the land had been transferred to another owner; this portion is called Block D Igloo-TD (e^2M, 2007). The boundaries identified in the HRR (e^2M, 2007) for the Block D Igloo MRS at the facility and the off-post Block D Igloo-TD MRS are presented in **Figure 3.**

E.2.3 2007 Inspection Summary

In 2007, a Site Inspection (SI) was conducted under the MMRP for the RVAAP restoration program. During the SI, UXO surveys were conducted around the former igloo footprint and at four documented debris locations (**Figure 3**). No DoD military munitions were observed on the ground surface within the interior of the former igloo or within a circumference of 100 feet surrounding the area. Several subsurface anomalies were recorded within the former igloo footprint but were considered to possibly be attributed to the remnants of the former reinforced concrete floor. No subsurface anomalies were detected within 100 feet surrounding the former igloo locations that were surveyed. At the four debris locations, no visual evidence of intact DoD military munitions was found and very few subsurface anomalies were detected. At locations where subsurface anomalies were recorded, the findings were attributed to debris associated with the former rail lines and roadway.

A soil sample for was collected at one location (RVAAP-BDI-SS-1) within the former igloo footprint area to identify MC-related contamination (**Figure 3**). Lead and arsenic were detected at concentrations that exceeded their facility background screening values and one-tenth the EPA Residential Soil Preliminary Remediation Goals. These metals were considered potential MC-related contamination from the 1943 explosion. The *Final Site Inspection Report* (SI Report; e^2M, 2008) recommended further characterization work for MC-related contamination (metals) at the former igloo.

The *Final Site Inspection Report* (SI Report; e^2M, 2008) recommended the MRS footprint be reduced from 622.24 acres to 340.2 acres. The revised footprint consisted of the area immediately surrounding the former Igloo 7-D-15 and all remaining documented debris locations (and areas in between) that were documented in the Army CTT Range/Site Inventory but had not been investigated as part of the SI (e^2M, 2008). Although the area of the MRS was reduced, inclusion of the documented debris locations increased the maximum distance of the MRS from the point of detonation at former Igloo 7-D-15 from 3,000 feet to nearly 10,000 feet. This resulted in non-continuous and irregular-shaped investigations areas that made up the new MRS. The revised Block D Igloo MRS following the SI is presented in **Figure 4**.

E.2.4 2011 Remedial Investigation Summary

During planning for the Remedial Investigation (RI), a boundary evaluation was prepared to verify the maximum fragmentation distance-horizontal (MFD-H) associated with the clusters of M-41 20-pound (lb) fragmentation bombs that exploded at Igloo 7-D-15. The results of the evaluation consequently reduced the size of the RI area to approximately 92.14 acres from the 340.2 acres recommended in the SI Report (e^2M, 2008). Based on the revised MFD-H, the maximum distance to be investigated from the former igloo footprint was reduced from approximately 10,000 feet to 2,389 feet. The area investigated for the RI is presented in **Figure 5**.

A total of 178 DoD military munitions-related items were found on the ground surface during the RI. All of these items were documented as safe (i.e., MD) by the UXO-qualified personnel in the field. In the subsurface, a total of 3,140 subsurface DoD military munitions-related items were encountered during the

RI at a maximum depth of 8 inches bgs. The UXO-qualified personnel determined that 3,135 of these items were safe (i.e., MD) and 5 of the items were MEC (CB&I, 2015). The maximum depth that MEC were found was 6 inches bgs.

Further characterization for MC-related contamination was conducted during the RI field work as recommended in the SI Report (e^2M, 2008). Three soil samples (BDISS-001, -003, and -004) were collected using the Incremental Sampling Methodology (ISM) in areas where MD was well distributed on the ground surface and was also present in the subsurface. Two discrete soil samples (BDISS-05 and -06) were collected beneath two of the individual MEC items found during the RI. The ISM samples were collected at depths between 0 to 0.5 feet (0 to 6 inches) bgs and the discrete soil samples were collected at 0.5-foot (6-inch) intervals below the individual MEC items. The depths of the discrete samples ranged from 0.25 feet (3 inches) to 0.83 feet (10 inches) bgs. The RI soil sample locations are presented in **Figure 5**.

Nitroguanidine was detected at two of the three ISM sampling locations (BDISS-001 and -004) and at both discrete sample locations. The nitroguanidine concentrations were all very low and were not considered MC-related contamination. Therefore, nitroguanidine was removed from further consideration.

Antimony and iron were detected in all three of the ISM samples and were carried forward for evaluation in the Human Health Risk Assessment (HHRA) and the Ecological Risk Assessment (ERA) in the RI. The risk assessments determined that antimony and iron did not pose risks to the human or environmental receptors at the MRS. *The Final Remedial Investigation Report for RVAAP-060-R-01 Block D Igloo Munitions Response Site* (RI Report; CB&I, 2015) indicated MC-related contamination was unlikely at the MRS (CB&I, 2015). A summary of the site risks, as determined for the MRS in the RI Report (CB&I, 2015), is discussed further in Section G.

The RI concluded that the nature and extent of MEC and MC had been adequately characterized. The RI concluded that the total area that was affected by the explosion that occurred at Igloo 7-D-15 is approximately 101.6 acres. This area was considered the revised Block D Igloo MRS after the RI. The revised MRS area maintains the calculated MFD-H of 2,389 feet from the former igloo and includes a 100-foot buffer zone beyond the bound lateral extent of MD that represents the potential for MEC. The MRS was assigned a Munitions Response Site Prioritization Protocol priority of 3 (CB&I, 2015). The RI recommended an FS as the next course of action. The RI results and the MRS area following the RI is presented in **Figure 5**.

E.2.5 2018 Feasibility Study

The ARNG prepared the *Final Feasibility Study for RVAAP-060-R-01 Block D Igloo Munitions Response Site* (FS; HGL, 2018a) for the Block D Igloo MRS in 2018. The FS evaluated possible alternatives in detail and provided a comparative analysis of those alternatives based on criteria outlined in the NCP. The FS identified four possible alternatives to address potential explosives hazards associated with DoD military munitions at the Block D Igloo MRS. The alternatives consisted of 1) No Action, 2) Land Use Controls (LUCs), 3) Surface Removal and LUCs, and 4) Surface and Subsurface Removal. The FS also developed the Remedial Action Objectives (RAOs) based on the potential for DoD military munitions presenting explosive hazards at the Block D Igloo MRS (HGL, 2018a).

E.2.6 2018 Proposed Plan

Also, in 2018, the ARNG completed the Proposed Plan (HGL, 2018b) for the Block D Igloo MRS. The Proposed Plan documented the preferred alternative (Alternative 4 – Surface and Subsurface Removal) to address DoD military munitions hazards.

E.2.7 History of CERCLA Enforcement Activities

To date, there have been no CERCLA enforcement actions at the Block D Igloo MRS.

E.3 Nature and Extent of Contamination

Data gathered by the ARNG during the SI and subsequent RI for the Block D Igloo MRS effectively characterized the nature and extent of DoD military munitions and MC-related contamination at the MRS. A total of 5 intact DoD military munitions confirmed to be MEC have been found at the MRS. The MEC items were corroded and weighed between 1 to 5 lbs. The MEC items were firmly entrenched in the ground at a maximum depth of 0.5 feet (6 inches) bgs and required hand tools (i.e., shovels) in order to be removed. The MEC consisted of parts and pieces of the M-41 20-lb fragmentation bomb with the exception of one MEC item that was a fuze from an unknown munitions type.

The maximum distance of the subsurface MEC was approximately 1,800 feet due east of former Igloo 7-D-15. The locations of the subsurface MEC were biased towards the areas where the MD were observed on the ground surface during the RI field work. Based on the five MEC items found during the RI, the average density is anticipated to be 3.723 MEC per acre and actual density at a 95-percent confidence level is calculated to be 6.512 MEC per acre. Therefore, it is statistically possible that between 350 and 600 intact DoD military munitions consisting of MEC may be present at the MRS (CB&I, 2015).

Soil samples were collected for the evaluation of MC-related contamination during the RI at areas with concentrated surface and subsurface MD and beneath individual MEC items. The RI Report (CB&I, 2015) concluded that MC-related contamination was not present at the Block D Igloo.

E.4 Conceptual Site Model

A CSM is a representation of an MRS and its environment that is used to facilitate understanding of the MRS and the potential contaminant exposure pathways that might be present. The CSM describes potential contamination sources and their known or suspected locations, humans and/or ecological receptors present, and the interactions between them. The CSM summarizes which potential receptor "exposure pathway" for contamination (are or may be) "complete" and which are (and are likely) to remain "incomplete". A pathway is considered complete when a source is known to exist and when receptors have access to the MRS while engaging in some activity that results in contact with the source. A pathway is considered potentially complete when a source has not been confirmed but is suspected to exist and when receptors have access to the MRS while engaging in some activity that results in contact with the source. Lastly, an incomplete pathway is any case where one of the four components (source, activity, access, or receptors) is missing from the MRS. The following sections provide the CSM for DoD military munitions confirmed as MEC and MC-related contamination as determined by the investigations conducted under the MMRP for the Block D Igloo MRS.

E.4.1 Source

The RI identified the source of DoD military munitions at the Block D Igloo MRS as the M-41 20-lb fragmentation bombs associated with the 1943 explosion at former Igloo 7-D-15. A total of 178 DoD military munitions were found on the ground surface during the RI and were all documented as safe (i.e., MD) by the UXO-qualified personnel in the field. A total of 3,140 subsurface DoD military munitions were encountered during the RI at a maximum depth of 8 inches bgs. The UXO-qualified personnel determined that 5 of these items were MEC and the remaining 3,135 items were determined to be safe (i.e., MD). The MEC items were in corroded condition and weighed between 1 to 5 lbs. The MEC items were firmly entrenched in the ground at a maximum depth of 0.5 feet (6 inches) bgs and required hand tools (i.e., shovels) in order to be removed (CB&I, 2015).

