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Seneca Army Depot Activity
Romulus, New York

USACE – New York District
US Army, Engineering & Support Center

Compilation of Previous Investigations and Studies

Open Detonation Grounds
Seneca Army Depot Activity

Contract No. W912DY-08-D-0003
Task Order No. 0013
EPA SITE ID# NY0213820830
NY Site ID# 8-50-006

November 2018

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COMPILATION OF PREVIOUS INVESTIGATIONS AND STUDIES

FOR THE OPEN DETONATION GROUNDS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NEW YORK

Prepared for:

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Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ACRONYM	DEFINITION	ACRONYM	DEFINITION
2,4-DNT	2,4-Dinitrotoluene	EPA	Environmental Protection Agency
µg	micrograms	EPC	Exposure Point Concentration
AOCs	Areas of Concern	ERAGS	Ecological Risk Assessment Guidance for Superfund
AOI	Area of Interest	ES	Engineering Science
AP	Armor Piercing	ESI	Expanded Site Inspection
APHE	Armor-Piercing High Explosive	FS	Feasibility Study
ASR	Archives Search Report	ft	feet
AT	Anti-Tank	GIS	Geographic Information System
AWQS	Ambient Water Quality Standards	GPR	Ground Penetrating Radar
BD	Base Detonating	GPS	Global Positioning System
BERA	Baseline Ecological Risk Assessment	HC	Hexachloroethane
bgs	below ground surface	HE	High Explosive
BRAC	Base Realignment and Closure	HEAT	High Explosive Anti-Tank
CFR	Code of Federal Regulations	HEI	High Explosive Incendiary
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	HHRA	Human Health Risk Assessment
CLP	Contract Laboratory Program	HI	Hazard Index
COC	Contaminant of Concern	HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
COPC	Contaminant of Potential Concern	HQ	Hazard Quotient
COPEC	Contaminant of Potential Ecological Concern	HVAR	High Velocity Aerial Rocket
CSM	Conceptual Site Model	ID	Identification
cy	cubic yards	kg	kilogram
DGM	Digital Geophysical Mapping	LAW	Light Antitank Weapons
DoD	Department of Defense	lb	pound
DQO	Data Quality Objective	LOAEL	Lowest-Observable Adverse Effect Level
ECSM	Ecological Conceptual Site Model	LTM	Long Term Monitoring
EE/CA	Engineering Evaluation/ Cost Analysis	LUCs	Land Use Controls
ELAP	Environmental Laboratory Accreditation Program	MC	Munitions Constituents
EM	Electromagnetic	MCL	Maximum Contaminant Level
EP	Extraction Procedure	MCPA	2-methyl-4-chlorophenoxyacetic acid
MD	Munitions Debris	QC	Quality Control
MDAS	Material Designated as Safe	RAGS	Risk Assessment Guidance for Superfund
ME	Maine	RAP	Rocket Assisted Projectile
MEC	Munitions and Explosives of Concern	RCRA	Resource Conservation and Recovery Act
MEC HA	Munitions and Explosives of Concern Hazard Assessment	RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
mm	millimeter	RI	Remedial Investigation
MPPEH	Material Potentially Presenting an Explosive Hazard	ROD	Record of Decision
MRS	Munitions Response Site	RRD	Range Related Debris

ACRONYM	DEFINITION	ACRONYM	DEFINITION
MS	Matrix Spike	RSL	Regional Screening Levels
MSD	Matrix Spike Duplicate	RTK	Real Time Kinematic
MSL	Mean Sea Level	SAP	Semi-Armor Piercing
mV	millivolt	SCIDA	Seneca County Industrial Development Agency
MW	Monitoring Well	SCO	Soil Cleanup Objective
NA	Not Applicable	SEDA	Seneca Army Depot Activity
NELAC	National Environmental Laboratory Accreditation Conference	SI	Site Investigation
NOAEL	No-Observed Adverse Effect Level	SOW	Statement of Work
NTU	Nephelometric Turbidity Units	SPLP	Synthetic Precipitation Leaching Procedure
NY	New York	SWMU	Solid Waste Management Unit
NYCRR	New York Codes Rules and Regulations	SVOCs	Semi-Volatile Organic Compounds
NYS	New York State	TAL	Target Analyte List
NYSDEC	New York State Department of Environmental Conservation	TBC	To Be Considered
OB	Open Burning	TCL	Target Compound List
OD	Open Detonation	TRV	Toxicity Reference Value
OE	Ordnance and Explosives	USACE	U.S. Army Corps of Engineers
OE EE/CA	Ordinance and Explosives Engineering Evaluation/ Cost Analysis	USEPA	United States Environmental Protection Agency
ORS	Ordnance Related Scrap	UXO	Unexploded Ordnance
PAL	Provisional Action Level	VOCs	Volatile Organic Compounds
Parsons	Parsons Government Services, Inc.	VT	Variable Time
PCBs	Polychlorinated Biphenyls	WP	White Phosphorus
PT	Point Detonation		
QA	Quality Assurance		

CHAPTER 1
INTRODUCTION

1.1 PURPOSE

This Compilation of Previous Investigations and Studies Report was prepared to describe and summarize the results and findings of several previous investigations and removal actions performed at the Open Detonation (OD) Grounds at the Seneca Army Depot Activity (hereafter referred to as "SEDA" or "the Depot") in Romulus, New York (**Figure 1.1**). This report presents a compilation of the description and results of each study to present a single site-wide description of the nature and extent of munitions and explosives of concern (MEC)/material potentially presenting an explosive hazard (MPPEH) and contaminants of potential concern (COPCs) [including munitions constituents (MC)] at the OD Grounds.

1.2 BACKGROUND

The SEDA is located approximately 40 miles south of Lake Ontario, near Romulus, New York, as shown in **Figure 1.1**. The facility is located in an uplands area, at an elevation of approximately 600 feet mean sea level (MSL), that forms a divide separating two of the New York Finger Lakes; Cayuga Lake on the east and Seneca Lake on the west. Sparsely populated farmland covers most of the surrounding area. New York State (NYS) Highways 96 and 96A adjoin SEDA on the east and west boundaries, respectively.

The SEDA previously occupied approximately 10,600 acres of land located in the Towns of Varick and Romulus in Seneca County, New York. The former military facility was owned by the U.S. Government and operated by the Army between 1941 and approximately 2000, when the SEDA military mission ceased. The historic military mission at the SEDA included receipt, storage, distribution, maintenance, and demilitarization of conventional ammunition, explosives, and special weapons. In 1995, the SEDA was designated for closure under the Department of Defense (DoD) Base Realignment and Closure (BRAC) process.

The OD Grounds Site is located in the northwestern corner of the Depot in Seneca County, New York and is also known as SEAD-006-R-01 (alias SEAD-45 and SEAD-115). The OD Grounds was used to destroy excess, obsolete, or unserviceable munitions. Operations at the OD Grounds began circa 1941 when the Depot was first constructed and continued at regular intervals until circa 2000 when the military mission of the Depot ceased. This facility operated under Interim Status as a Subpart X Miscellaneous Unit for open burning and open detonation of explosives, propellants and pyrotechnics and other unserviceable ammunition under 40 Code of Federal Regulations (CFR) Part 265 and New York Codes, Rules and Regulations (NYCRR) 373-1. Due to the closure of the Site, the Resource Conservation and Recovery Act (RCRA) permit was not finalized as Final Status. RCRA Closure requirements and RCRA Corrective Action requirements were deferred to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) program by the New York State Department of Environmental Conservation (NYSDEC). Under this deferment, the Army was permitted to safely dispose and demilitarize munitions via open burning and open detonation. Final Closure of the open burning tray will occur at the end of these activities. During operations, munitions were placed in a hole created in the hill with additional demolition material, covered with a minimum of 8 feet of soil, and detonated remotely. After demolition was completed, explosively displaced portions of the mound were reconstructed by bulldozing displaced and native soils back into the central earthen mound. The historic operations resulted in MEC, MPPEH, and munitions debris (MD) being expelled from the demolition location to the surrounding area. The investigations confirmed the area encompassing 1,000 feet to 2,500 feet from the OD Hill received "kickouts" from the demolition operation (**Figure 1.2**).

According to the Seneca County Industrial Development Agency's (SCIDA) revised planned future use of property within the SEDA, the area that encompasses the OD Grounds is located in the "Conservation/Recreation" parcel of the former Depot (**Figure 1.3**). SCIDA transferred the site to a future user for the same use: conservation and passive recreation. "Passive recreation" refers to a use of the land where there is limited activity and reduced potential for subsurface soil contact (i.e., does not include playgrounds or ballparks, but includes seasonal hunting and deer sight-seeing tours). The land will also have restricted access through institutional controls such as fencing and security.

1.3 PREVIOUS INVESTIGATIONS

Several investigations and ordnance removals were completed at SEAD-45 since the first sampling in 1979. **Table 1.1** lists the previous investigations. This section summarizes the studies or field work that were completed, and the general scope of the work performed. To assign specific work areas to each study, the OD Grounds was divided into areas based on the radius around the center of the demolition berm. Over time the site was expanded to account for MD and MEC found outside the original 1,800-foot boundary (as defined in the Archives Search Report [ASR]). Each investigation covers a specific area of the site reported as a circle or ring with the inner and outer radius specified. Additional detail for each project including the results of the investigation or findings of the removal actions is presented in **Chapter 2**.

Note Concerning Munitions Terminology: Multiple munitions investigations have been conducted at the OD Grounds since the 1990s (**Table 1.1**). Since that time, munitions terminology has changed from referring to "ordnance and explosives" or "OE" (i.e., explosively hazardous munitions items) and "OE scrap" (i.e., non-explosively hazardous pieces of expended munitions) to using the terms MEC (e.g., UXO and DMM), Material Potentially Presenting an Explosive Hazard (MPPEH), and MD (the definitions of these terms are presented in the Glossary). In addition, reports for the OD Grounds have sometimes used the more general term "MPPEH" to describe MEC and MD. For purposes of this report, correct terminology has been used wherever possible – i.e., the terms "MEC," "UXO," and "DMM" have been used in place of the terms "OE" and "MPPEH" wherever possible. However, the outdated terms may still be used if it is not possible to infer from the context of the original document which of the newer terms should be used. In these cases, the original terms will be presented in quotation marks.

TABLE 1.1
SUMMARY OF PREVIOUS INVESTIGATIONS
OD GROUNDS, SEDA, ROMULUS, NY

PREVIOUS INVESTIGATION AND DOCUMENT ISSUE DATE	YEAR	SUMMARY
US Army Environmental Hygiene Agency (USAEHA) Study	1982	Collected eight soil samples and analyzed for metals and explosives.
Expanded Site Inspection (Engineering Science, Inc., 1995)	1995	Geophysics, test pitting, groundwater and surface water sampling conducted.
Archives Search Report	1998	Site inspection, archives search and employee interviews to document previous military use and potential environmental contamination that could remain at the Seneca Army Depot.
Ordnance and Explosives (OE) Engineering Evaluation / Cost Analysis (Parsons, 2004)	2000	Characterized the nature and extent of OE at the OD Grounds using geophysical survey techniques and intrusive investigations.
Phase I Geophysical Investigation (Weston, 2005)	2003	Geophysical surveys collected using EM61 MK2 towed-array system to identify 14,700 anomalies within open areas between the 1,000 ft. and 1,500 ft. radius of OD Hill.
Phase II OE Removal Activities (Weston, 2006)	2006	Reacquired, removed, and disposed of approximately 8,500 MEC/Unexploded Ordnance (UXO) and MD items located between the 1,500 ft. and 2,500-ft. radius from the OD Hill to a depth of 4 ft.
Additional Munitions Response Site Investigation (Parsons, 2010)	2010	Topographic and geophysical surveys of portions of the OD Grounds and the collection and analysis of soil samples from test pits and surface locations.
MMRP Clearance of Inner Radius at OD Grounds (CB&I)	2013	CB&I initiated field work in the inner 1000 feet of the OD Grounds Site and completed a DGM survey in that area. Select anomalies were investigated.
Feasibility Study and Human Health Risk Assessment (HHRA) [not finalized] (Parsons, 2015)	2015	Documented possible remedial action alternatives to remediate the OD Grounds.
Munitions Response Action (Phase III) (Parsons, 2016)	2012-2014	Reacquired, and investigated 14,688 anomalies, removed, and disposed of 15,885 munitions related items located between the 1,500 ft. and 2,500 ft. radius from the OD Hill to a depth of 4 ft.
MEC Clearance at OD Grounds	2012	Prior to early termination of contract, DGM survey of inner 1,000 feet completed.
Perchlorate Sampling	2018	Perchlorate sampling in soil, groundwater, ditch soil, and surface water.

1.3.1 United States Army Environmental Hygiene Agency Study

According to the Expanded Site Inspection (ESI) (ES, 1995) Monitoring wells MW-1 through MW-5 were sampled in 1979 for conventional pollutants and explosives. The explosive compound 4-amino-2,6-dinitrotoluene was detected in groundwater from wells MW-1 through MW-4 and from Reeder Creek. In 1982, USAEHA analyze soil samples at eight locations for EP Toxicity (As, Ba, Cd, Cr, Hg, Pb, Se, and Ag) and explosives. Cd and explosives were detected in all samples.

1.3.2 Expanded Site Inspection (1995 Engineering-Science)

Scoping documents were prepared for the ESI, and these documents were reviewed and commented on by the United States Environmental Protection Agency (USEPA) and New York State Department of Environmental Conservation (NYSDEC). The purpose of the ESI was to investigate Solid

Waste Management Units (SWMUs) that were designated as Areas of Concern (AOCs) within the SEDA (Engineering-Science Inc. [ES], 1995). These inspections were conducted at seven high priority AOCs, one of which was SEAD-45. The ESI at SEAD-45 included electromagnetic (EM-31) and ground penetrating radar (GPR) surveys. These two surveys focused on a grid approximately 800 by 900 ft directly over the center of the open detonation mound. Test pits were also excavated to identify the sources of select anomalies.

The MC/COPCs investigation included 9 surface soil samples, 5 subsurface soil samples, 8 groundwater samples, and 4 surface water and sediment sample pairs. All samples were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), herbicides, metals, and nitroaromatics.

1.3.3 Archives Search Report (ASR)

The U.S. Army Corps of Engineers (USACE) St. Louis District conducted a site inspection, archives search and employee interviews to document previous military use and potential environmental contamination that could remain at the Seneca Army Depot. The ASR initially subdivided the depot into 27 Areas of Interest (AOIs) based on physical attributes, homogeneity, and current and historical land use (USACE, 1998). The ASR evaluated each AOI to determine whether the area should or should not be investigated for Ordnance and Explosives (OE) / Unexploded Ordnance (UXO). Each AOI was classified as requiring further investigation or not requiring further investigation based on a review of historical documents, aerial photography, and employee interviews. Most of the AOIs were also visited by USACE to determine whether any traces of OE were readily apparent. It was determined that 12 of the AOIs identified in the ASR would need further investigation to determine the exact nature of possible ordnance contamination.

At the time of the ASR, the area denoted as SEAD-45 was considered to be a large open area approximately 60-acres in size surrounding a large berm that was used to suppress the effects of ordnance demolition activities. Aerial photographs from 1954 show there may have been burn pads that were covered by 1978. A variety of ordnance was destroyed by detonation at this area, including explosives, rockets, and heavy artillery. The blast radius shown on old drawings included in the ASR is 1,800 ft from the center of the demolition berm. The ASR indicated that OE scrap and fragments of demolished ordnance were prevalent throughout the SEAD-45 area.

1.3.4 OE Engineering Evaluation / Cost Analysis – 0 to 1,800 Ft Radius (2004 Parsons-ES)

The OE Engineering Evaluation / Cost Analysis (EE/CA) focused on characterizing OE contamination, analyzing risk management alternatives, and recommending feasible OE exposure reduction alternatives for eleven AOIs including SEAD-45. This objective was accomplished at SEAD-45 using a geophysical survey with the purpose of characterizing the horizontal and vertical extent of ordnance remaining within the AOI. A digital geophysical mapping (DGM) survey was conducted using an EM61 Time Domain Metal Detector (EM61) to detect ferrous and non-ferrous metal objects. This survey was performed between June 2000 and December 2000 and included 13 acres of 100- by 100-ft grids and 3.5 acres of "meandering path" surveys. Following the surveys, an intrusive investigation of select anomalies was performed.

1.3.5 Phase I – 1,000 to 2,500 Ft Radius (2005 Weston)

The Phase I investigation was a time-sensitive geophysical investigation of potential MEC and MD within the SEAD 45/115 Open Detonation Grounds at the SEDA (Weston, 2005). The Phase I investigation was performed by Weston Solutions, Inc. (Weston) with Parsons conducting the geophysical mapping. The primary objective of this project was to conduct a time-sensitive geophysical investigation and anomaly identification between the 1,000-ft and 2,500-ft radial limits of the OD Grounds. The purpose for collecting this information was to generate mapping and database information that could be used to refine acreage estimates for the remedial zones outlined in the EE/CA (Parsons, 2001), and to develop a cost estimate for future MEC removal actions at the site. Approximately 454 acres of wooded and non-wooded areas were divided into an inner radius from 0 ft to 1,000 ft (72 acres) from the OD Grounds center and an outer radius from 1,000 ft to 2,500 ft (382 acres) from the OD Grounds center. Based on the OE EE/CA (Parsons ES, 2004), the inner 1,000-ft radius was considered to have a high density of potential MEC and munitions debris targets, meaning that the current geophysical methods were not able to distinguish individual anomalies within the data when comparing the geophysical response with that of typical background measurements. Therefore, the Phase I investigation focused on the outer radius from 1,000 ft to 2,500 ft from the OD Grounds Center. Phase I site investigation activities were conducted between May 2003 and August 2003.

1.3.6 Phase II – 1,500 to 2,500 Ft Radius (2006 Weston)

The primary objective of the Phase II project was to reacquire, remove and dispose of approximately 8,500 OE/UXO items and ordnance related scrap (ORS) anomalies located in non-wooded/open areas between the 1,500 ft and 2,500 ft radius (WESTON, 2006). Additionally, potential munitions items located within 220 transects through wooded areas [mag & flag] defined during the Phase I also required reacquisitions, removal and disposal. The clearance depth for both work areas was 4 ft below ground surface (bgs) based upon a public access scenario. Anomaly and reacquisition activities were conducted between 9 September 2003 and 30 March 2005.

1.3.7 Additional Munitions Response Site Investigation – 0 to 1,500 Ft Radius (2010 Parsons)

This project performed a focused investigation within the OD Grounds 0 – 1,500 ft radius, documented in "Additional Munitions Response Site Investigation Report" (Parsons, 2010). The investigation included a topographic and geophysical test plot survey to determine the volume of soil in the OD Hill, estimate the depth of the bedrock surface beneath the OD Hill, determine and document the density of geophysical anomalies from the ground surface to depth at selected areas, and determine the nature of MPPEH items that are present at the OD Grounds. This project also included soil sampling to determine the vertical and horizontal extent of metals, explosives, SVOCs, pesticides and herbicides, and PCBs in the OD Hill and surrounding area; and sampling was conducted to assess the potential leachability to groundwater of certain compounds.

1.3.8 MMRP Work of Inner Radius – 0 to 1,000 Ft Radius (2013 CB&I)

Shaw (CB&I) prepared a work plan for proposed work in the area within 1,000 feet of the OD Hill (Shaw, 2012). Shaw conducted a DGM survey of the area within 1000 feet, and their DGM data were provided to USACE. The DGM data is included in **Figure 1.4**. CB&I's contract was terminated before any additional scope was completed.

1.3.9 Munitions Response Action – 1,000 To 2,000 Ft Radius (2012-2014 Parsons)

The purpose of this munitions response action was to remove MPPEH from the Kickout Area (1,000- to 2,000-foot radius) at locations not addressed by previous actions, as documented in the Completion Report (Parsons, 2016). Work included reacquisition and intrusive investigation of 14,688 previously located geophysical anomalies and analog metal detector surveys and removal ("Mag and Dig") in the inaccessible areas (e.g., wooded, heavily vegetated, or steep terrain). Field work for this task was completed over three field seasons between April 2012 and December 2014.

1.3.10 MMRP Work of Inner Radius – 0 to 1,000 Ft Radius

Shaw (CB&I) prepared a work plan for proposed work in the area within 1,000 feet of the OD Hill (Shaw, 2012). CB&I's contract was terminated before their scope was completed, and documentation of the details of their work is not available for review at this time. Before their contract was terminated, CB&I did complete a DGM survey within the 1,000 ft radius.

1.3.11 Perchlorate Sampling (2018 Parsons)

Parsons conducted groundwater and soil sampling at the OD Grounds in June 2018 to evaluate the presence or absence of perchlorate in the vicinity of the OD Hill. Perchlorate samples were collected at nine well locations using low flow sampling methods. Soil samples were collected from two depths at ten locations, for a total of 20 samples.

CHAPTER 2
MUNITIONS AND EXPLOSIVES OF CONCERN AND MUNITIONS CONSTITUENTS/CONTAMINANTS OF POTENTIAL CONCERN CHARACTERIZATION METHODS

2.1 MUNITIONS AND EXPLOSIVES OF CONCERN CHARACTERIZATION METHODS

2.1.1 Expanded Site Inspection (1995 ES)

In 1993, the ESI completed geophysical investigations to help characterize the environmental setting of the OD Grounds with respect to MEC. To evaluate the potential for buried unexploded ordnance, electromagnetic (EM-31) surveys and ground penetrating radar surveys were conducted in the area surrounding the elongated detonation hill. Where the electromagnetic data indicated anomalies possibly associated with buried metallic objects, a subsequent ground-penetrating survey was performed to characterize the anomaly source. The methods used for these two surveys are described in Section 2.2.1 of the *Final Expanded Site Inspection Seven High Priority SWMU's, SEAD 4, 16, 17, 24, 25, 26, and 45* (ES, 1995).

2.1.2 OE Engineering Evaluation / Cost Analysis – 0 to 1,800 Ft Radius (2004 Parsons-ES)

Conducted in the year 2000, the OE EE/CA included grid based and meandering path surveys using the EM61 sensor. Following data processing and anomaly selection, an intrusive investigation was performed on select anomalies within the survey areas. In addition to the DGM methods, several grids were investigated using mag and flag methods where vegetation prevented the use of the EM61. The methods used for the grid based, meandering path, and mag and flag surveys are described in Sections 3.1.2, 3.1.3 and 3.1.4 of the Final OE EE/CA Report (Parsons-ES, 2004). Of note in these specific sections are that the EM61 survey was performed using a 2.5-ft wide path using fiducial measurements off surveyed grid markers. The meandering path data was collected in a single pass away from and back from the detonation berms along brush cleared paths and a Trimble 4700 Real Time Kinematic (RTK) Global Positioning System (GPS) was time synced with the data collection for locating anomalies.