Approximately 1 acre of wetlands and approximately 1,200 linear feet of an unnamed stream are located within the MRS. No DoD military munitions were found during the evaluation of the accessible portions of the wetlands and stream during the RI; however, the presence of buried DoD military munitions confirmed as MEC at the MRS suggests that MEC may be present in the saturated and surface water areas as well.

E.4.2 Receptors

A receptor for the CSM is any human who comes into physical contact with a potential explosive hazard. The theoretical future Resident Receptor (Adult and Child) was evaluated for this MRS; however, the human receptor that has the greatest opportunity for exposure to an explosive hazard at the MRS is the Industrial Receptor. Conditions that achieve protectiveness for the Industrial Receptor will be protective of the theoretical future Resident Receptor (Adult and Child). The Industrial Receptor represents a full-time worker whose activities are consistent with full-time employees or military personnel who are expected to work daily at CJAG over their career. The maximum exposure depth for the Industrial Receptor is 4 feet bgs, which is below the maximum depth that MEC was found during the RI field work (6 inches bgs). The Industrial Receptor is also representative of the people that may access the wetlands at the MRS (ARNG, 2014).

Ecological receptors were identified for the MRS in the RI Report (CB&I, 2015) and included terrestrial invertebrates (earthworms), voles, shrews, robins, foxes, and hawks. However, current guidance states that people are typically considered the primary and often the only receptor to MEC. As a result, no ecological receptors are identified for the MRS (USACE, 2016). The presence of ecological or cultural resources on the MRS is identified in order to avoid or repair any negative impacts the cleanup activities could have on the ecology (e.g., vegetation removal).

E.4.3 Interactions

Interaction describes ways that receptors contact a source and includes both access and activity considerations. Activity describes ways that receptors come into contact with a source. Access describes the degree to which DoD military munitions are available to potential receptors. A receptor may contact DoD military munitions on the surface by walking or handling if picked up. A receptor may contact DoD military munitions in the subsurface when performing intrusive activities.

The MRS extends from the footprint of former Igloo 7-D-15 in the "D" Block storage magazine area to the east into the "E" Block storage magazines that are actively used for military training and readily accessible by facility personnel. The MRS crosses several roadways in the igloo areas, but the surrounding area is undeveloped. The surface water and saturated areas at the MRS are either forested wetlands or wet fields with shallow water depths (i.e., less than 3 feet deep). These areas are not physically restricted and are readily accessible to all workers in the area. Once on the MRS, workers would have access to any DoD military munitions on the ground surface or on top of sediment in the saturated and surface water areas.

Workers would also have access to subsurface DoD military munitions if they did any digging or other intrusive activities. The maximum exposure depth in subsurface soil for the Industrial Receptor is 4 feet bgs, which is greater than the maximum depth that DoD military munitions were found during the RI field work (8 inches bgs). Based on the soil types and climate conditions at the MRS, any DoD military munitions within 30 inches of the ground surface are considered susceptible to freeze-thaw cycling, which may result in subsurface DoD military munitions being pushed up to the ground surface. Due to the abundance of low-lying vegetation and the low potential for soil erosion at the MRS, any DoD military munitions that may become exposed on the ground surface are not expected to move on their own (CB&I, 2015). The

theoretical future Resident Receptor (Adult and Child) would also have access to subsurface DoD military munitions found during the RI field work.

E.4.4 CSM Analysis

Although only DoD military munitions that were verified as safe (i.e., MD) were found on the ground surface during the RI field work, the presence of MEC in the subsurface strongly suggests that additional MEC likely exists on the ground surface at uninvestigated locations. The exposure pathway for MEC on the ground surface would be the handling of MEC or treading underfoot for workers in the area (CB&I, 2015).

Subsurface MEC were encountered at depths less than 1-foot bgs. Based on these results, the MEC exposure pathway for subsurface soil (greater than 0 inches bgs) is considered complete for all receptors that may engage in intrusive activities while using the MRS. Any buried MEC at the MRS may eventually become exposed due to freeze/thaw cycling.

The presence of DoD military munitions in the surface water and saturated areas was not confirmed during the RI; however, these areas are relatively shallow (i.e., less than 3 feet deep). If DoD military munitions are present in these areas, any receptors accessing these areas may come into contact with it by walking or handling if picked up. Therefore, the MEC exposure pathway for sediment in the saturated and surface water areas at the MRS is considered potentially complete. The MEC CSM for the Block D Igloo MRS is presented in **Figure 6**.

The RI confirmed that no known or suspected MC-related contamination risk exists at the MRS, including evaluation for the Unrestricted (Residential) Land Use, and the MC-related contamination exposure pathway for receptors is incomplete (CB&I, 2015).

F. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The current land use activities at the Block D Igloo MRS are maintenance, natural resource management, environmental sampling, and military training. The future land use is not expected to change (HGL, 2018a) and there are no current plans for the MRS to change from an industrial land use to a residential land use.

Groundwater is being investigated and addressed under the Facility-wide Groundwater Monitoring Program. Groundwater use is currently restricted at one area of concern in the central portion of the facility. It is anticipated that groundwater may be used for potable and/or non-potable purposes at select locations on the facility in the future (OHARNG, 2016).

G. SUMMARY OF SITE RISKS

Brief summaries of the of the MEC Hazard Assessment (HA), HHRA, and ERA that were completed for the Block D Igloo MRS are provided in this section.

G.1 MEC Hazard Assessment

Based on the findings in the RI (CB&I, 2015), a complete exposure pathway exists for DoD military munitions verified as MEC in surface and subsurface soils and a potentially complete MEC pathway exists for sediment in the saturated surface water areas at the Block D Igloo MRS. The MEC HA methodology evaluates human health and safety concerns associated with potential exposure to DoD military munitions at a MRS. There are four Hazard Level Categories with 1 being the highest level of hazard and 4 being the lowest level. At the completion of the RI, the Block D Igloo MRS was assigned a baseline MEC HA score of 540 which corresponds to a MEC Hazard Level of 3. This Hazard Level and MEC HA score are based on current conditions at the MRS and assumes that no DoD military munitions removal action has occurred (CB&I, 2015).

G.2 Summary of Baseline Risk Assessments

The HHRA estimates the risk that MC-related contamination at the MRS poses to human receptors if no cleanup action were taken. It provides the basis of taking action and identifies the contaminants and the exposure pathways that need to be addressed by the remedial action. The ERA evaluates the potential for adverse effects posed to ecological receptors from the release of MC-related contamination at a MRS. This section of the ROD summarizes the results of the baseline HHRA and ERA completed for the MRS.

G.2.1 Evaluation for Site-Related Chemicals (SRCs)

SRCs were determined for the surface soil samples collected during the RI field activities through the facility data screening process, as presented in the *Final Facility-Wide Human Health Cleanup Goals for the RVAAP* (Science Applications International Corporation, 2010). A total of two inorganic SRCs were identified in surface soils and were considered as MC-related contamination associated with the M-41 20-lb fragmentation bomb. These SRCs were antimony and iron and they were only identified in the ISM samples collected at a maximum depth of 0.5 feet (6 inches) bgs. Nitroguanidine was detected at two of the three ISM sampling unit locations and at both discrete sample locations, but is not an MC associated with the M-41 20-lb fragmentation bomb and was removed from further considered as an MC-related contaminant at the MRS. Antimony and iron that were identified as SRCs were then carried through the HHRA and ERA process to evaluate for potential receptors (CB&I, 2015).

Iron concentrations exceeded the CJAG background screening value of 23,100 milligrams per kilogram (mg/kg) at ISM locations BDISS-001 and BDISS-003 (**Figure 5**). The maximum iron concentration (35,200 mg/kg) was estimated (i.e., "J" flagged) and was detected at ISM location BDISS-001, located approximately 150 feet northeast of the former Igloo 7-D-15 footprint (CB&I, 2015).

Antimony was detected at all three ISM locations with concentrations that ranged between 1.1 and 1.8 mg/kg (**Figure 5**). The detected antimony concentrations exceeded the CJAG background screening value of 0.96 mg/kg (CB&I, 2015).

G.2.2 Summary of Human Health Risk Assessment

The HHRA was conducted for the surface soil samples collected at the MRS during the RI field work to determine if the identified SRCs were chemicals of potential concern (COPCs) and/or chemicals of concern (COCs) that may pose a risk to future human receptors. The HHRA considered the future land use for the MRS as military training and the Representative Receptors were identified as the National Guard Trainee and the Range Maintenance Soldier. The Representative Receptors for military training, in conjunction with the evaluation of the Resident Receptor (Adult and Child) for Unrestricted Land Use, formed the basis for identifying COCs in the RI. Evaluation for Unrestricted Land Use was performed to assess for baseline conditions and the no action alternative under CERCLA, and as outlined in the *Human Risk Assessment Manual* (USACE, 2005). Since the RI was initiated before the finalization of the ARNG's *Final Technical Memorandum: Land Uses and Revised Risk Assessment Process for the Ravenna Army Ammunition Plant Installation Restoration Program* (ARNG, 2014), the Commercial Industrial Land Use using the Industrial Receptor was not included.

Iron was the only SRC identified as a COPC in the first screening step. However, weight of evidence suggested that the detected iron concentrations were not likely to pose risks to human receptors, including the Resident Receptor (Adult and Child), and Unrestricted Land Use was achieved for MC-related contamination for the Block D Igloo MRS (CB&I, 2015). Therefore, there are no unacceptable risks to a theoretical future residential receptor from MC-related contamination.

G.2.3 Summary of Ecological Risk Assessment

Both iron and antimony were identified as chemicals of potential ecological concern (COPECs) in the soil samples collected at the MRS during the RI field work. COPECs are determined in the ERA and may differ from COPCs. Given the conservativeness of the ERA and the low overall concentrations of antimony that were detected, the potential of exposure to iron and antimony to affect ecological receptors at the MRS was considered to be very low. These metals are not considered to pose a concern to the environment. No final COPECs were identified for surface soil and no further investigation (i.e., a Level III Baseline) or action was considered necessary at the Block D Igloo MRS for ecological purposes. Therefore, no COPECs require additional investigation (CB&I, 2015).

G.2.4 Baseline Risk Assessment Evaluation Summary

Soil samples were collected during the RI for analysis for MC-related contamination at three locations where the concentrated areas of buried MD and individual MEC items were found. The RI confirmed that no known or suspected risks associated with MC-related contamination exist at the MRS, including evaluation for the Unrestricted (Residential) Receptor, and the MC-related contamination pathways for the Block D Igloo MRS are considered incomplete for human receptors (CB&I, 2015). In accordance with current guidance, humans are typically considered as the primary and often the only receptor to DoD military munitions; therefore, no ecological receptors are identified for the explosive hazards at the MRS (USACE, 2016).

H. REMEDIAL ACTION OBJECTIVES

The RAOs were developed based on the hazards, receptors, and exposure pathways identified at the Block D Igloo MRS and the analysis of ARARs. The theoretical future Resident Receptor (Adult and Child) was evaluated for this MRS; however, the human receptor that has the greatest opportunity for exposure to an explosive hazard at the MRS is the Industrial Receptor. Achievement of the RAOs for the Industrial Receptor will be protective of the Resident Receptor. The RAOs are:

- Reduce the unacceptable potential hazard of DoD military munitions on the ground surface and in sediment at the saturated and surface water areas within the MRS to address the likelihood of exposure to the Industrial Receptor via direct contact such that the likelihood of encounter is negligible.
- Reduce the unacceptable potential hazard of DoD military munitions to a depth of 4 feet bgs within the MRS to address the likelihood of exposure to the Industrial Receptor via direct contact such that the likelihood of encounter is negligible.

I. DESCRIPTION OF REMEDIAL ALTERNATIVES

Remedial alternatives that were developed to address DoD military munitions at the Block D Igloo MRS were:

- No Action;
- LUCs;
- Surface Removal and LUCs;
- Surface and Subsurface Removal.

Following the preliminary evaluation of the developed remedial alternatives, all four remedial alternatives were retained for further consideration in the detailed analysis in the FS (HGL, 2018a), and are described below. The individual components of the remedial alternatives that were developed are in **Table 1.**

Table 1 Components of Remedial Alternatives

Remedial Alternative	Individual Components
No Action	• No components • Continued use of the MRS in its current condition with no removal action for DoD military munitions taken
LUCs	• No planned physical removal action for DoD military munitions taken • Engineering controls (i.e., fence and signs) • Educational awareness training program • Annual monitoring (i.e., inspections) • Five-Year Reviews
Surface Removal and LUCs	• Surface removal of DoD military munitions • Engineering controls (i.e., Seibert stakes and signs) • Educational awareness training program • Annual monitoring (i.e., inspections) • Five-Year Reviews
Surface and Subsurface Removal	• Surface and subsurface removal of military munitions • Attains UU/UE for the theoretical future Resident Receptor that is also protective of the Industrial Receptor to its maximum exposure depth of 4 feet bgs • No LUCs required following the remedial action

bgs denotes below ground surface
DoD denotes U.S. Department of Defense
LUC denotes land use control
MRS denotes Munitions Response Site.
UU/UE denotes unlimited use/unrestricted exposure

I.1 No Action

The No Action alternative consists of continued use of the Block D Igloo MRS in its current condition with no action taken whatsoever, including administrative, remedial, or other action to location, remove, dispose, or prevent exposure to DoD military munitions at the MRS. Consideration of the No Action alternative is required by the NCP for baseline comparison with other alternatives. There are no costs associated with the No Action alternative.

I.2 Land Use Controls

Capital Cost: *$626,025*
O&M Cost: *$245,094*
Periodic Cost: *$27,224*
Present Worth Cost: *$898,343*
Five-Year Reviews: *$94,505*
Construction Time Frame: ..... *<1 year*
Operation Time Frame: ..... *30 years*

The LUCs alternative would not include any planned removal of DoD military munitions at the MRS. Rather; it would focus on restricting access and reducing human exposure to DoD military munitions

through engineering controls, educational controls, and annual monitoring that were developed through the Institutional Analysis in the FS Report (HGL, 2018a), and as described below.

The engineering controls would consist of an 8-foot high chain-link fence and warning signs around the perimeter of the MRS. The proposed fence would include gates at both ends of North D Road in "D" Block and Roads 1E, 2E, and 3E in "E" Block that traverse through the MRS. Fencing would be installed on both sides of Smalley Road in order to allow access through the MRS. The total length of fence would be approximately 12,500 feet. The signs warning unauthorized personnel from entering the MRS would be placed along the fence at approximate 50-foot spacing. The proposed locations for the installation of the engineering controls for this alternative are presented in **Figure 7**.

MEC avoidance would be implemented during fence installation activities to ensure that there are no explosive hazards at the locations where the workers are traversing and securing the fence posts in the ground. The MEC avoidance procedures would consist of a UXO-qualified person conducting an instrument-aided surface sweep of the perimeter of the MRS where the workers would be walking, laying down materials, and installing the fence. If any DoD military munitions confirmed as MEC is encountered, the UXO-qualified person would immediately stop work, document the location, and evacuate the work area.

DoD military munitions that are verified as MEC and considered acceptable to move would be transported off the MRS to temporary magazines at Open Demolition Area #2 for consolidated detonation. If a MEC item is not acceptable to move, then blow in-place (BIP) is unavoidable. Any destruction activities, whether it is consolidated detonation or BIP, would require notification to the Ohio EPA, OHARNG/CJAG, and local emergency facilities. Post-demolition activities would include pre- and post-environmental sampling to ensure no MC-related contamination is present. Any pits or holes created by the detonation would be backfilled and seeded with a CJAG–approved seed mix. All DoD military munitions verified as MD would be collected for off-site disposal at a licensed facility for flashing and recycling.

Educational controls to be implemented would include different levels of general awareness training that would be dependent on the personnel and activities to be conducted at the MRS. Full time-employees at CJAG would receive annual general awareness training to notify them of existing conditions, existing engineering controls, DoD military munitions hazards at CJAG, and reporting procedures (i.e., the Three R's of Safety – recognize, retreat, report). Training units, visitors, and contractors that may enter the MRS would receive a general munitions awareness brief that would emphasize the aforementioned reporting procedures to the CJAG Range Control. Any DoD military munitions confirmed as MEC found at the MRS during current and future activities would be managed and destroyed in accordance with aforementioned CJAG-specific procedures. Those procedures are part of the briefings currently given to all receptors and include reporting any DoD military munitions found to CJAG Range Control.

Monitoring (i.e. inspections) would be conducted on an annual basis to ensure that the LUCs remain effective and protective of potential human receptors. Five-Year Reviews would be required to ensure the effectiveness of this alternative because it does not achieve UU/UE at the MRS.

I.3 Surface Removal and Land Use Controls

Capital Cost: *$1,642,116*
O&M Cost: *$245,094*
Periodic Cost: *$27,224*
Present Worth Cost: *$1,914,434*
Five-Year Reviews: *$94,505*
Construction Time Frame: ..... *1-2 years*

Operation Time Frame: ..... 30 years

The Surface Removal and LUCs alternative would use instrument-aided surface sweeps to identify and remove DoD military munitions exposed at/or just below the ground surface and the sediment in the saturated and surface water areas at the MRS. Extensive subsurface excavation in surface soil and sediments would not be conducted. Military training consisting of foot traffic would be allowed at the MRS following completion of the response action for this alternative; however, surface removal of DoD military munitions alone would not attain UU/UE and there would be digging restrictions to prevent authorized personnel who may enter the MRS from encountering subsurface DoD military munitions. LUCs consisting of engineering and educational controls and annual monitoring would be required to mitigate the potential for human exposure to remaining subsurface DoD military munitions.

Detection would be the first step in the surface removal of DoD military munitions, which would be accomplished by conducting an instrument-aided surface sweep. UXO-qualified personnel would systematically walk the MRS and mark, identify, and record the locations of all DoD military munitions found on the surface for inspection, removal, or subsequent demolition. The search would be conducted with a hand-held analog magnetometer such as the Schonstedt GA52-CX, or similar instrument. The operator would systematically search sweep lanes within grids using the magnetometer to identify anomalies. If the instrument indicates a response but the anomaly is not found on or just below the ground surface or sediment in shallow surface water, the UXO-qualified personnel would move on without extensive digging into the subsurface.

An instrument-aided surface sweep using a hand-held analog magnetometer can be used in areas with thick vegetation and ground cover; however, vegetation clearing would still be required in areas with thick scrub brush and along the edges of the wetlands and unnamed stream. Vegetation clearing would allow for proper operation of the detection equipment and to provide visibility for the safety of UXO-qualified personnel.

Removal of DoD military munitions on the ground surface would be performed by UXO-qualified personnel intrusively investigating detected anomalies confirmed by the hand-held analog magnetometer instrument. Any DoD military munitions found would be evaluated to determine if it was MEC or MD by the UXO-qualified personnel. If the DoD military munitions was partially exposed, or protruding above the surface, limited digging with hand tools would be conducted until the item could be verified as MEC or MD. It is not anticipated that the surface removal activities under this alternative would greatly disturb the environment, since only targets on or just below the ground surface would be investigated.

Disturbance of the fine sediments in the wetland areas would result in low visibility. As a result, the UXO-qualified personnel would conduct an underwater tactile investigation of any anomalies that are identified.