The description of the instruments used, and instrument checks performed are described in Section 3.2 and 3.3 of the Final OE EE/CA Report (Parsons-ES, 2004). Anomaly reacquisition and intrusive investigation methods are described in Sections 3.6 and 3.7 of the Final OE EE/CA Report (Parsons-ES, 2004). Quality control (QC) of the surveyed areas is discussed in Section 3.7.5 of the Final OE EE/CA Report (Parsons-ES, 2004).

2.1.3 Phase I – 1,000 to 2,500 Ft Radius (2005 Weston)

In 2003, Phase I activities included brush removal and DGM over most of the areas within the 1,000-ft to 2,500-ft buffer area of the OD grounds. Section 2.1 of the Final Site-Specific Project Report (Weston, 2005) described the selection of and set-up of the towed array system for DGM collection, Section 2.2 describes site preparation and brush clearing methods, and Section 2.3 describes the methods used for the DGM. For tracking and reference purposes, a geospatial 125-ft by 125-ft grid system was established for the site using existing North American Datum 83 New York Central State Plane Coordinates. Grids were numbered 1 through 44 from south to north and lettered "A" through "RR" from west to east. In the field, the inner and outer radial limits of the OD Grounds were identified using stakes and/or flagging. Extensive brush clearing was completed and where full brush clearing could not be completed due to the size of trees (over 6-inch in diameter), 10 ft wide transect where cleared. Prior to DGM, a MEC avoidance inspection was done to remove surface MEC. DGM data was collected using an EM61 MK2 towed array system with integrated RTK GPS. The transects were spaced at 10-ft in order to meet a data quality objective (DQO) of no more than 0.25 cumulative acres of data gaps in the mapping coverage.

Section 2.5 of the Final Site-Specific Project Report (Weston, 2005) describes the QC and quality assurance (QA) procedures use during the project. QC seeds were placed at a rate of 1 per 5 acres (41 seeds) and QA procedures included 48 seeds, reacquisition of 367 targets and intrusive investigation of 1,248 anomalies to verify the functionality and accuracy of the geophysical data. Appendix F of the Weston (2005) Final Site-Specific Project Report describes the methods used for reacquisition and intrusive activities.

2.1.4 Phase II – 1,500 to 2,500 Ft Radius (2006 Weston)

The Phase II investigation (Weston, 2006) documents the activities and methods performed to reacquire, remove, and dispose of target anomalies identified based on analog and DGM and survey data collected during the Phase I investigation (Weston, 2005). Activities included site preparation, anomaly investigation, anomaly reacquisition and removal, and demilitarization and disposal. Section 2.2 and 2.3 of the Phase II Ordnance and Explosives Removal Report (2006, Weston) describes the site preparation and anomaly investigation.

Prior to intrusive activities, the location of targets were identified using Real Time Kinematic surveying equipment and the coordinates of each target were downloaded into the Trimble surveying equipment and flagged based on GPS coordinates. Technicians worked within specific grids and performed a surface sweep of the area within a 48-inch diameter of each flagged location. Following the surface sweep, the technicians performed a subsurface investigation to a minimum depth of 4 ft, or until the anomaly was either located or the signal was eliminated. This process was initially completed for anomalies that had a response greater than or equal to 13 mV and the list was later refined based on the types of items found within the 13mV to 50mV range to include only anomalies that had a response greater than or equal to 50 mV.

In order to establish evidence that the transects located closest to the Open Detonation Hill were more saturated with OE/ORS, WESTON began investigating the transects by clearing the transects located along or in the vicinity of 1,500-ft radius. The UXO Technicians, using the Schonstedt GA-52Cx, swept the transect two times in opposite directions ensuring that all anomalies were located. During the course of Phase II, demilitarization operations consisting of either a blow-in-place, intentional detonation, or thermal treatment (open burn) were conducted as needed to prepare OE for demilitarization and off-site disposal. Section 2.4, 2.5, and 2.6 of the Phase II Ordnance and Explosives Removal Report (Weston, 2006) describes in depth the methods used throughout the Phase II investigation.

2.1.5 Additional Munitions Response Site Investigation – 0 to 1,500 ft Radius (2010 Parsons)

The Draft Completion Report for Additional Munitions Response Site Investigations (Parsons, 2010) documented the activities and methods performed as part of the Site Investigation (SI). There were three main components to the MEC Characterization effort, a topographical survey, DGM, and intrusive investigation. The topographical survey was performed by collecting detailed ground surface elevations using a Trimble Base Station and Rover GPS to collect data to calculate the volume of the OD Hill at the center of the OD Grounds. To evaluate a depth profile of debris in the OD Hill area, a geophysical survey was conducted using EM methods over several test plots followed by removal of soil. Additional EM data collection occurred at depths of 1 foot bgs or 2 feet bgs. Lastly intrusive investigation of anomalies over 50mV within the test plots were investigated to document the nature of the anomalies within the test plot area.

2.1.6 Munitions Response Action – 1,000 To 2,000 Ft Radius (2012-2014 Parsons)

The Draft Completion Report for Munitions Response Action (Parsons, 2016) documented the activities and methods performed as part of the munitions response action. Methods used under this response action include anomaly reacquisition and intrusive investigation, analog surveys and intrusive investigation, and MPPEH handling. The Geonics EM61-MK2 time domain electromagnetic sensor (EM61-MK2) instrument and the Trimble® R8 real-time kinematic global positioning system were used for reacquisition of existing anomalies that exceeded the Work Plan defined 50mV response threshold during the previously obtained surveys. The clearance of each mag and dig work area was performed by teams comprised of certified UXO technicians using analog instruments, including Schonstedt magnetometers and White's metal detectors. MPPEH handling on this project included tracking to establish the final disposition of items identified as MPPEH in the field. Once an item was identified preliminarily (immediately after digging) as MPPEH the item was again visually inspected by the UXO QC. After further review, items found not to contain any residual explosive hazard following inspection were recategorized as material designated as safe (MDAS). Items that were still considered MPPEH were divided into two groups; those requiring thermal treatment or those requiring explosive perforation. Only the explosively perforated items could be further classified as MEC items (MEC prior to processing) before they were classified as MDAS after processing. However, not all items requiring explosive perforation ended up having been MEC. Some items cannot be distinguished from safe items that look the same; therefore, demolition is necessary due to the potential that the item was MEC.

2.1.7 MMRP Work of Inner Radius – 0 to 1,000 Ft Radius

Shaw (CB&I) prepared a work plan for proposed work in the area within 1,000 feet of the OD Hill (Shaw, 2012). CB&I's contract was terminated before their scope was completed, and documentation of the details of their work is not available for review at this time. Before their contract was terminated, CB&I did complete a DGM survey within the 1,000 ft radius. The munitions removed during this surface clearance were stored on site and handled and disposed of under a new contract in 2018. The documentation of what was removed during the inner radius work is based only on what was found during the 2018 removal of material left from the previous clearance effort.

2.2 MUNITIONS CONSTITUENTS/CONTAMINANTS OF POTENTIAL CONCERN CHARACTERIZATION METHODS

2.2.1 Expanded Site Inspection (1993 ES)

In 1993, the ESI completed numerous tasks to characterize the environmental setting of OD Grounds (formerly SEAD-45) regarding MC and COPCs. These tasks included soil sampling, groundwater investigation, and surface water/sediment investigation.

The soil sampling program included methods such as test pitting and grab samples. Subsurface samples were collected from test pits located within the OD mound and from test pits located on the north and west edges of the mound. The samples collected from the test pits were sampled at a 3-foot depth. Grab samples of surface soils were obtained by removing representative sections of soil from 0 to 2 inches below ground surface. Fourteen soil samples were collected and analyzed for the following: Target Compound List (TCL) VOCs, TCL SVOCs, and TCL pesticides/PCBs and Target Analyte List (TAL) metals and cyanide according to the NYSDEC Contract Laboratory Program (CLP) Analytical Services Protocol Statement of Work (SOW). Explosive compounds were analyzed by the Environmental Protection Agency (EPA) Method 8330, herbicides were analyzed by EPA Method 8150, and nitrates were analyzed by EPA Method 352.2.

The groundwater investigation program included the installation of four wells. One well was located upgradient of the mound to obtain background water quality data. The other three wells were located downgradient of the detonation mound. Wells were of standard construction (i.e., 2-inch I.D. Schedule 40 polyvinyl chloride [PVC] with a well screen slot size of 0.010). Wells were screened from 3 feet above the water table (if space allowed) to the top of competent bedrock. A sand pack was placed by tremie pipe in the annulus and extended a few feet above the well screen. A bentonite seal was placed above the sand pack. Eight groundwater samples were collected and analyzed for the following: TCL VOCs, TCL SVOCs, and TCL pesticides/PCBs and TAL metals and cyanide according to the NYSDEC CLP Analytical Services Protocol SOW. Explosive compounds were analyzed by the EPA Method 8330, herbicides were analyzed by EPA Method 8150, and nitrates were analyzed by EPA Method 352.2.

Surface water samples were collected on the site by immersing a clean glass beaker or a sample bottle without preservatives. Sediment samples were collected by scooping sediment into decontaminated stainless-steel bowls with a decontaminated trowel. Three sets of samples were collected from three drainage channels east of the detonation mound and one set was collected from within the marsh area northwest of the detonation mound. Four surface water samples and four sediment samples were collected. All the samples were analyzed for the following: TCL VOCs, TCL SVOCs, and TCL pesticides/PCBs and TAL metals and cyanide according to the NYSDEC CLP Analytical Services Protocol SOW. Explosive compounds were analyzed by the EPA Method 8330, herbicides were analyzed by EPA Method 8150, and nitrates were analyzed by EPA Method 352.2.

2.2.2 Additional Munitions Response Site Investigation – 0 to 1,500 ft Radius (2010 Parsons)

Ninety-two samples, including quality assurance/quality control samples, were collected at the OD Grounds. Samples were collected from: 1) the surface of OD Hill (20 locations); 2) surface locations at cardinal, ordinal and, intermediate locations, on a series of expanding concentric rings ("Doughnut

Rings") exterior to the OD Hill (37 locations), and 3) surface and subsurface locations (i.e., 0, 2.5, 5, 7.5 and 10 ft bgs) from four test pits excavated immediately adjacent to the toe of the OD Hill mound (19 locations). Appropriate QC/QA samples, including matrix spike/matrix spike duplicate (MS/MSD), sample duplicate, and field blanks, were collected.

Samples were submitted to Katahdin Analytical Services in Scarborough, ME, which is a New York State National Environmental Laboratory Accreditation Conference (NELAC) certified and DoD Environmental Laboratory Accreditation Program (ELAP) certified laboratory. All the samples were analyzed for TAL metals using Methods SW846 6010B/7471A. Explosive compounds were analyzed by SW846 Method 8330B in 38 of the samples. TCL SVOCs (SW846 Method 8267C), pesticides/PCBs (SW846 Method 8081A/8082), and organochlorine herbicides (SW846 Method 8151) were analyzed in 26 of the samples. Eight samples were analyzed for metals leachability using a synthetic precipitation leaching procedure (SPLP) via SW846 Method 1312 coupled with Method SW846 6010B/7471A.