Any DoD military munitions confirmed as MEC that is encountered at either the terrestrial or underwater areas at the MRS would be evaluated by the UXO-qualified personnel to determine whether it is acceptable to move for consolidated detonation or if it would require BIP. Any destruction activities, whether it is consolidated detonation or BIP, would require notification to the Ohio EPA, OHARNG/CJAG, and local emergency facilities.

Any DoD military munitions confirmed as MEC and requiring BIP may result in in temporary road closures and nearby work locations depending on the location of the MEC item. Special precautions would be taken to avoid impacting the environment for any underwater DoD military munitions confirmed as MEC that required BIP. Engineering controls consisting of physical barriers (i.e., sand bags) would be considered to attenuate the blast wave. Following BIP at either the terrestrial or underwater areas, environmental testing and restoration would be required to ensure no MC-related contamination impacts to the environment.

LUCs are included in this alternative because DoD military munitions would remain in the subsurface after the surface removal. It is anticipated that the surface removal of DoD military munitions would permit the Industrial Receptor to access the MRS with no intrusive activities; however, engineering controls would be necessary to warn unauthorized personnel from entering the MRS. These engineering controls would consist of Seibert stakes and warning signs that would be placed along the perimeter of the MRS as well as along the sides of Smalley Road that travels through it. The Seibert stakes and signs would be alternately placed and would be spaced approximately 50 feet apart. The path where the Seibert stakes would be installed is 12,500 feet and follows the same path as for the chain-link fence under the LUCs alternative. This equates to approximately 250 Seibert stakes along the proposed path. The proposed locations for the installation of the engineering controls for this alternative are presented in **Figure 8**.

Educational controls would include the general awareness training discussed for the LUCs alternative in Section H.2. Full time-employees at CJAG would receive annual general awareness training to notify them of existing conditions, existing engineering controls, DoD military munitions hazards at CJAG, and reporting procedures (i.e., the Three R's of Safety – recognize, retreat, report). Training units, visitors, and contractors that may enter the MRS would receive a general munitions awareness brief that would emphasize the aforementioned reporting procedures to the CJAG Range Control

Monitoring (i.e., inspections) would be conducted to ensure the effectiveness of the LUCs. Five-Year Reviews would be required to ensure the effectiveness of this alternative because it does not achieve UU/UE at the MRS.

MEC avoidance would be implemented during installation of the Seibert stakes and warning signs to ensure that there are no explosive hazards where the workers are traversing and securing the posts in the ground. The MEC avoidance procedures would consist of a UXO-qualified person conducting an instrument-aided surface sweep of the perimeter of the MRS where the workers will be walking, laying down materials, and installing the posts. If DoD military munitions confirmed as MEC is encountered, the UXO-qualified person would immediately stop work, document the location, and evacuate the work area. The aforementioned procedures for MEC demolition would be followed in the event that DoD military munitions confirmed as MEC was found.

I.4 Surface and Subsurface Removal

Capital Cost:.....*$7,039,235*
O&M Cost: *$0*
Periodic Cost:.....*$0*
Present Worth Cost:.....*$7,039,235*
Construction Time Frame:.....*2-3 years*

The Surface and Subsurface Removal alternative would use a combination of analog and digital magnetometer instruments and manual digging to investigate, map, and remove all surface and subsurface DoD military munitions at the MRS to the maximum exposure depth of 4 feet bgs for the Industrial Receptor. Instrument-aided surface sweeps would be conducted for sediments in the saturated and surface water areas at the MRS and would target DoD military munitions at depths where it can be investigated and removed manually. Manual digging is the preferred method of DoD military munitions removal for this alternative since the maximum depth of DoD military munitions found during the RI was at 8 inches bgs. Successful completion of this alternative would attain UU/UE as well as a negligible probability of exposure for the Industrial Receptor at the MRS.

Detection of DoD military munitions at the terrestrial areas of the MRS would be accomplished by 100-percent coverage using a portable Geometrics Model G-858G Cesium Gradiometer, or similar

instrument, which is capable of detecting the items between ground surface and 4 feet bgs. Use of a digital magnetometer would allow for rapid data collection with minimal personnel, resulting in a digital, georeferenced map of the entire MRS. The data would be collected, processed, evaluated, and analyzed to select target anomalies likely to represent munitions of interest. Where an isolated target anomaly is present, the coordinates would be located again, and the anomaly would be "reacquired" to precisely pinpoint its location with a pin flag for subsequent removal. A Schonstedt GA52-CX analog magnetometer, or similar instrument, would be used in conjunction with the digital magnetometer to investigate inaccessible areas that could not be mapped due to thick ground cover or overhead canopy that limits data collection.

The instrument-aided surface sweeps for the sediments would be conducted with a hand-held analog magnetometer, such as the Schonstedt GA52-CX, Mag 1 underwater magnetometer, or similar instrument. The operator would systematically search sweep lanes within grids using the magnetometer to identify anomalies. Due to the saturated and flowing conditions of the sediments at the MRS, the maximum depth of the DoD military munitions in the sediment may be deeper than at the terrestrial portions of the MRS but is still anticipated to be relatively shallow (i.e., less than 2 feet deep) and detectable using the hand-held instruments.

Vegetation clearance would be required in areas with dense trees and brush where personnel would not be able to access with the man-portable gradiometer. Vegetation would only be removed to the extent that would allow for access and proper operation of the detection equipment. Areas of thick groundcover would be removed to provide visibility for the safety of the UXO-qualified personnel.

Any removal of DoD military munitions would be performed with shovels and other hand tools that minimize impact to the MRS landscape. The UXO-qualified personnel would establish 100 square foot area grids (10 feet by 10 feet) and investigate each anomaly and mark, identify, and record the locations of all DoD military munitions for investigation and removal or subsequent demolition. The conditions encountered during the RI indicated that the DoD military munitions associated with the explosion were well distributed at shallow depths (i.e., less than 1-foot bgs). Each anomaly would be investigated to a maximum depth of 4 feet bgs, the maximum exposure depth for the Industrial Receptor. Any DoD military munitions items found would be verified as safe (i.e., MD) or MEC by UXO-qualified personnel. It is not anticipated that manual excavation activities would greatly disturb the environment; however, each of the excavation areas would be re-graded and seeded with a CJAG–approved seed mix to ensure regrowth.

Disturbance of the fine sediments in the wetland areas would result in low visibility. As a result, the UXO-qualified personnel would conduct an underwater tactile investigation of any anomalies that are identified.

Any terrestrial and/or underwater DoD military munitions that are confirmed as MEC at the MRS would be evaluated by UXO-qualified personnel to determine whether it is acceptable to move for consolidated detonation or if it requires BIP. The MEC demolition activities would be conducted for terrestrial and underwater MEC as discussed for the Surface Removal and LUCs alternative in Section H.3.

J. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The alternatives were evaluated with respect to the nine comparative analysis criteria outlined by CERCLA. The nine criteria are categorized into three groups: Threshold Criteria, Primary Balancing Criteria, and Modifying Criteria. These criteria groups are as follows:

Threshold Criteria must be met for the alternative to be eligible for selection as a remedial option:

1. Overall protection of human health and the environment
2. Compliance with ARARs

Primary Balancing Criteria are used to weigh major trade-offs among alternatives:

1. Long-term effectiveness and permanence.
2. Reduction of toxicity, mobility, and volume through treatment
3. Short-term effectiveness
4. Implementability
5. Cost

Modifying Criteria may be considered to the extent that information is available during development of the FS (HGL, 2018a), but can be fully considered only after public comment on the Proposed Plan (HGL, 2018b).

1. State acceptance
2. Community acceptance

The comparative analysis evaluates the relative performance of the alternatives with respect to each of the nine criteria. Identifying the advantages and disadvantages of each alternative with respect to each other helps to identify the relative strengths of the preferred alternative. These strengths, combined with risk management decisions made by the ARNG and Ohio EPA, as well as input from the community, serve as the basis for the selected alternative.

J.1 Threshold Criteria

Overall Protection of Human Health and the Environment

No hazards are posed to the environment by the presence of DoD military munitions. The No Action alternative would not remove DoD military munitions and would not be protective of human health. Thus, the No Action alternative does not meet this criterion. The other action alternatives are protective of human health to differing degrees and meet this criterion. The Surface and Subsurface Removal alternative provides the greatest level of overall protection to human health by removing any DoD military munitions identified to the maximum exposure depth of 4 feet bgs. The Surface Removal and LUCs alternative provides the next greatest level of overall protection to human health since DoD military munitions on or just below the ground surface and sediment would be removed; however, subsurface DoD military munitions would remain. The LUCs alternative would be protective of human health by restricting direct contact to DoD military munitions through engineering and educational controls and monitoring but both surface and subsurface DoD military munitions would remain making it the least protective among the action alternatives.

Compliance with ARARs

There are no ARARs associated with the No Action alternative that would restrict or modify implementation. No ARARs are triggered for the three action alternatives since no activities would occur that would require dredging or filling activities in the wetlands or would result in large-scale excavation that may contribute to erosion and sedimentation.

J.2 Balancing Criteria

Long-Term Effectiveness and Permanence

The No Action alternative would not provide long-term effectiveness and permanence since no actions would be taken to address the explosive hazards associated with residual surface and subsurface DoD military munitions on the MRS. There are different degrees of long-term effectiveness and permanence

associated with the action alternatives. The LUCs alternative is effective in the long term and permanent; however, fewer DoD military munitions would be permanently removed in comparison to the other action alternatives. The Surface Removal and LUCs alternative would have greater effectiveness and permanence than the LUCs alternative since it would involve the removal of DoD military munitions on the ground surface and sediment in the shallow surface water areas. The Surface and Subsurface Removal alternative would have the greatest long-term effectiveness and permanence since it would include the removal of DoD military munitions in surface and subsurface soils and in sediment that would eliminate the explosive hazards at the MRS and result in UU/UE.

Reduction of Toxicity, Mobility, and Volume Through Treatment

The No Action alternative, LUCs alternative and Surface Removal and LUCs alternative do not satisfy the statutory preference for employing treatment as a principle element. The No Action alternative does not provide any reduction of the toxicity, mobility, and volume of DoD military munitions whatsoever. The LUCs alternative provides no treatment or removal of DoD military munitions that may be confirmed as MEC, other than MEC avoidance during the installation of the chain-link fence and the removal of any incidental DoD military munitions confirmed as MEC that is reported during future activities. The Surface Removal and LUCs alternative provides a reduction in the volume of DoD military munitions on or just below the ground surface and sediment; however, DoD military munitions would remain in the subsurface. The Surface and Subsurface Removal alternative includes the complete removal of surface/subsurface DoD military munitions and DoD military munitions in the sediment and satisfies the statutory preference for employing treatment as a principal element.

Short-Term Effectiveness

The No Action alternative presents no short-term environmental impacts or adverse risks to the UXO personnel, the nearby community, or land users such as workers or CJAG personnel in the area. The alternative requires no time commitment to implement.

The LUCs alternative poses short-term risks above the baseline conditions for workers installing the perimeter fence at the MRS and for UXO personnel conducting MEC avoidance and the incidental destruction of any DoD military munitions confirmed as MEC found during future activities. There would be minimal environmental impacts to the MRS since only vegetation clearance and soil disturbance would be required for installation of the perimeter fence. This alternative can be quickly implemented and would take less than 1 year to develop and implement the LUCs and install the perimeter fence.

The short-term effectiveness of the Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative would be affected by the handling, removal, and demolition operations of DoD military munitions confirmed as MEC by UXO-qualified personnel. UXO-qualified personnel are required to have specialized training that would mitigate the short-term explosive hazards for them and the onsite workers during the remedial action.

The vegetation clearing required at the MRS under the Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative would potentially adversely impact the environment in the short-term by disturbing wildlife habitat that is used by ground- and forest-nesting birds, including the sharp-shinned hawk, and by the Northern long-eared bat for roosting. CJAG vegetation removal restrictions that are protective of these habitats would be followed by not clearing vegetation during the April 1 to September 30 time-frame. Soil and sediment disturbance for both alternatives would be minimal, since removal of DoD military munitions would be conducted by manual excavation (i.e., hand digging and underwater tactile investigations) only.

The short-term exposure under the Surface Removal and LUCs alternative would be less than the Surface and Subsurface Removal alternative due to a shorter time frame to complete the surface clearance, develop and implement LUCs, and install the perimeter Seibert stakes and signs. The duration to complete the Surface Removal and LUCs alternative is 1 to 2 years. The duration to complete the Surface and Subsurface Removal alternative is 2 to 3 years.

Implementability

Although easy to technically implement, the No Action alternative would be the least administratively feasible to implement because the stakeholders would not accept it as the selected alternative. The LUCs alternative would be technically feasible to implement since there is no specialized equipment that is required to install the perimeter fence and awareness training and monitoring is already being conducted at CJAG. The LUCs alternative is administratively feasible to implement; however, there are adverse administrative concerns that installation of a perimeter fence would interfere with CJAG's mission as a military training facility by blocking access to areas and roadways where military training activities are routinely conducted.

The Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative would be technically feasible to implement since the equipment and personnel required to conduct the response actions are readily available. The Surface Removal and LUCs alternative would be administratively feasible to implement since it is protective of both authorized and unauthorized personnel and allows use of the MRS for military training which supports CJAG's mission. The Surface and Subsurface Removal alternative would be administratively feasible to implement since it attains UU/UE.

Overall, the degree of implementability for the Surface Removal and LUCs alternative and the Surface and Subsurface Removal alternative that involve the actual removal of DoD military munitions would be more complex than the No Action alternative and the LUCs alternative that do not include any planned removal actions for DoD military munitions. The Surface and Subsurface Removal alternative would be the most difficult alternative to implement since it would involve the removal of both surface and subsurface DoD military munitions.

Cost

There are no costs associated with the No Action alternative. The LUCs alternative has the lowest total present worth costs ($898,343) in comparison to the Surface Removal and LUCs alternative ($1,914,434) and the Surface and Subsurface Removal alternative ($7,039,235). Additionally, Five-Year Reviews would be required for both the LUCs alternative and the Surface Removal and LUCs alternative since UU/UE is not attained. The present worth costs associated with the Five-Year Reviews over the 30-year performance period would be $94,505 for each alternative. Present worth costs are dollar amounts estimated using current prices for goods and services.

J.3 Modifying Criteria

State Acceptance

The Ohio EPA has indicated they support the selected remedy in this ROD.

Community Acceptance

During the public comment period (March 1, 2019 -April 8, 2019), the community provided no comments that changed the selected remedy.

K. PRINCIPLE THREAT WASTE

UXO or DMM, if any, that remain present at CJAG may constitute a principle threat to human health at the Block D Igloo MRS due to the potential for it to pose an explosive hazard if the material is moved, handled, or disturbed. If UXO or DMM are later encountered on surfaces in those areas originally addressed by the selected remedy, UXO-qualified personnel or similarly qualified personnel will evaluate the material to determine if it poses an explosive hazard. Such material that is determined to pose an explosive hazard (which may be categorized as munitions and explosives of concern) will normally be treated on-site or removed for destruction per applicable DoD explosives safety standards and environmental laws and regulations. The ARNG and the Ohio EPA will consult, in accordance with the terms of the DFFO (Ohio EPA, 2004), to make a determination as to whether the material encountered and determined to pose an explosive hazard, should be classified as a principle threat waste (PTW), as defined by CERCLA, the NCP, and EPA guidance. If the material is determined to be a PTW, the ARNG will take the necessary actions to ensure protectiveness of human health and the environment to address unacceptable risks posed by the material designated as PTW.

L. SELECTED REMEDY

The selected remedy for the Block D Igloo MRS is Alternative 4 – Surface and Subsurface Removal. Alternative 4 satisfies the RAOs for the Block D Igloo MRS by reducing the unacceptable hazards of DoD military munitions for the Industrial Receptor in surface and subsurface soils and in sediment at the saturated and surface water areas at the MRS. Though there are no current plans for the MRS to change from an industrial land use to a residential land use, there will be no unacceptable risks to a potential future residential receptor from explosive hazards or MC-related contamination following implementation of the selected remedy.

L.1 Description of the Selected Remedy

Alternative 4 would use a combination of analog and digital magnetometer instruments and manual digging to investigate and remove all surface and subsurface DoD military munitions at the Block D Igloo MRS. Digging would be done to the maximum exposure depth of 4 feet bgs in order to protect the Industrial Receptor. Instrument-aided surface sweeps would be conducted for sediments in the saturated and surface water areas at the MRS and would target DoD military munitions at depths where it could be investigated and removed manually. Manual digging is the preferred method of DoD military munitions removal for this alternative, since the maximum depth of DoD military munitions verified as MEC found during the RI was at 6 inches bgs. The UXO-qualified personnel would establish 100 square foot area grids (10 feet by 10 feet) and investigate each anomaly and mark, identify, and record the locations of all DoD military munitions for removal or subsequent demolition. Disturbance of the fine sediments in the wetland areas would result in low visibility, and the UXO-qualified personnel would conduct an underwater tactile investigation of any anomalies that are identified. The underwater tactile investigations would be performed by UXO-qualified personnel who are familiar with the different ordnance categories/groups and the arming and functioning of each item. Demolition would be performed on all DoD military munitions that is verified as MEC. Any confirmed MEC would be evaluated by UXO-qualified personnel to determine whether it is acceptable to move for consolidated detonation or if it requires BIP. For MEC that is found underwater, a determination would be made by UXO-qualified personnel if the item was acceptable to move. If the item was not acceptable to move, then controlled underwater detonation would be performed.

This alternative represents the most significant reduction of explosives safety hazards associated with DoD military munitions at the Block D Igloo MRS. Successful completion of this alternative would achieve UU/UE and would also attain a negligible probability of exposure for the Industrial Receptor. No Five-Year Reviews would be required following the completion of the selected remedy.

L.2 Remedy Cost Estimate Summary

The estimated capital cost, O&M cost, periodic cost, total cost, and total present value for Alternative 4 are presented in **Table 2**. Changes to the selected remedy cost estimate are likely to change as the engineering design for the remedial alternative is further developed and refined as part of the Remedial Design process.

Table 2 Cost Estimate Summary for Alternative 4 – Surface and Subsurface Removal

Capital	$7,039,235
O&M	$0
Periodic	$0
Total Cost	$7,039,235
Present Worth (Capital + O&M + Periodic Costs)	$7,039,235

O&M denotes operation and maintenance
Costs are intended to have an accuracy of +50% /-30%

L.3 Expected Outcome of the Selected Remedy

Following implementation of the selected remedy, risks to human health will be mitigated by the removal of DoD military munitions in the surface and subsurface soils and in sediment in the saturated areas at the Block D Igloo MRS and the RAOs will be achieved. No unacceptable ecological risks were identified for the Block D Igloo MRS.

M. STATUATORY DETERMINATIONS

The selected remedy is protective of human health and the environment and satisfies the requirements of CERCLA §121(b). The selected remedy complies with ARARs, is cost effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent possible.

N. DOCUMENTATION OF NO SIGNIFICANT CHANGE

The Proposed Plan (HGL, 2018b) for the Block D Igloo MRS was released for public comment on March 1, 2019. The Proposed Plan (HGL, 2018b) recommended Surface and Subsurface Removal as the selected remedy under the MMRP and pursuant to CERCLA requirements for the Block D Igloo MRS. After the public comment period (March 1, 2019 – April 8, 2019), no significant changes regarding the selected remedy, as originally identified in the Proposed Plan (HGL, 2018b), were necessary or appropriate.