2.2.3 Perchlorate Sampling (2018 Parsons)

Perchlorate sampling conducted in June 2018 included activities and methods performed as part of the investigation into the presence or absence of perchlorate in the groundwater and soil at OD Grounds. Groundwater sampling was conducted at existing wells, that were in good condition as determined by a well condition survey conducted prior to sampling. New wells were installed at locations where the existing well was no longer in good condition. Sampling was conducted using low flow sampling methods. Soil samples were collected from two depths at ten locations. Surface (0-6 inches bgs) and subsurface (18 – 24 inches bgs [one location was 12 – 18 inches bgs due to refusal]) soil samples were analyzed for perchlorate. The samples were analyzed by TestAmerica – Denver using the USEPA Method 6860.

CHAPTER 3
MUNITIONS AND EXPLOSIVES OF CONCERN AND MUNITIONS CONSTITUENTS/CONTAMINANTS OF POTENTIAL CONCERN CHARACTERIZATION RESULTS

The following subsections describe the results from previous investigations and removal actions conducted at the OD Grounds at the Seneca Army Depot. The reports cover a long range of time; therefore, the terms used to describe the munitions related items found during each study has changed over time. When sufficient detail is available to specify, current terms (e.g., munitions debris, munitions and explosives of concern, material designated as safe, and material presenting a potential explosive hazard) were used to replace older terms such as "OE", as appropriate. Original terms have been used as necessary when an appropriate replacement cannot be determined.

3.1 MUNITIONS AND EXPLOSIVES OF CONCERN CHARACTERIZATION RESULTS

3.1.1 Expanded Site Inspection (1995 Engineering Science)

3.1.1.1 Description

The Expanded SI included electromagnetic (EM-31) and ground penetrating radar surveys at SEAD-45. The purpose of this investigation was to conduct an ESI at SWMUs that were designated as AOCs within the SEDA (ES, 1995). The area for the surveys focused on an approximately 800- by 900-ft grid directly centered over the open detonation mound. The surveys did not include the topographic footprint of the OD Hill but were focused on the area adjacent to the hill.

3.1.1.2 Results

The ESI report used both the quadrature and in-phase response of the EM-31 for site evaluation. As stated in the ESI report, the in-phase response is particularly sensitive to concentrations of discrete metallic objects, whereas the quadrature response is better at identifying large scale changes in the subsurface. The final ESI report (ES, 1995) reports that the quadrature response of the EM survey identified a few linear features later identified as piles and blasting wires and many small isolated anomalies throughout the survey area. The in-phase EM survey identified the same linear features as well as additional smaller isolated anomalies scattered across much of the survey area. Five detailed GPR grids were conducted to further characterize several anomalies identified by the EM survey. Two were characterized as having a long linear signal; one was estimated at 10-12 linear feet and another at 38 linear feet. The specific source of the EM anomalies in the other three GPR grids could not be identified in the GPR records.

Following the surveys, 10 test pits were excavated to identify the sources of various EM anomalies. These test pits identified buried pipe and determined that 8 to 10 anomaly lobes were caused by conduit and blasting wire leading to the former blasting pits. One of the test pits encountered a variety of material, including munitions fragments, wood, ash, wire, nails, etc., much of which contributed to the observed EM anomalies.

3.1.2 OE Engineering Evaluation / Cost Analysis – 0 to 1,800 Ft Radius (2004 Parsons-ES)

3.1.2.1 Description

As described in the Final OE EE/CA report (Parsons-ES, 2004), a DGM survey was conducted using an EM61 between June 2000 and December 2000. The DGM survey covered 13 acres of 100- by 100-ft grids within a 60-acre area (approximately 1,600 by 1,600 ft) centered over the Open Detonation Berm. Additional DGM was conducted northwest and west of the DGM gridded area and within the 1,800-ft buffer of the OD range. These "meandering path" surveys collected 3.5 acres of data across an area of approximately 174-acres (**Figure 3.1**). Following the DGM surveys, intrusive investigation of select anomalies was performed. Within the center gridded area, an additional 1.4 acres of data was collected using mag and flag methods in 6 grids where the EM61 could not be used due to vegetation. All anomalies were flagged; two of these grids were investigated intrusively.

The grid survey (DGM and mag-and-flag survey) covered approximately 24% of the 60 acres investigation area and identified 1,337 anomalies. Because the metallic density was so high, a typical background of -2 to 6mV could not be used to contour the data. Due to this issue anomalies were selected by increasing the contouring range as needed until the 20 highest amplitude anomalies could be selected from each grid. In total 1,152 anomalies were identified for intrusive investigation in the fifty-seven EM61 grids. Two of the mag-and-flag grids were also intrusively investigated; however, detailed data was not collected for these grids.

The meandering path data covered approximately 2% of the 174 acres investigated. Due to the thick brush to the east and an existing removal action on the SEAD 23 Open Burning (OB) Grounds to the south, the transect data was confined to the west and north of the grid investigation area. **Figure 3.1** shows the locations of the OE EE/CA grids and meandering path transects.

3.1.2.2 Results

Of the 1,337 grid-based DGM anomalies, 1,152 were intrusively investigated and 49 UXO items and 432 "OE" items (likely MD) were identified. Of the 970 meandering path anomalies, 701 were intrusively investigated. On the meandering paths 21 UXO items and 380 "OE" items (Likely MD) were identified. **Figure 3.1** shows the locations of recovered munitions related items and UXO items, respectively. **Table 3.1** summarizes the areas and estimated densities based on the EE/CA data. **Table 3.2** summarizes the depth distribution of recovered items. As shown in **Table 3.2**, during the OE EE/CA 99% of the recovered MEC/MPPEH/MD items were found within the top 18 inches of soil. **Table 3.3** lists the munitions types that were identified from munitions debris or MEC found during the OE EE/CA investigation.

TABLE 3.1 SUMMARY OF DGM RESULTS AND DENSITIES
OE EE/CA (2004 PARSONS-ES)

COVERAGE		FINDINGS		RESULTS		COMMENTS
AREA	ACRES	ANOMALIES	MPPEH	ANOMALIES PER ACRE	MPPEH PER ACRE	
Center Area	Total Acres: 60 DGM Acres: 13	Identified: 1,337 Dug: 1,152	49 of 1,152 anomalies	102.8 (1)	3.76 to 4.37 (2)(3)	The anomaly per acre estimate and resulting MPPEH per acre estimates are likely biased low due to selection methods caused by a high density of metal in these areas.
Buffer Area: Outside center to 1,800-ft buffer	Total Acres: 174 DGM Acres: 3.5	Identified: 970 Dug: 701	21 of 701 anomalies	277.1	6 to 8.3 (2)(3)	The MPPEH per acre estimates have some uncertainty due to assumptions applied to un-dug anomalies.

(1) During the data processing the high density of metal prevented anomaly selection at a normal background threshold. The method used as described and referenced in Section 2.1.2 required increasing the contouring range until individual anomalies could be selected, as such the anomaly density is likely biased low and the total number of anomalies per acre is likely much larger than those presented.

(2) Due to 1) the selection process and 2) not digging all anomalies there is likely a certain degree of uncertainty in the calculation of MPPEH density. The lower range assumes that none of the undug anomalies were MPPEH and it may be an underestimate of the MPPEH density.

(3) The upper estimate assumes that the same rate of MPPEH will occur in the undug anomalies (4.25 MPPEH per 100 anomalies in the center area and 3.00 MPPEH per 100 anomalies in the buffer area) and may represent either and over or under estimate of the actual MPPEH density within the selected anomalies.

TABLE 3.2 DEPTH OF RECOVERED ITEMS
OE EE/CA (2004 PARSONS-ES)

DEPTH (INCHES BGS TOP OF ITEM)	RECOVERED ITEM TYPE		GRAND TOTAL	
	OE	UXO		
0	26	8	34	3.9%
0.5 to 6	647	57	704	79.8%
7 to 12	121	4	125	14.2%
13 to 18	14	0	14	1.6%
19 to 24	2	0	2	0.2%
25 to 30	0	0	0	0.0%
31 to 36	1	1	2	0.2%
37+	1	0	1	0.1%
Total	812	70	882	100.0%

TABLE 3.3 MUNITIONS TYPES IDENTIFIED OE EE/CA (2004 PARSONS-ES)

INVESTIGATION AREA	IDENTIFIED MUNITIONS TYPES
0 to 1,800 ft radius	37mm Projectile: Armor-Piercing High Explosive (APHE), M80
	40mm Rifle Grenade
	75mm Projectile: APHE, M61A1
	105mm Projectile: White Phosphorous (WP), M60 Series
	4lb. Fragmentation Bomb: M83 (Butterfly)
	Fuzes (various models)
	3.5-inch Rocket
	5-inch high velocity aerial rocket (HVAR)
	20mm Projectiles
	25mm Projectiles
	57mm Projectiles
	81mm Mortar Round
	90mm Projectiles
	115mm Projectiles
	120mm Projectiles
	155mm Projectiles
	250lb bombs (concrete filled, left in place due to weight).

3.1.3 Phase I – 1,000 to 2,500 Ft Radius (2005 Weston)

3.1.3.1 Description

A time-sensitive geophysical investigation was conducted between the 1,000-foot (ft) and 2,500-ft radial limits of the OD Grounds at the Seneca Army Depot Activity (SEAD 45/115 OD Grounds) between 02 June 2003 and 27 August 2003. The Phase I investigation was performed by Weston Solutions, Inc. (Weston) with Parsons conducting the geophysical mapping. The purpose for collecting this information was to refine acreage estimates for the remedial zones outlined in the OE EE/CA (Parsons-ES, 2004) and to develop a cost estimate for future MEC removal actions at the site.

The Phase I investigation included a MEC avoidance inspection, vegetation clearing, surveying, DGM, and "mag and flag" mapping. For the DGM effort, an EM61 towed-array system was used to collect data in all non-wooded/open areas and where sufficient transects could be cut to collect towed array data (approximately 213 acres between the 1,000-ft and 2,500-ft radial limits of the OD Grounds). Where trees greater than 6 inches in diameter limited sufficient brush clearing, an analog "mag & flag" approach using hand-held Schonstedt magnetometers was used to locate subsurface anomalies in wooded/transect areas (9.65 acres between the 1,000-ft and 2,500-ft radial limits of the OD Grounds) (**Figure 3.2**). QA and QC seeds were used to evaluate the project. Reacquisition of 367 targets and intrusive investigation of 1,248 anomalies was completed to verify the functionality and accuracy of the geophysical data.

3.1.3.2 Results

In total, approximately 213 acres of DGM and 9.65 acres of "mag and flag" transect data was collected as part of the Phase I investigation. Results of the digital and analog geophysical surveys indicate that approximately 599 targets per acre exist between 1,000 ft and 1,500 ft of the OD Grounds center and approximately 139 targets per acre (non-wooded areas) to 293 targets (wooded transect areas) exist between 1,500 ft and 2,500 ft from the OD Grounds center. It should be noted that this variability is due to the difference between sensors used to collect the digital and analog data. These results confirm that the density of MPPEH and munitions debris within the OD Grounds decreases further away from the OD Grounds center, as was indicated in the OE EE/CA (Parsons-ES, 2004). Due to the high-density of targets found outside the initial 1,000-ft inner radius, the area of the OD Grounds that is considered to have a high density of MPPEH and MD was extended to a radial limit of 1,500 ft from the OD Grounds Center.

As part of the QA process, USACE selected 1,248 locations for intrusive investigation. A total of 512 items were manually excavated from target anomaly locations identified using the EM61 MK2 in non-wooded/open areas of the OD Grounds. Another 736 items were excavated from anomaly target locations within the transects. Anomaly densities and derived MPPEH densities, based on the distribution of anomalies and number of MPPEH items identified during the intrusive investigation are presented in **Tables 3.4 and 3.5** which illustrates that the number of anomalies and MPPEH decreases with distance from OD Hill. Anomaly size, as interpreted by larger mV response, shows a correlation with distance from OD Hill (**Table 3.6**). The number of targets with higher mV response tending to be within the 1,000 - 1,500 ft radius whereas the number of targets with smaller mV responses were found farther from OD Hill. More than half of the targets identified within the 1,000 - 1,500 ft radius were greater than 50mV in contrast to nearly half of the targets identified within the 1,500 - 2,000 ft radius were between 10 and 20 mV. As illustrated in **Table 3.7**, the intrusive selection is more heavily weighted toward investigation of larger anomalies. The distribution of mV responses (sum of channels 1 to 4) in the entire anomaly data set was compared to the distribution of the items intrusively investigated and tended to bias towards targets greater than 50mV. The majority of MPPEH items discovered were at responses greater than 50mV (**Table 3.7**). The depth distribution of excavated items is presented in **Table 3.8**. Approximately 98% of the intrusively investigated items were found at a maximum depth (top of item) of 12 inches bgs. **Table 3.9** lists a summary of the munitions types that were identified from munitions debris or MPPEH found during the Phase I investigation.

TABLE 3.4 SUMMARY OF DGM RESULTS AND DENSITIES IN NON-WOODED AREAS PHASE I INVESTIGATION (2003 WESTON)

COVERAGE		FINDINGS		RESULTS		
AREA	ACRES	ANOMALIES	MPPEH	ANOMALIES PER ACRE	MPPEH PER ACRE	COMMENTS
<1,000 ft buffer of the OD Grounds Center	Total Acres: 72.3 DGM Acres: (Not Available)	Identified: 1,093	46 MPPEH in 500 intrusively investigated anomalies (9.2 MPPEH per 100 anomalies)	--	--	The DGM Acreage was not reported as these anomalies were outside the investigation area.
1,000 to 1,250 ft buffer of the OD Grounds Center	Total Acres: 40.6 DGM Acres: 20.8	Identified: 16,076		773 (1)	71.1 (2)	Anomalies per acre estimate is anticipated to be biased low due to closely spaced and overlapping anomalies; therefore, the MPPEH per acre estimate is likely biased low.
1,250 to 1,500 ft buffer of the OD Grounds Center	Total Acres: 49.4 DGM Acres: 26.9	Identified: 13,014		484 (1)	44.5 (2)	Anomalies per acre estimate is anticipated to be biased low due to closely spaced and overlapping anomalies; therefore, the MPPEH per acre estimate is likely biased low.
1,500 to 1,750 ft buffer of the OD Grounds Center	Total Acres: 58.6 DGM Acres: 38.2	Identified: 10,740		281	25.9 (3)	Anomalies per acre estimate is anticipated to be accurate. MPPEH per acre estimate is likely biased high.
1,750 to 2,000 ft buffer of the OD Grounds Center	Total Acres: 67.6 DGM Acres: 39.6	Identified: 7,217		182	16.7 (3)	Anomalies per acre estimate is anticipated to be accurate. MPPEH per acre estimate is likely biased high.
2,000 to 2,250 ft buffer of the OD Grounds Center	Total Acres: 76.6 DGM Acres: 47.6	Identified: 6,577		138	12.7 (3)	Anomalies per acre estimate is anticipated to be accurate. MPPEH per acre estimate is likely biased high.
2,250 to 2,500 ft buffer of the OD Grounds Center	Total Acres: 85.6 DGM Acres: 48.6	Identified: 6,071		125	11.5 (3)	Anomalies per acre estimate is anticipated to be accurate. MPPEH per Acres estimate is likely biased high.

(1) The Final Site-Specific Project Report (Weston, 2005) described the area between 1,000 and 1,500 ft of the OD grounds center as being "saturated" (i.e., having closely spaced and overlapping anomalies). Therefore, it is assumed that target selection in these areas was impacted by the high density of metal and that the anomaly densities are biased low in this area.

(2) To derive the MPPEH density, the MPPEH rate from the intrusive results was multiplied by the anticipated number of anomalies in each zone. Intrusive results were biased toward larger anomalies more likely to represent MPPEH (81% of intrusively investigated anomalies were over 50mV in amplitude). Therefore, the MPPEH per anomaly estimates may bias the MPPEH density to be higher than the actual density. However, because the total number of anomalies are expected to be biased lower due to the anomaly density in this area, the calculated MPPEH densities may also be biased low. Therefore, there is a significant level of uncertainty in the MPPEH rates in areas closer to the OD Hill.

(3) To derive the MPPEH density the MPPEH rate from the intrusive results was multiplied by the anticipated number of anomalies in each zone. Intrusive results were biased toward larger anomalies which are more likely to represent MPPEH than smaller amplitude anomalies. Therefore, the MPPEH per acre estimate may represent an over estimate of the actual MPPEH density within these areas.

TABLE 3.5 SUMMARY OF ANALOG RESULTS AND DENSITIES IN WOODED AREAS PHASE I INVESTIGATION (2003 WESTON)

COVERAGE		FINDINGS		RESULTS		
AREA	ACRES	ANOMALIES	MPPEH	ANOMALIES PER ACRE	MPPEH PER ACRE	COMMENTS
Wooded Area: 1,000 to 2,500 ft buffer of the OD Grounds Center	Total Acres: ~165 Mag and Dig Acres: 9.65	Identified: 2,829 Investigated: 736	3 MPPEH in 736 intrusively investigated anomalies (0.4 MPPEH per 100 anomalies)	293	1.2	The MPPEH per acre estimate is significantly lower that rates in DGM data and is likely an underestimate.

TABLE 3.6 SUMMARY OF ANOMALY RESPONSE PHASE I INVESTIGATION (2003 WESTON)

MV RESPONSE	NUMBER OF TARGETS						NUMBER OF INTRUSIVE TARGETS	
	1,000 - 1,500 FT		1,500 - 2,500 FT TOTAL		TOTAL			
0 - 10	494	2%	2,289	7%	2,783	5%	0	0%
10.1 - 20	5,907	20%	14,583	48%	20,490	34%	24	5%
20.1 - 30	3,668	12%	4,106	13%	7,774	13%	27	5%
30.1 - 40	2,711	9%	2,193	7%	4,904	8%	25	5%
40.1 - 50	2,047	7%	1,304	4%	3,351	6%	21	4%
> 50.1	15,356	51%	6,130	20%	21,486	35%	403	81%
TOTAL	30,183	100%	30,605	100%	60,788	100%	500	100%

TABLE 3.7 SUMMARY OF ANOMALY TYPE BY MV RESPONSE
PHASE I INVESTIGATION (2003 WESTON)

MV RESPONSE	NUMBER OF INTRUSIVE TARGETS	NUMBER OF ANOMALY TYPES							
		MPPEH		MD		NON-OE		NO CONTACT	
0 - 10	0	0	0%	0	0%	0	0%	0	0%
10.1 - 20	24	1	4%	5	21%	15	63%	3	13%
20.1 - 30	27	2	7%	10	37%	10	37%	5	19%
30.1 - 40	25	2	8%	11	44%	10	40%	2	8%
40.1 - 50	21	1	5%	11	52%	9	43%	0	0%
>50.1	403	40	10%	210	52%	149	37%	4	1%
TOTAL	500	46	9%	247	49%	193	39%	14	3%

TABLE 3.8 DEPTH DISTRIBUTION OF NON-SEED ITEMS IN NON-WOODED AREAS
PHASE I INVESTIGATION (2003 WESTON)

DEPTH (INCHES BGS TO TOP OF ITEM)	ANOMALY TYPE				GRAND TOTAL	
	NO CONTACT	NON-OE	MPPEH	ORS		
0	0	25	2	15	42	9%
0.5 to 6	0	127	36	192	355	73%
7 to 12	0	32	8	37	77	16%
13 to 18	0	6	0	1	7	1%
19 to 24	0	1	0	2	3	1%
25 to 30	0	0	0	0	0	0%
31 to 36	0	1	0	0	1	0%
37+	0	1	0	0	1	0%
No Contact	14	--	--	--	14	--
TOTAL	14	193	46	247	500	100%

TABLE 3.9 MUNITIONS TYPES IDENTIFIED PHASE I INVESTIGATION (2003 WESTON)

Category	Identified Munitions Types
Bomb	20-lb (unspecified type)
	Unspecified type and size
Fuze	Burster
	Dispenser
	Nose Fuze (unspecified type)
	Variable Time Fuze (unspecified)
	Fuze (M51 series [T-bar], M103, unspecified)
Mortar	Mortar, 4.2 inch, type unspecified
	Mortar, Unknown type/size
Other	Mine, Armor Piercing (AP) Bouncing Betty
	155mm Rocket Assisted Projectile Round Tail
Projectile	Projectile, 105mm, (unspecified type)
	106mm High Explosive Anti-Tank (HEAT) projectile
	Projectile, 20mm, (High Explosive [HE], Unspecified)
	Projectile, 40mm, (unspecified type)
	Projectile, 57mm, (unspecified type)
	Projectile, 6 inch, APHE
	Projectile, 75mm, (APHE, HE, Smoke, unspecified type)
	Projectile, 76mm, (APHE [unspecified model], unspecified type)
Rocket	Rocket, 2.36 inch, (unspecified type)
	Mini-Rocket
	Rocket Burster

3.1.4 Phase II - 1,500 to 2,500 Ft Radius (2003-2005 Weston)

3.1.4.1 Description

The Phase II removal was conducted between the 1,500-ft and 2,500-ft radial limits of the SEAD 45/115 OD Grounds between September 2003 and March 2005 by Weston. The anomaly and intrusive results counts summarized in the Draft Phase II Ordnance and Explosives Removal Report (Weston, 2006) are inconsistent with the Final Phase I and II database provided by USACE. A final version of the Removal Report was not provided during the production of this compilation report; therefore, the values and numbers summarized from the Phase II removal action are derived directly from the USACE database with the assistance of a Geographic Information System (GIS) to develop zone specific estimates. Because the database contains the intrusive results from both the Phase I and Phase II intrusive efforts the *full* data set was summarized in this section. During the Phase I and II efforts, an intrusive investigation was conducted at 6,474 anomaly locations identified during the Phase I geophysical investigation and at 169 of the 220 "mag & flag" wooded area transects mapped during the Phase I investigation (**Figure 3.3**).

The Phase I and II investigations included anomaly reacquisition, anomaly intrusive investigation, demilitarization operations (blow-in-place, intentional detonation, or thermal treatment), and off-site scrap disposal. The 6,474 anomalies investigated in the open areas represented targets ranging from

9.5 mV to 163,495mV. The geodatabase identifies 6,148 anomalies with a sum total mV response greater than 50mV in the buffer area beyond 1,500 feet. Of those 6,148 anomalies, 3,427 of them were intrusively investigated. A total of 36 QC seeds were recovered during the anomaly removal. Within the 169 mag and flag transects, 6,663 items were removed. During Phase II QC inspections were conducted on 10% of all anomalies and 10% of the transect areas.