PART III: RESPONSIVENESS SUMMARY FOR PUBLIC COMMENTS ON THE PROPOSED PLAN FOR RVAAP-060-R-01 BLOCK D IGLOO MRS

A. Overview

In March 2019, the ARNG/OHARNG released the Proposed Plan. On March 6, 2019, ARNG held a public meeting for the Block D Igloo MRS (which included two other MRSs: Ramsdell Quarry Landfill MRS Area 2 (South) and Erie Burning Grounds) at the Charlestown Town Hall, 6368 Rock Spring Road, Ravenna, Ohio 44266. ARNG/OHARNG, Ohio EPA, and USACE were present for the meeting, and approximately 20 members of the community attended the meeting. The 30-day public comment period was held from March 1, 2019 to April 8, 2019.

B. Summary of Stakeholder Issues and Lead Agency Responses

There were three comments received verbally during the public meeting. The transcript from the meeting (including the discussions summarized in B.1, below) was incorporated into the Administrative Record.

B.1 Oral Comments from Public Meeting

General oral comments and/or questions were received from members of the public at the March 2019 public meeting, as summarized below (the transcript from this meeting is part of the Administrative Record):

1. One member of the public expressed concern about TNT in groundwater at all the sites on the facility, including those discussed at the Public Meeting (Ramsdell Quarry Landfill MRS Area 2 [South], Erie Burning Grounds, and Block D Igloo). The project team provided information on the Remedial Investigation sampling and risk assessments, and details on where to find this information online at rvaap.org. The individual wanted to know what laboratory had performed the chemical analysis for the data. The project team responded that there are many sites at the facility, with many reports and multiple years of data, and therefore many laboratories have been used during the installation history. The individual asked if there was a cleanup being conducted at the facility, and the team replied yes, all the sites discussed at the March 2019 public meeting are part of the facility's cleanup program. Block D Igloo is the only site of those discussed at the Public Meeting that will require any further removal activities. The other two sites (Ramsdell Quarry Landfill MRS Area 2 (South) and Erie Burning Grounds) are recommended for No Further Action. This individual also asked if there were drinking water wells at the facility and if those wells were regularly sampled for TNT. The project team replied that there are groundwater monitoring wells and potable wells (used for drinking water purposes) on CJAG and both types of wells are regularly sampled.
2. Another member of the public asked where the soil removed from Block D Igloo would be disposed of. The project team replied that only metallic items (potential munitions) will be removed from the site, after being separated from the surface and subsurface soil. No soil will be removed from the MRS.
3. A member of the public expressed concern about CJAG being considered for a potential location for the Missile Defense Agency and there being a negative impact to CJAG's consideration due to the environmental cleanup needed for sites such as the MRSs discussed at this public meeting. The project team replied that while there are environmental sites within the potential footprint of the Missile Defense Agency location that most of the sites have achieved Remedy in Place or No Further Action status. None of the sites discussed at the March 2019 public meeting were within that potential footprint.

B.2 Written Comments from Public Meetings

No written comments or questions were received from members of the public during the public comment period.

B.3 Telephone Comments from Public

No telephone comments or questions were received from members of the public during the public comment period.

C. Technical and Legal Issues

There were no technical or legal issues raised during the public comment period.

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FIGURES

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Legend

Camp James A Garfield/
Former RVAAP

Figure 1
Location Map
Camp James A Garfield/
Former RVAAP
Portage/Trumbull Counties
Ohio

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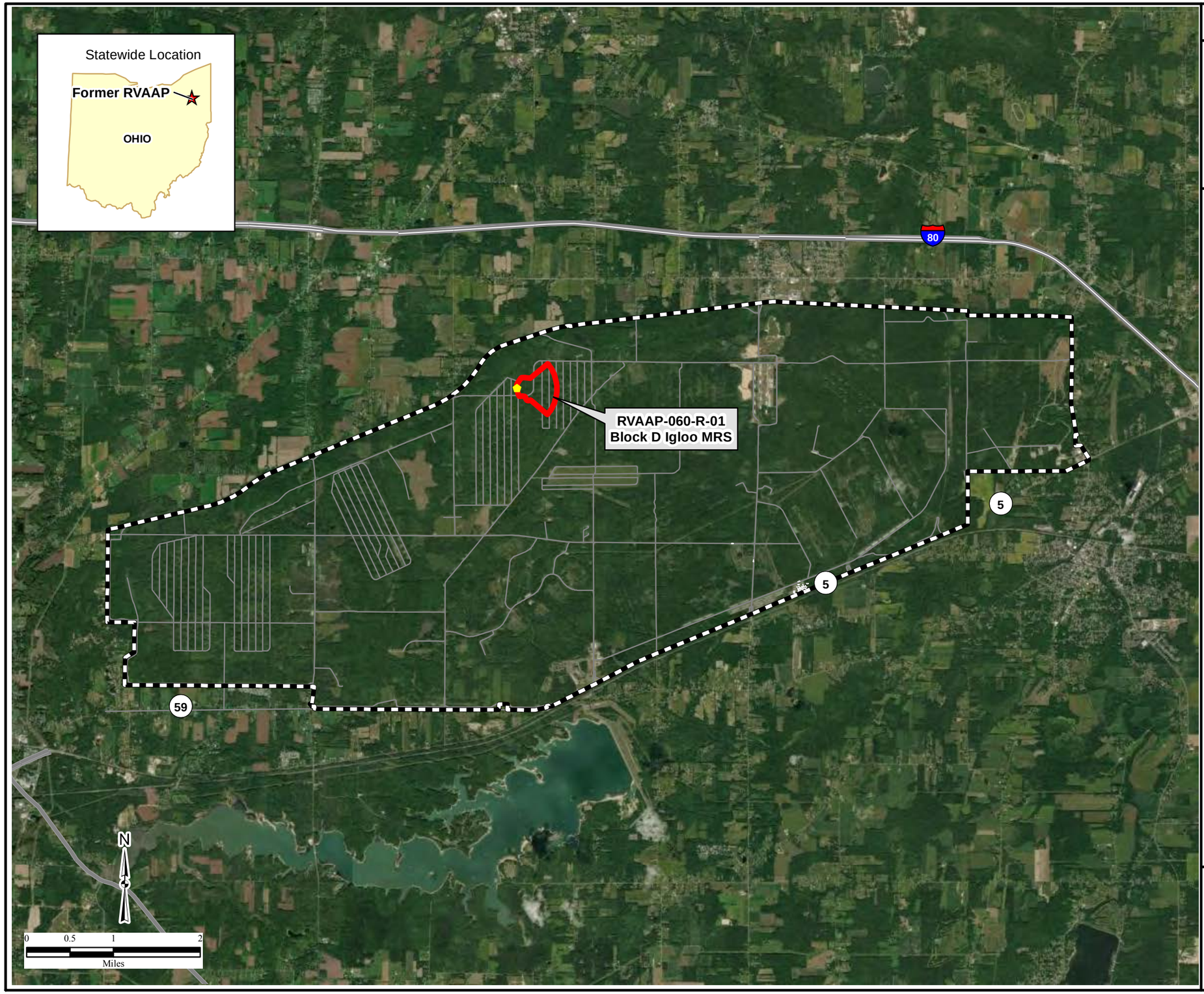
Figure 2
MRS Location
Camp James A Garfield/
Former RVAAP
Portage/Trumbull Counties, Ohio



Legend

- Igloo 7-D-15
- RVAAP-060-R-01 Block D Igloo MRS Boundary
- Facility Boundary
- Road

Notes:
MRS=munitions response site
RVAAP=Ravenna Army Ammuntion Plant

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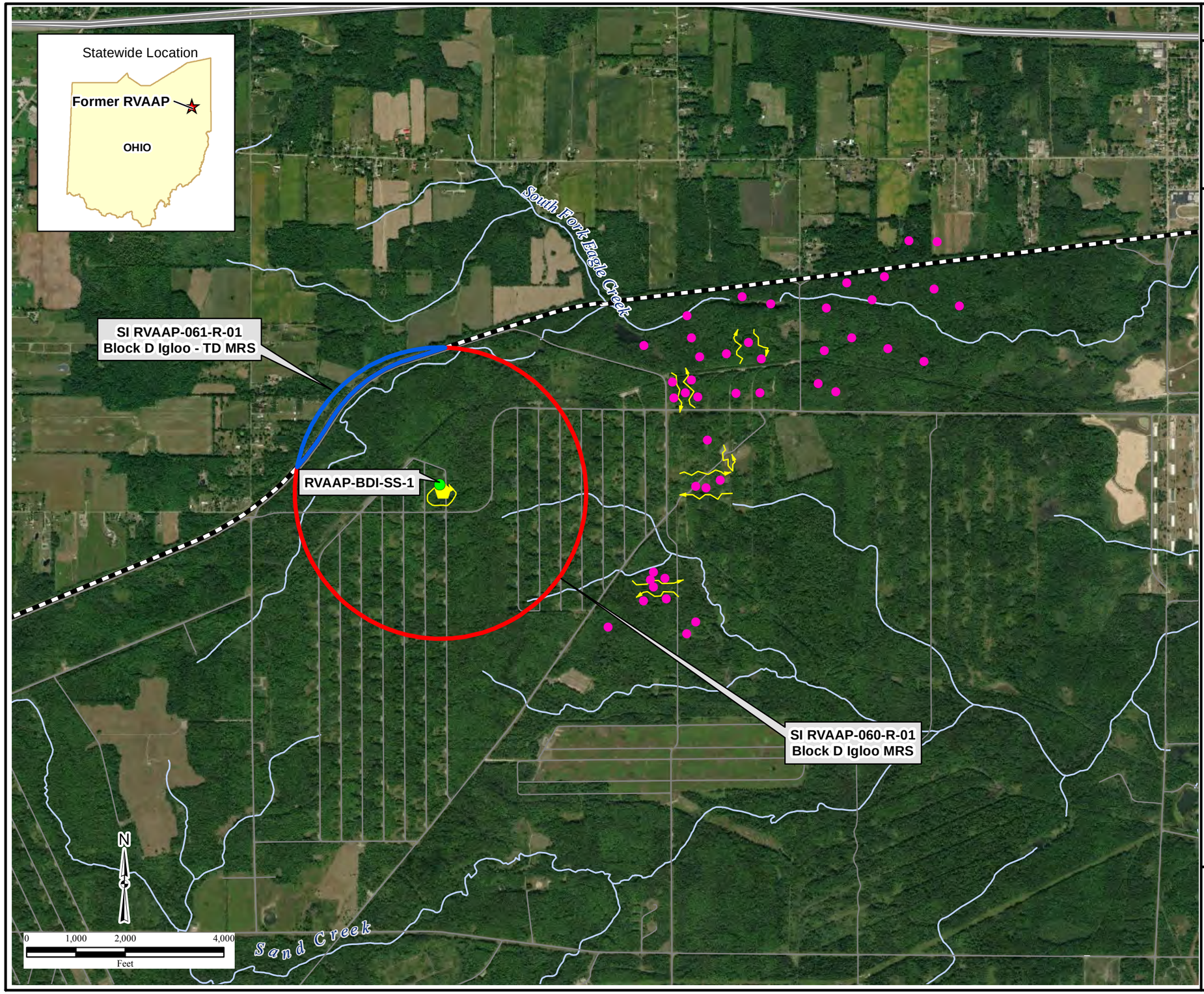
Figure 3
SI MRS Boundaries Map
Block D Igloo MRS
Camp James A Garfield/
Former RVAAP
Portage/Trumbull Counties, Ohio