3.1.4.2 Results

Based on the final database provided by USACE, 6,474 targets identified during the Phase I DGM were intrusively investigated. In addition, 169 of the 220 transects of "mag and flag" areas were intrusively investigated. The removal efforts resulted in removal of 854 OE items, 8,538 Ordnance Related Scrap, 3,998 Non-OE items, 974 No-contacts, and 36 QC items. Anomaly densities and derived MPPEH densities based on the distribution of anomalies and number of OE items identified during the intrusive investigation are presented in **Table 3.10**. While the data reports the items found using older language and refers to the items as Ordnance and Explosives and Ordnance Related Scrap, we have assumed that each OE item represented MPPEH and ORS is MD and have used this newer terminology within the summary tables. These data help to show how the results change with distance from the OD grounds. While the Phase II effort was focused on the 1,500-foot to 2,500-foot buffer area, additional details from the database have been included where available.

Table 3.11 summarizes the number of total anomalies, number of intrusively investigated anomalies, number of items found, and the number of MPPEH items found within several ranges of mV responses (Sum of channels 1 to 4). The percentage of MPPEH items per intrusively investigated anomaly shows that the occurrence of MPPEH items increases with mV strength; however, MPPEH items were found in all mV ranges. **Table 3.12** shows the distribution of the type of items found based on several ranges of mV responses (Sum of channels 1 to 4). The percentages show the distribution by type in each mV range and show that the rates of MPPEH and MD tend to increase with mV response the Non-OE is relatively stable around 40-45% and decreases over 50 mV. No contacts decrease significantly as the mV response increases.

Tables 3.13 and 3.14 show the depth distribution of excavated items for the "mag and dig" investigation in the wooded areas and the post DGM intrusive investigation in the open areas, respectively. Based on the intrusive data records, 96.3% and 95.5% of the items in the wooded and non-wooded areas, respectively, were found at a maximum top of item depth of 12 inches bgs. **Table 3.15** lists the munitions types that were identified from munitions debris or MPPEH found during the Phase II investigation.

TABLE 3.10 SUMMARY OF DGM RESULTS AND DENSITIES IN NON-WOODED AREAS PHASE II REMOVAL (2003-2005 WESTON)

COVERAGE		FINDINGS		RESULTS				
AREA	ACRES	ANOMALIES	COUNT	MPPEH	MPPEH PER TARGET	ANOMALIES PER ACRE	MPPEH PER ACRE	COMMENTS
<1,000 ft buffer of the OD Grounds Center	Total Acres: 72.3 DGM Acres: (Not Available)	6.3mV to 13mV	Identified: 89 Investigated: 0 Items: 0	--	--	--	--	No Anomalies within the 1,000-foot buffer where investigated as part of the Phase I or Phase II investigation.
		13mV to 50mV	Identified: 370 Investigated: 0 Items: 0					
		≥50mV	Identified: 634 Investigated: 0 Items: 0					
1,000 to 1,250 ft buffer of the OD Grounds Center	Total Acres: 40.6 DGM Acres: 20.8	6.3mV to 13mV	Identified: 769 Investigated: 0 Items: 0	--	--	37.0	--	Total Anomaly Density is 773 per acre(1). Insufficient intrusive data to calculate reliable MPPEH densities. The high MPPEH/anomaly ratio suggest that the anomaly selection was biased (2).
		13mV to 50mV	Identified: 5,294 Investigated: 1 Items: 1	1	100%	254.5		
		≥50mV	Identified: 10,013 Investigated: 11 Items: 12	6	50%	481.4		
1,250 to 1,500 ft buffer of the OD Grounds Center	Total Acres: 49.4 DGM Acres: 26.9	6.3mV to 13mV	Identified: 1,735 Investigated: 0 Items: 0	--	--	64.5	--	Total Anomaly Density is 484 per acre(1). Insufficient intrusive data to calculate reliable MPPEH densities at low mV range. Other MPPEH densities may be biased by small data set (2). Total MPPEH Density is estimated at 105 per acre assuming a 3% MPPEH rate in the low mV range.
		13mV to 50mV	Identified: 6,552 Investigated: 18 Items: 18	2	11%	243.6	26.8 (3)	
		≥50mV	Identified: 4,727 Investigated: 39 Items: 45	17	44%	175.7	77.3 (3)	

TABLE 3.10 SUMMARY OF DGM RESULTS AND DENSITIES IN NON-WOODED AREAS PHASE II REMOVAL (2003-2005 WESTON)

COVERAGE		FINDINGS		RESULTS				
AREA	ACRES	ANOMALIES	COUNT	MPPEH	MPPEH PER TARGET	ANOMALIES PER ACRE	MPPEH PER ACRE	COMMENTS
1,500 to 1,750 ft buffer of the OD Grounds Center	Total Acres: 58.6 DGM Acres: 38.2	6.3mV to 13mV	Identified: 2,262 Investigated: 124 Items: 127	4	3.1%	59.2	1.8	Total Anomaly Density is 281 per acre. Total MPPEH Density is 40 per acre.
		13mV to 50mV	Identified: 5,438 Investigated: 484 Items: 551	64	13%	142.4	18.5	
		≥50mV	Identified: 3,040 Investigated: 1,594 Items: 2,268	395	25%	79.6	19.9	
1,750 to 2,000 ft buffer of the OD Grounds Center	Total Acres: 67.6 DGM Acres: 39.6	6.3mV to 13mV	Identified: 3,503 Investigated: 102 Items: 104	2	2.0%	88.5	1.8	Total Anomaly Density is 182 per acre. Total MPPEH Density is 12 per acre.
		13mV to 50mV	Identified: 2,350 Investigated: 638 Items: 679	54	8.5%	59.3	4.7	
		≥50mV	Identified: 1,364 Investigated: 917 Items: 1,164	133	15%	34.4	5.2	
2,000 to 2,250 ft buffer of the OD Grounds Center	Total Acres: 76.6 DGM Acres: 47.6	6.3mV to 13mV	Identified: 2,579 Investigated: 2 Items: 2	0	--	54.2	--	Total Anomaly Density is 138 per acre. Insufficient intrusive data to calculate reliable MPPEH densities at low mV range. Total MPPEH Density is estimated at 4.3 per acre assuming a 3% MPPEH rate in the low mV range.
		13mV to 50mV	Identified: 3,130 Investigated: 852 Items: 920	18	2.1%	65.8	1.4	
		≥50mV	Identified: 868 Investigated: 393 Items: 451	29	7.4%	18.2	1.3	

TABLE 3.10 SUMMARY OF DGM RESULTS AND DENSITIES IN NON-WOODED AREAS PHASE II REMOVAL (2003-2005 WESTON)

COVERAGE		FINDINGS		RESULTS				
AREA	ACRES	ANOMALIES	COUNT	MPPEH	MPPEH PER TARGET	ANOMALIES PER ACRE	MPPEH PER ACRE	COMMENTS
2,250 to 2,500 ft plus buffer of the OD Grounds Center	Total Acres: 85.6 DGM Acres: 48.6	6.3mV to 13mV	Identified: 2,254 Investigated: 23 Items: 23	0	--	46.4	--	Total Anomaly Density is 125 per acre. Total MPPEH Density is estimated at 2.7 per acre assuming a 3% MPPEH rate in the low mV range.
		13mV to 50mV	Identified: 2,941 Investigated: 753 Items:819	11	1.5%	60.5	0.88	
		≥50mV	Identified: 876 Investigated: 523 Items: 553	13	2.5%	18.0	0.45	

(1) The Final Site-Specific Project Report (Weston, 2005) described the area between 1,000 and 1,500 ft of the OD grounds center as being "saturated" (i.e., having closely spaced and overlapping anomalies). Therefore, it is assumed that target selection in these areas was impacted by the high density of metal and that the anomaly densities are biased low in this area.

(2) To derive the MPPEH density, the MPPEH rate from the intrusive results was multiplied by the anticipated number of anomalies in each zone. Intrusive results were biased toward larger anomalies more likely to represent MPPEH (81% of intrusively investigated anomalies were over 50mV in amplitude). Therefore, the MPPEH per anomaly estimates may bias the MPPEH density to be higher than the actual density. However, because the total number of anomalies are expected to be biased lower due to the anomaly density in this area, the calculated MPPEH densities may also be biased low. Therefore, there is a significant level of uncertainty in the MPPEH rates in areas closer to the OD Hill.

(3) To derive the MPPEH density the MPPEH rate from the intrusive results was multiplied by the anticipated number of anomalies in each zone. Intrusive results were biased toward larger anomalies which are more likely to represent MPPEH than smaller amplitude anomalies. Therefore, the MPPEH per acre estimate may represent an over estimate of the actual MPPEH density within these areas.

TABLE 3.11 SUMMARY OF RESULTS BY MV RESPONSE
PHASE II REMOVAL (2003-2005 WESTON)

MV RESPONSE	NUMBER OF ANOMALIES		NUMBER OF ANOMALIES INTRUSIVELY INVESTIGATED		NUMBER OF ITEMS FOUND		NUMBER OF MPPEH ITEMS		MPPEH PER INTRUSIVE ANOMALY
0 - 10	2,783	4.6%	60	0.9%	61	0.8%	1	0.13%	1.7%
10.1 - 20	20,490	33.7%	1,648	25.5%	1,747	22.6%	51	6.8%	3.1%
20.1 - 30	7,774	12.8%	772	11.9%	843	10.9%	48	6.4%	6.2%
30.1 - 40	4,904	8.1%	337	5.2%	369	4.8%	33	4.4%	9.8%
40.1 - 50	3,351	5.5%	205	3.2%	239	3.1%	28	3.7%	13.7%
> 50.1	21,486	35.3%	3,452	53.3%	4,478	57.9%	588	79%	17.0%
TOTAL	60,788	100%	6,474	100%	7,737	100%	749	100%	--

TABLE 3.12 SUMMARY OF ANOMALY TYPE BY MV RESPONSE
PHASE II REMOVAL (2003-2005 WESTON)

MV RESPONSE	NUMBER OF INTRUSIVE ITEMS	NUMBER OF ITEMS BY TYPE AND PERCENT OF TOTAL ITEMS									
		MPPEH		MD		NON-OE		QC		NO CONTACT	
0 - 10	61	1	1.64%	4	6.6%	20	32.8%	0	0%	36	59.0%
10.1 - 20	1747	51	2.92%	416(1)	23.8%	765(1)	43.8%	2	0.11%	513	29.4%
20.1 - 30	843	48	5.69%	252	29.9%	376	44.6%	2	0.24%	165	19.6%
30.1 - 40	369	33	8.94%	120	32.5%	152	41.2%	0	0%	64	17.3%
40.1 - 50	239	28	11.72%	90	37.7%	98	41.0%	2	0.84%	21	8.8%
> 50.1	4478	588	13.13%	2431(1)	54.3%	1258(1)	28.1%	30	0.67%	171	3.8%
TOTAL	7,737	749	10%	3302	43%	2680	35%	36	0.5%	970	13%

(1) The Draft Phase II Ordnance and Explosives Removal Report (Weston, 2006) lists the intrusive results in Appendix C. Eleven items were identified using the anomaly type code "NON" indicating Non-OE; however, the comments indicated the items were ORS. Therefore, the counts in this table have been updated to list these eleven items as ORS.