Legend

- Igloo 7-D-15
- MC Soil Sample Location
- Location of Non-munitions Debris From the 1943 Explosion of Igloo 7-D-15
- Survey Transects
- SI RVAAP-060-R-01 Block D Igloo MRS
- SI RVAAP-061-R-01 Block D Igloo -TD MRS
- Facility Boundary
- Road
- Stream

Notes:
MRS=munitions response site
RVAAP=Ravenna Army Ammuntion Plant

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HGL_RVAAP_BDI_003_Fig3_BlockDIgloo_Si_MRS_Bound.mxd
03/14/2019 JWR
Source Aptim

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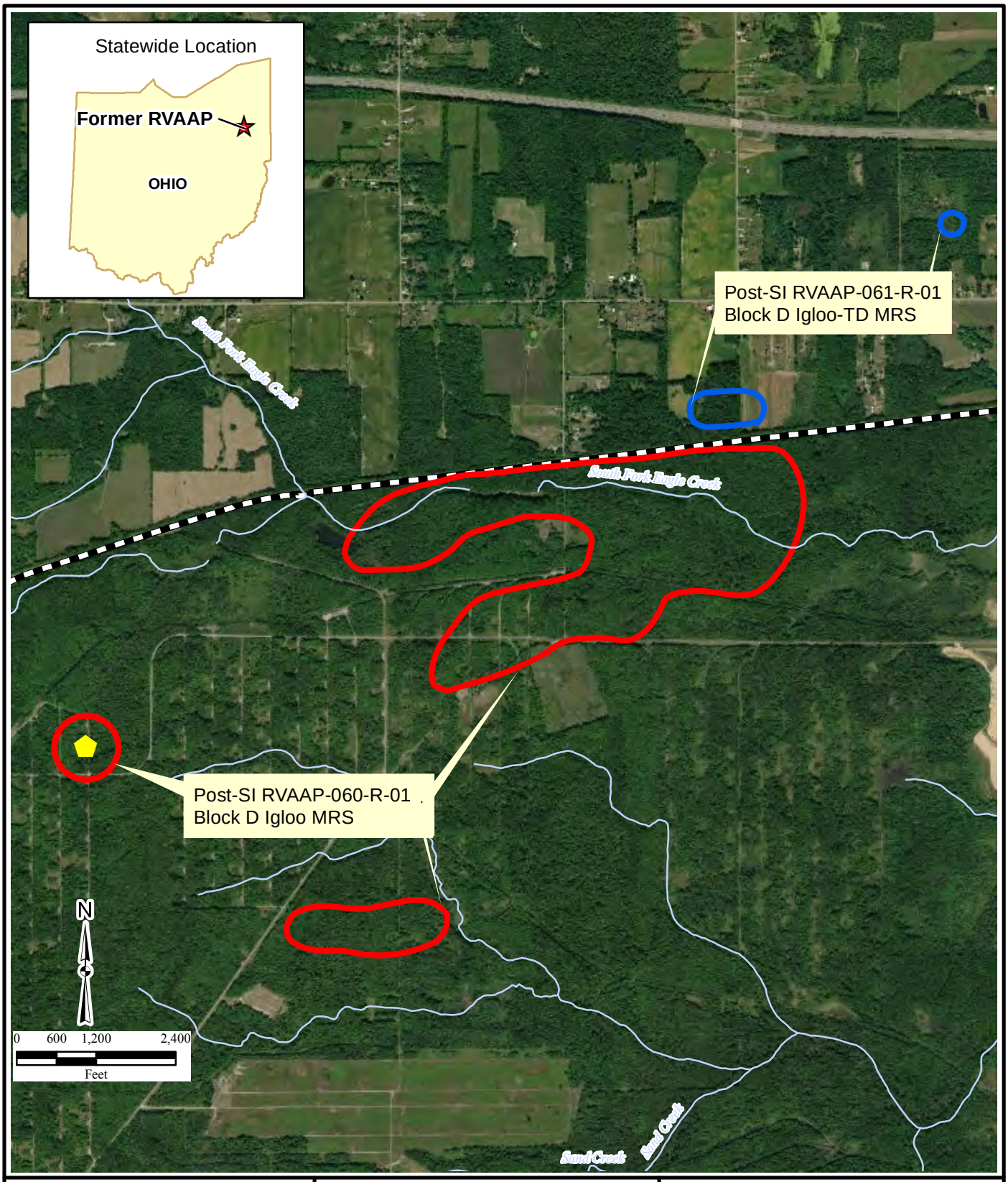

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03/14/2019 JWR
Source Aptim

Igloo 7-D-15
Stream
Post-SI Block D Igloo MRS
Post-SI Block D Igloo-TD MRS
Facility Boundary

Figure 4
Post-SI MRS Boundaries Map
Block D Igloo MRS
Camp James A Garfield/
Former RVAAP
Portage/Trumbull Counties. Ohio

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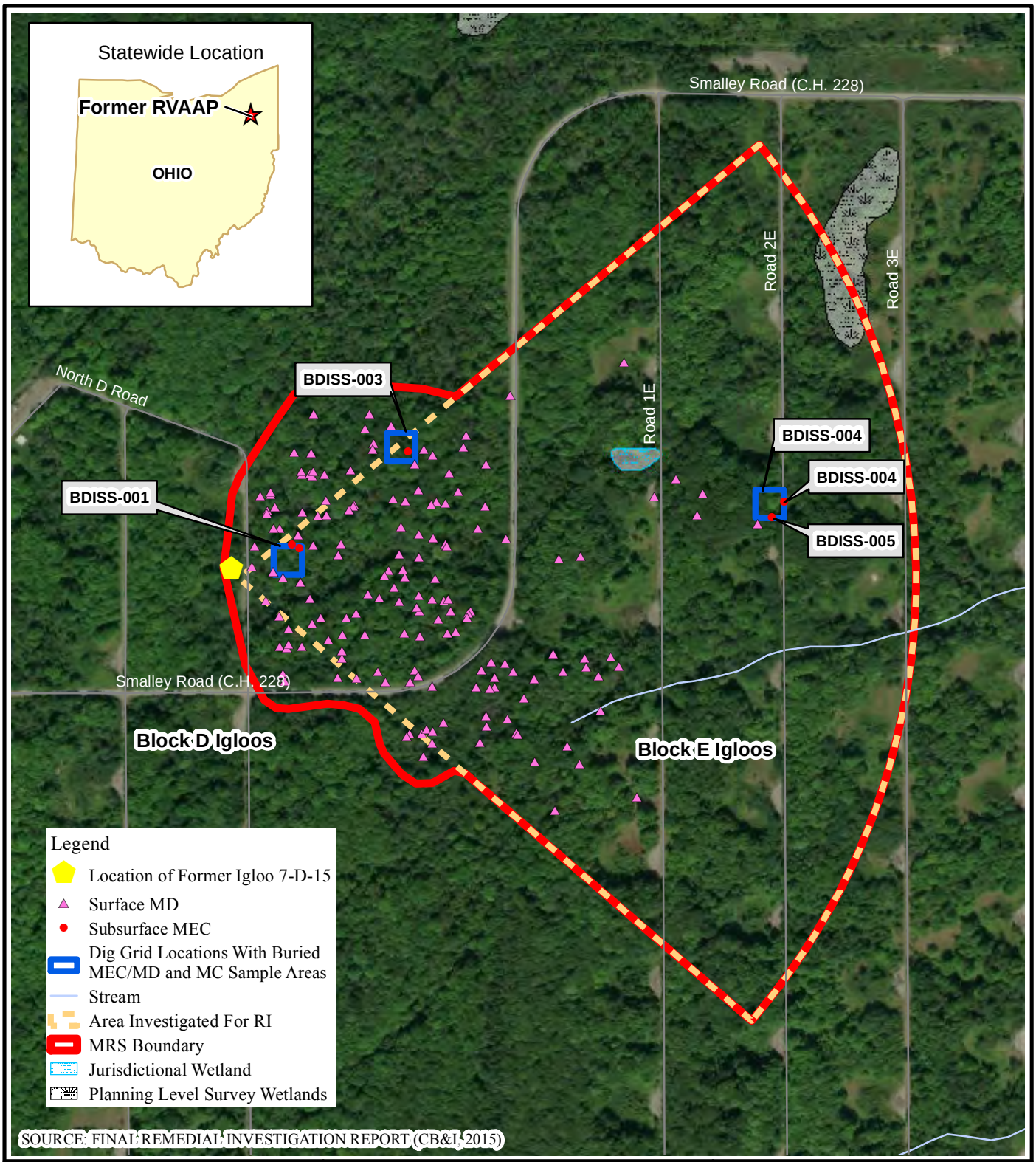