TABLE 3.13 DEPTH DISTRIBUTION OF NON-SEED ITEMS IN WOODED AREAS PHASE II REMOVAL (2003-2005 WESTON)

DEPTH (INCHES BGS TOP OF ITEM)	ANOMALY TYPE				GRAND TOTAL	
	MPPEH	MD	NON-OE	NO CONTACT		
0/OTS	1	12	32	0	45	0.68%
0.5 to 6	81	4403	848	1	5333	80%
7 to 12	22	777	244	2	1045	16%
13 to 18	1	17	36	0	54	0.81%
19 to 24	0	2	9	0	11	0.17%
25 to 30	0	0	3	0	3	0.05%
31 to 36	0	0	1	0	1	0.02%
Various	0	0	25	0	25	0.38%
NA	0	25	120	1	146	2.2%
Total	105	5236	1318	4	6663	100%

TABLE 3.14 DEPTH DISTRIBUTION OF NON-SEED ITEMS IN NON-WOODED AREAS PHASE II REMOVAL (2003-2005 WESTON)

DEPTH (INCHES BGS TOP OF ITEM)	ANOMALY TYPE					GRAND TOTAL	
	MPPEH	MD	NON-OE	QC	NO CONTACT		
0	4	44	133	18	0	199	2.6%
0.5 to 6	546	2672(1)	1616(1)	6	2	4842	63%
7 to 12	170	561 (1)	748(1)	6	864	2349	30%
13 to 18	25	27	115	4	96	267	3.5%
19 to 24	2	7	38	0	8	55	0.71%
25 to 30	1	1	15	0	0	17	0.22%
31 to 36	1	1	0	1	0	3	0.04%
37+	0	0	4	1	0	5	0.06%
Total	749	3302	2680	36	970	7737	100%

(1) The Draft Phase II Ordnance and Explosives Removal Report (Weston, 2006) lists the intrusive results in Appendix C. Eleven items were identified using the anomaly type code "NON" indicating Non-OE; however, the comments indicated the items were ORS. Therefore, the counts in this table have been updated to list these eleven items as ORS.

TABLE 3.15 MUNITIONS TYPES IDENTIFIED PHASE II REMOVAL (2003-2005 WESTON)

CATEGORY	IDENTIFIED MUNITIONS TYPES
Bomb	20-lb (unspecified type)
	Unspecified type and size
Fuze	Adapter
	Burster
	Dispenser
	Nose Fuze (unspecified type)
	Fuze (M66, M51 series [T-bar], M47, M103)
Mine	Mine, AP Bouncing Betty (M2A1 and type unspecified)
Mortar	Mortar, 4.2 inch, type unspecified
	Mortar, 60mm, type unspecified
	Mortar, 81mm, type unspecified
	Mortar, Unknown type/size
Other	1.1 inch Anti-aircraft Mk1 Mod 14
	155mm Rocket Assisted Projectile (RAP) Round Tail
	155mm Smoke Pot
	Smoke pot
	5 inch RAP Base Plate
Projectile	Projectile, 20mm, unspecified type
	Projectile, 25mm
	Projectile, 30mm, Unspecified
	Projectile, 37mm, (APHE, HE, unspecified type)
	Projectile, 3 inch, Mk 31
	Projectile, 40mm, (HE, unspecified type)
	Projectile, 57mm, (HE, unspecified type)
	Projectile, 6 inch, APHE
	Projectile, 75mm, (APHE, HE, Smoke, unspecified type)
	Projectile, 76mm, (APHE [unspecified model], unspecified type)
	Projectile, 105mm, (illumination, unspecified type)
	Projectile, 106mm, HEAT
	Projectile, 155mm, (unspecified type)
Rocket	Rocket, 2.36 inch, (WP, unspecified type)
	Rocket, 3 inch, (unspecified type)
	Rocket, 3.5 inch, (unspecified type)
	Mini-Rocket
	Rocket Burster

3.1.5 Additional Munitions Response Site Investigation – 0 to 1,500 ft Radius (2010 Parsons)

3.1.5.1 Description

A focused site investigation was conducted by Parsons ES in 2010 and included topographic and geophysical surveys of specific areas within the OD Grounds and the collection and analysis of soil samples from test pits and surface soil locations. The objectives of the site investigation included determining MC/COPC concentrations in sub-surface and surface soils in or adjacent to the OD Hill; depth of soil and debris in saturated areas for geophysical mapping to identify individual anomalies; determine the volume of soil in the OD Hill; and estimation of the bedrock surface at the OD Grounds. The MC/COPC elements conducted as part of this site investigation are discussed in Section 3.2.2.

The focused SI included a preliminary assessment of the vertical deposition of MPPEH, MD, MC/COPCs, and cultural debris at five text plot locations selected at different distances and in different directions from the OD Hill. **Figure 3.4** shows the location of the five test plots. The following process was followed at each test plot:

1) DGM data previously collected at the site was evaluated and anomalies greater than 50 mV in magnitude where excavated to remove the source.
2) One foot of soil was removed from the text plot area.
3) DGM data was recollected over the excavated area.
4) Anomalies were counted and anomalies over 50 mV were investigated.
5) If the initial geophysical survey at a test plot location continued to show high levels of geophysical anomalies, additional one-foot excavations and repeat DGM surveys were conducted as directed by the Army.

3.1.5.2 Results

Review of the geophysical data gathered indicated that anomaly densities generally decrease with depth of excavation, especially at distances greater than 100 to 200 feet from the OD Hill mound. **Table 3.16** summarizes the anomaly density at each of the test plot locations. The overall assessment of the data suggests that there may be a directional component to the vertical deposition of anomalies, as is evidenced by the absence of anomalies to the southeast of the OD Hill and the presence of anomalies to the northeast and northwest at roughly comparable distances from the detonation site. Additionally, the results suggest that areas in close proximity to the OD Hill may have more subsurface anomalies due to the extensive amount of soil rework that was done at this Site during its operational period.

The topographic investigation concluded that bedrock underlying the area of the OD Hill mound is estimated to vary from 10 to 20 ft bgs. Based on the topographic survey (**Figure 3.4**), the estimated volume of the earthen mound above ground surface is 38,000 cubic yards (cy). The estimated volume of soil in the OD Hill above bedrock surface is 75,000 cy (Parsons, 2010).

TABLE 3.16 ANOMALY DENSITIES IN TEST PLOTS
ADDITIONAL MUNITIONS RESPONSE SITE INVESTIGATION (2010 PARSONS)

TEST PLOT ID	CLEARANCE DEPTH	SQUARE FEET	ACRES	TARGETS	DENSITY (TARGETS/ACRE)
Area 1	1 foot	9,324.12	0.21	10	47
Area 2	1 foot	8,651.95	0.20	5	25
Area 3	1 foot	4,158.16	0.10	0	0
Area 5	1 foot	4,141.89	0.10	24	252
	2 feet	1,850.9	0.04	12	282
Area 6	1 foot	6,993.08	0.16	0	0

3.1.6 Munitions Response Action – 1,000 To 2,000 Ft Radius (2012-2014 Parsons)

3.1.6.1 Description

During the 2012 field effort, between April 18, 2012 and August 7, 2012, Parsons reacquired and intrusively investigated 14,688 anomalies that had been previously identified during the Phase I Report conducted by Weston Solutions (Weston, 2005). These anomaly locations were identified based on geophysical investigations completed in the open areas between the 1,000 ft. to 1,500 ft. radius rings. Using RTK GPS, Parsons reacquired the location of each anomaly that exceeded the Work Plan defined 50mV response threshold during the previously obtained surveys. A total of 14,688 anomaly locations were reacquired and intrusively investigated.

Work areas where DGM surveys were not performed during the previous investigation (e.g., vegetated areas inaccessible to the EM61-MK2, or with poor GPS coverage) were cleared using analog mag and dig techniques during this munitions response action. In total the analog survey covered 59.8 acres, which overlaid 158 grids (including some partial grids).

3.1.6.2 Results

DGM Removal Areas - Of the 14,688 anomaly locations investigated (**Figure 3.5**), 748 anomaly locations contained MPPEH. At several anomaly locations, multiple MPPEH items were recovered from a single location during intrusive investigation activities. In all, 1,387 MPPEH items were recovered. The MPPEH items were processed to both render inert and determine which of the MPPEH items were MEC. Of the 1387 MPPEH items, 757 items were thermally processed, and 630 items were explosively perforated. Only the explosively perforated items could be further classified as MEC items (MEC prior to processing) before they were classified as MDAS after processing. A total of 104 items were classified as MEC. **Tables 3.17, 3.19, 3.20**, and **3.22** summarizes the outcome of the reacquisition and intrusive investigation of anomalies.

TABLE 3.17 REACQUISITION INVESTIGATION SUMMARY
MUNITIONS RESPONSE ACTION – 1,000 TO 2,000 FT RADIUS (2012-2014 PARSONS)

Total number of geophysical anomalies	14,688	
Item Type	Number of Items	Estimated Weight [1]
MD	14,497	35,043 lbs.
Other	951	1,156 lbs.
MPPEH (initial classification)	1,387	2,680 lbs.
TOTALS[2]	16,835	38,879 lbs.
MPPEH (thermally processed) MPPEH (explosively perforated) MPPEH (total after secondary classification)	757 630 1387	n/a
MEC (final classification after explosive perforation)	104	n/a

1) All reported weights in this table are estimates determined by the UXO teams in the field.

2) Totals in this row refer to the number of unique items. More than one item may have been recovered at one geophysical anomaly location. As a result, the "Totals" value may be higher than the "Total number of geophysical anomalies" value.

Analog Removal Areas - During the analog removal over 59.8 acres, 1,023 MPPEH items were recovered by the field teams. The MPPEH items were then reviewed by UXO management and processed to both render inert and determine which of the MPPEH items were MEC. Of the 1,023 MPPEH items identified by the field teams, 110 items were thermally processed, 348 items were explosively perforated, and the remainder were determined to be MDAS. Only the explosively perforated items could be further classified as MEC items (MEC prior to processing) before they were classified as MDAS after processing. A total of 140 items were classified as MEC. **Tables 3.18, 3.21,** and **3.22** summarizes the outcome of the mag and dig investigation. Several fill areas that were identified during both the analog and digital removal were investigated as part of the analog removal. MD, MPPEH, and MEC found in fill area locations are called out in **Table 3.21**. All of the MEC and MPPEH found below 36 inches were found during backhoe digs.

TABLE 3.18 MAG AND DIG INVESTIGATION SUMMARY
MUNITIONS RESPONSE ACTION – 1,000 TO 2,000 FT RADIUS (2012-2014 PARSONS)

Item Type	Number of Items	Estimated Weight [1]
Classification in the Field		
MD	58,410	120,271 lbs.
Other	34,174	25,450 lbs.
MPPEH (initial classification) [3]	1,549	2,252 lbs.
TOTALS [2]	94,133	147,973 lbs.
Post-Secondary Classification [3]		
MPPEH MPPEH (thermally processed) MPPEH (explosively perforated) MD	1,073 Total 613 460 58,886	n/a
Post-Demolition Classification		
MEC (final classification after explosive perforation)	140	n/a

(1) All reported weights in this table are estimates determined by the UXO teams in the field.

(2) Totals in this row refers to the number of unique items. More than one item may have been recovered at one analog anomaly location. As a result, the "Totals" value may be higher than the "Total number of analog anomalies or digs" value.

(3) Many of the items initially classified as MPPEH in the field were later determined to be MD after secondary classification by qualified personnel.