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Source APTIM

N

0 250 500 1,000
Feet

Figure 5
Post-RI MRS Boundaries Map
Block D Igloo MRS
Camp James A Garfield/
Former RVAAP
Portage/Trumbull Counties, Ohio

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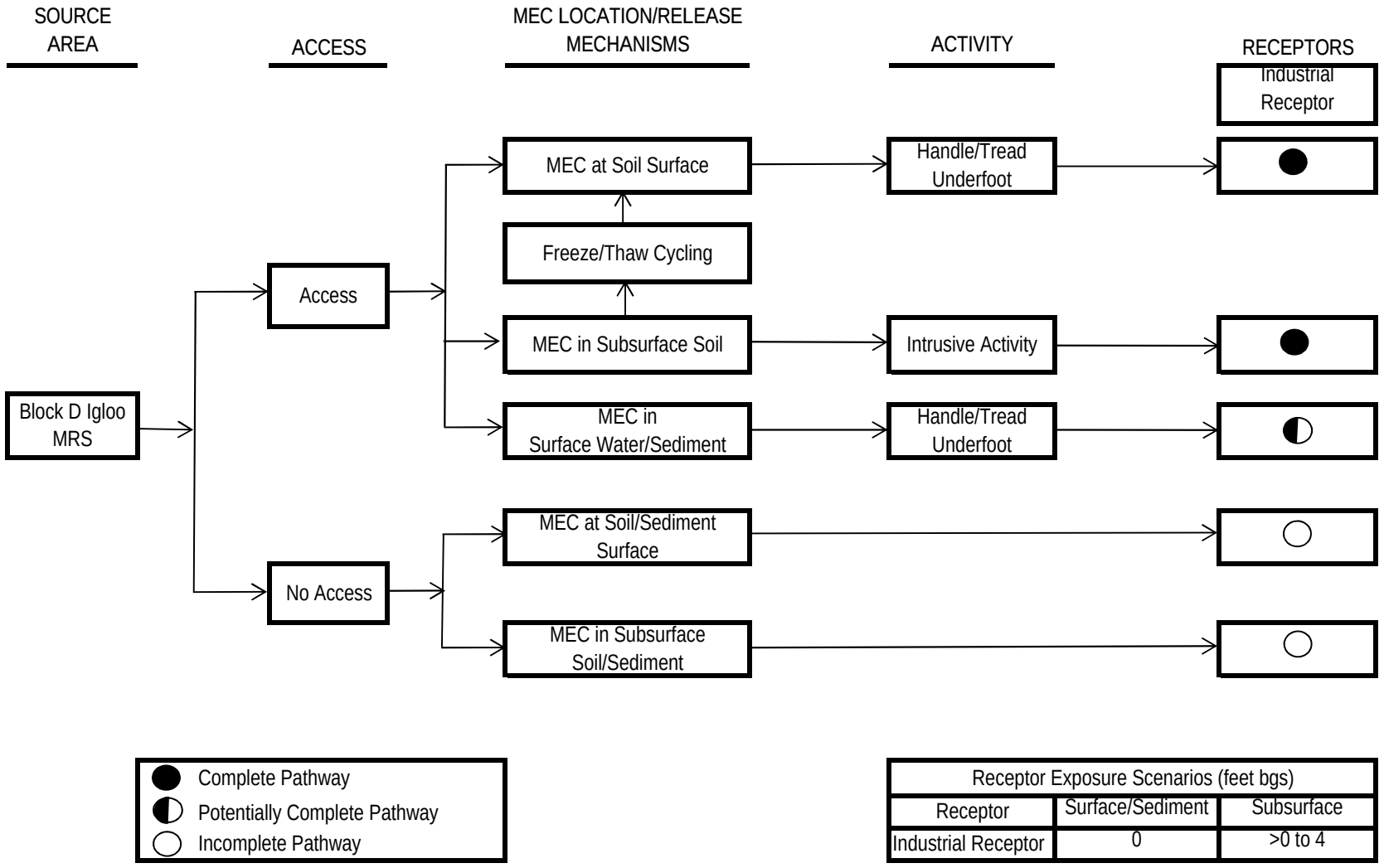
FIGURE 6. MEC CONCEPTUAL SITE MODEL
RVAAP-060-R-01 BLOCK D IGLOO MRS



Receptor Exposure Scenarios (feet bgs)		
Receptor	Surface/Sediment	Subsurface
Industrial Receptor	0	>0 to 4

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03/14/2019 JWR
Source Aptim

Legend

- Location of Former Igloo 7-D-15
- Stream
- Munitions Response Site Boundary
- Jurisdictional Wetland
- Planning Level Survey Wetlands
- Chain-Link Fence

Figure 7
Chain Link Fence Location
Block D Igloo MRS
Camp James A Garfield/
Former RVAAP
Portage/Trumbull Counties, Ohio

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03/14/2019 JWR
Source Aptim

Legend

- Location of Former Igloo 7-D-15
- Stream
- Munitions Response Site Boundary
- Jurisdictional Wetland
- Planning Level Survey Wetlands
- Seibert Stake/Sign Post (50 foot spacing)

Figure 8
Seibert Stake and Sign Locations
Block D Igloo MRS
Camp James A Garfield/
Former RVAAP
Portage/Trumbull Counties, Ohio

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Appendix A
Public Notice of the Proposed Plan

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3124040S

Proof of Publication

Record Publishing Company
1050 W. Main Street,
Kent, OH 44240
Phone (330) 541-9400
Fax (330) 673-6363

I, Thompson being first duly sworn depose and say that I am Advertising Clerk of

Record Publishing Company

30 Record-Courier a newspaper printed and published in the city of Kent, and of General circulation in the County of Portage, State of Ohio, and personal knowledge of the facts herein stated and that the notice hereto annexed was Published in said newspapers for 2 insertions on the same day of the week from and after the 24th day of February, 2019 and that the fees charged are legal.

Name of Account: HydroGeoLogic Inc
Ad Number: 12534680
No. of Lines: 70

Day(s) Published: 02/24, 03/03.
Printers Fee: $432.00

Sworn to and subscribed before this 4th day of March, 2019.

Elizabeth McDaniel
Notary Public
Commission Expires June 19, 2021

PUBLIC NOTICE

Camp James A. Garfield Joint Military Training Center
Environmental Office
1438 State Route 534 SW – Newton Falls, OH 44444
614-336-6136

Public meeting to be held Wednesday, March 6, 2019 for Army National Guard Release of Proposed Plans for three Munitions Response Sites at the Former Ravenna Army Ammunition Plant: Ramsdell Quarry Landfill Area 2 (South) Erie Burning Grounds Block D Igloo

Ravenna – The Army National Guard, in consultation with the Ohio Environmental Protection Agency, submits for public review and comment three Proposed Plans for three Munitions Response Sites at the former Ravenna Army Ammunition Plant (RVAAP), now known as Camp James A. Garfield (CJAG), in Portage and Trumbull counties, Ohio.

The Ramsdell Quarry Landfill Area 2, Erie Burning Grounds, and Block D Igloo Munitions Response Sites (MRSs) within the former RVAAP in Portage and Trumbull Counties, Ohio. These MRSs are being addressed under the Military Munitions Response Program (MMRP) in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The Proposed Plans present the current status and information regarding the MRSs. The Proposed Plans detail the recommendation for No Further Action or other appropriate recommendation at the MRSs and provides the rationale for each recommendation.

On Wednesday, March 6, 2019, a public meeting will be held at the Charlestown Town Hall, 6368 Rock Spring Road, Ravenna, Ohio 44266 beginning at 6:00 p.m., with an informal open house when technical staff will be available to answer questions. At 6:30 p.m., the Army National Guard will briefly describe the assessment of the MRSs, present the No Further Action or other appropriate recommendation, and then request verbal comments from the public. Written comments regarding this recommendation may be submitted to the Army National Guard during the 30-day comment period from March 1 to April 3, 2019. All written comments should be addressed to CJAG Environmental Office; 1438 State Route 534 SW, Newton Falls, OH 44444 or sent via email to Kathryn.s.tait.nfg@mail.mil.

In accordance with CERCLA, the No Further Action or other appropriate recommendation presented in the Proposed Plans was summarized along with site details presented in earlier remedial investigation and feasibility study reports. All reports are now available for public review at the RVAAP Restoration Program Information Repositories at the Reed Memorial Library (167 East Main Street, Ravenna) and the Newton Falls Public Library (204 South Canal Street, Newton Falls). The reports are also available online at www.rvaap.org.

The final remedy for the MRSs will be selected based, in part, on public comments. In coordination with Ohio Environmental Protection Agency, the Army National Guard will select a final remedy after reviewing and considering all public comments submitted during the 30-day public comment period from March 1, 2019 to April 3, 2019. The Army National Guard encourages the public to review and comment on the recommendation presented in this document.

For more information or to participate in the review, please visit the RVAAP Restoration Program website (www.rvaap.org) or call Kathryn Tait at 614-336-6136.

RC, 2/24 & 3/3/2019, 12534680

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#054-2T Feb. 23 & March 2, 2019 #WOH0050361

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