TABLE 3.19 SUMMARY OF INTRUSIVE RESULTS AND DENSITIES IN NON-WOODED AREAS PHASE III INVESTIGATION (2012-2014 PARSONS)

COVERAGE		FINDINGS		RESULTS		COMMENTS
AREA	ACRES	ANOMALIES	MPPEH	ANOMALIES PER ACRE	MEC/MPPEH PER ACRE	
1,000 to 1,250 ft buffer of the OD Grounds Center	Total Acres: 40.6 DGM Acres: 20.8	Identified: 16,076 Investigated: 10,002 Items: 11,824	564 MPPEH (thermally treated) 377 MPPEH (explosively perforated, no HE) 84 confirmed MEC	774 (1)	MEC = 6.5/acre(2) Total MPPEH and MEC = 79/acre(2)	The MPPEH per acre estimate may represent an over estimate of the actual MPPEH density within these areas(3).
1,250 to 1,500 ft buffer of the OD Grounds Center	Total Acres: 49.4 DGM Acres: 26.9	Identified: 13,014 Investigated: 4,686 Items: 5,011	193 MPPEH (thermally treated) 149 MPPEH (explosively perforated, no HE) 20 confirmed MEC	484 (1)	MEC = 2.1/acre(2) Total MPPEH and MEC = 37.4/acre(2)	The MPPEH per acre estimate may represent an over estimate of the actual MPPEH density within these areas(3).

(1) The Final Site-Specific Project Report (Weston, 2005) described the area between 1,000 and 1,500 ft of the OD grounds center as being "saturated" (i.e., having closely spaced and overlapping anomalies). Therefore, it is assumed that target selection in these areas was impacted by the high density of metal and that the anomaly densities are biased low in this area.

(2) To derive the MPPEH density, the MPPEH rate from the intrusive results was multiplied by the anticipated number of anomalies in each zone. Intrusive results were biased toward larger anomalies more likely to represent MPPEH (100% of intrusively investigated anomalies were over 50mV in amplitude). Therefore, the MPPEH per anomaly estimates may bias the MPPEH density to be higher than the actual density. However, because the total number of anomalies are expected to be biased lower due to anomaly density in this area, the calculated MPPEH densities may also be biased low. Therefore, there is a significant level of uncertainty in the MPPEH rates in areas closer to the OD Hill.

(3) To derive the MPPEH density the MPPEH rate from the intrusive results was multiplied by the anticipated number of anomalies in each zone. Intrusive results were biased toward larger anomalies which are more likely to represent MPPEH than smaller amplitude anomalies. Therefore, the MPPEH per acre estimate may represent an over estimate of the actual MPPEH density within these areas.

TABLE 3.20 DEPTH DISTRIBUTION OF ITEMS IN NON-WOODED AREAS PHASE III INVESTIGATION (2012-2014 PARSONS)

DEPTH (INCHES BGS TOP OF ITEM)	ANOMALY TYPE							
	NO CONTACT OR SAME ANOMALY	MD	MPPEH (THERMAL TREATMENT)	MPPEH (EXPLOSIVELY PERFORATED NO HE)	MEC (MPPEH EXPLOSIVELY PERFORATED AND HE WAS PRESENT)	OTHER (RRD, CULTURAL, SHARED ANOMALY, SEEDS, HOT ROCK)	GRAND TOTAL	
0	0	81	0	0	0	86	167	1.0%
0.5 to 6	0	7,310	404	233	58	181	8,186	48.6%
7 to 12	0	6,769	334	266	46	111	7,526	44.7%
13 to 18	0	265	14	16	0	19	314	1.9%
19 to 24	0	43	3	9	0	3	58	0.3%
25 to 30	0	12	2	2	0	0	16	0.1%
31 to 36	0	14	0	0	0	7	21	0.1%
37+	0	4	0	0	0	0	4	0.02%
No Contact	543	0	0	0	0	0	543	3.2%
Total	543	14,498	757	526	104	407	16,835	100%

TABLE 3.21 DEPTH DISTRIBUTION OF ITEMS IN WOODED AREAS PHASE III INVESTIGATION (2012-2014 PARSONS)

DEPTH (INCHES BGS TOP OF ITEM)	DIG TYPE					GRAND TOTAL	
	MD	MPPEH (THERMAL TREATMENT)	MPPEH (EXPLOSIVELY PERFORATED NO HE)	MEC (MPPEH EXPLOSIVELY PERFORATED AND HE WAS PRESENT)	OTHER (RRD, CULTURAL, SHARED ANOMALY, SEEDS, HOT ROCK)		
0	281	3	5	1	818	1,108	1.2%
0.5 to 6	36,220 [26](1)	65 [1]	153 [1]	127 [21]	18,071	54,636	58.0%
7 to 12	18,905 [77]	45 [1]	65	62 [21]	9,712	28,789	30.6%
13 to 18	2,143 [10]	0	1	11[9]	1,163	3,318	3.5%
19 to 24 (2)	1,033 [26]	500(3)	0	17 [16]	3,948	5,498	5.8%
25 to 30	142 [10]	0	0	7 [6]	14	163	0.17%
31 to 36	137 [124]	0	0	1	126	264	0.28%
37 to 42 (4)	17 [5]	0	0	3 [3]	105	125	0.13%
43 to 48	0	0	0	2	217	219	0.23%
49 to 54	0	0	0	5 [5]	0	5	0.01%
55 to 60	8 [8]	0	0	0	0	8	0.01%
Total	**58,886**	**613**	**224**	**236**	**34,174**	**94,133**	**100.0%**

(1) The numbers shown in brackets "[ ]" represent the number of the listed items that were found in fill locations.

(2) Depth results included a category for 19 to 36 inches bgs. The category included 240 MD and 53 other. These counts have been included with the 19 to 24-inch bgs range.

(3) The 500 MPPEH items at the 19 to 24 inch bgs level were all found in a single dig, the items consisted of small items like fuzes and primers.

(4) Depth results included a category for over 36 inches bgs. The category included 5 MD and 5 other. These counts have been included with the 37 to 42-inch bgs range.

TABLE 3.22 MUNITIONS TYPES IDENTIFIED PHASE III INVESTIGATION (2012-2014 PARSONS)

CATEGORY	IDENTIFIED MUNITIONS TYPES
Bomb	4-lb (Fragmentation [M83 Butterfly], Incendiary)
	20-lb (Fragmentation)
	Unspecified type and size
Fuze	Adapter
	Base Detonating Fuze (Mk221, M68, M66, M62/M92, M60, M48, M46, M38, unspecified)
	Bomb Fuze (type and model unspecified)
	Bomb Fuze, Nose (Mk271, M104, M103, unspecified type)
	Booster (fly-k type)
	Mine Fuze (M16, unspecified type)
	Point Detonating Fuze (M54, M52, M48, M46, M4, M104, unspecified type)
	Prime Detonator (M14)
	Projectile Fuze, Variable Time
	Rifle Grenade Fuze (M9)
	Tail Fuze (M123 series)
	Variable Time Fuze (unspecified)
	Fuze (M4A2)
Grenade	Grenade, Hand, Fragmentation, MkII
	Undetermined, foreign rifle grenade (HE and type unspecified)
	Rifle Grenade Cartridge
	Grenade, Rifle, Anti-Tank, (M9A1, M9)
Mine	Mine, AP, (M16 and M2)
Other	Cartridge, .50 caliber, with 20mm case
	Cartridge, 20mm, High Explosive Incendiary (HEI), MK 1
	Activator, Flare, M48
	Cartridge, Flare, multiple fuzed together items
	Booster cup
	Candle, Flare, M48
	Flare, Trip, Parachute, M48
	Booster, with wire
	Canister, Hexachloroethane (HC) Smoke
	Canister, split open, possible HE
	Burster adapter
	Burster tube
	Burster tube assembly
	Cartridge case with intact primer
Projectile	Projectile, 1.1 inch, Mk 1 series
	Projectile, 105mm, (HE and unspecified type)
	Projectile, 2.75 inch, possible residue
	Projectile, 20mm, (HEI, unspecified type) (MK1 and M97)
	25mm Projectiles

CATEGORY	IDENTIFIED MUNITIONS TYPES
Projectile	Projectile, 30mm, (HE [T328], TP [T328], Unspecified)
	Projectile, 37mm, (AP, Drill Round [M54/M63], HE [M74, M54/M63])
	Projectile, 3 inch, Mk 31
	Projectile, 40mm, (HE [Mk II], Practice [M382/M385], unspecified type)
	Projectile, 57mm, (HE [T-18E1, M306A1], WP [M308 series], unspecified type)
	Projectile, 6 inch, APHE
	Projectile, 75mm, (APC-T [M61], HE [M41/M48], HEAT [M66], Recoilless [M309], unspecified type)
	Projectile, 76mm, (APHE [unspecified model], unspecified type)
	Projectile, 81mm, High Explosive (HE), M374
	90mm Projectiles
	Projectile, type undetermined
Rocket	Rocket, 2.36 inch, (HEAT, unspecified type)
	Rocket, 2.75 inch, unspecified
	Rocket, 3.5 inch, (HEAT [M28], WP, unspecified type)
	Rocket, 4.5 inch, type unspecified
	Rocket, 5 inch, HVAR
	Rocket, 66mm, Light Antitank Weapon (LAW) (M72A2 and M71A2)
	Rocket, 68mm, type undetermined
	Rocket, size & type undetermined

3.1.7 MMRP Work of Inner Radius – 0 to 1,000 Ft Radius

3.1.7.1 Description

Shaw (CB&I) prepared a work plan for proposed work in the area within 1,000 feet of the OD Hill (Shaw, 2012). CB&I's contract was terminated before their scope was completed, and documentation of the details of their work is not available for review at this time. Before their contract was terminated, CB&I did complete a DGM survey within the 1,000 ft radius. The selected targets from the DGM data is included in **Figure 1.4**. Since no additional data or analysis are available for this phase of work, data are not discussed further. Based on discussions with the Army, the contract did include a surface clearance of UXO/DMM. Parsons was tasked by the Army and completed the handling and disposal of the UXO/DMM in 2018.

3.1.7.2 Results

Table 3.23 below lists the items that were identified during the removal of stored material as part of the 2018 activities. The location of where the items were found is not clearly documented; however, based on CB&I's scope, it is assumed that the items were all removed from the 0 – 1,000-foot radius of the OD Grounds during CB&I Shaw MMRP work. A total of 8 drums of MD were certified as MDAS and shipped offsite for disposal.

TABLE 3.23
SUMMARY OF ITEMS IDENTIFIED AS LIKELY SURFACE FINDS FROM 0-1,000 FT RADIUS

TYPE	CATEGORY	QUANTITY
20mm projectiles	MEC	120
Rifle grenade fuzes	MEC	6
M66 BD fuzes	MEC	6
M48 PD fuzes	MEC	2
M72 LAW warheads	MEC	2
2.36" HEAT warhead	MEC	1
BD fuze partial	MD	1
90mm unknown	MD	1
Unknown components	MD	2
57mm M306	MEC	4
57mm projectile	MD	1
MK 2 grenade	MEC	1
40mm projectile	MEC	1
40mm projectile	MD	1
75mm projectile	MD	4
M2 mine (kill mechanism)	MEC	1
Unknown fuzes	MD	6
M3 mine partial	MD	1

3.2 MUNITIONS CONSTITUENTS/CONTAMINANTS OF POTENTIAL CONCERN CHARACTERIZATION RESULTS

3.2.1 Expanded Site Inspection (1993 ES)

3.2.1.1 Description

The ESI included an analysis of soil, groundwater, surface water, and sediment samples (**Figure 3.6**). The primary chemicals of interest during the ESI were metals, nitrates, and explosive compounds. Due to the previous operating practices of SEAD-45, these chemicals had the potential to have been adsorbed in the soil. The samples collected included five soil samples from test pits, nine surface soil samples, eight groundwater samples, four surface water samples, and four sediment samples. The main purpose of the sampling and investigation programs were to obtain background information of soil and water quality and to determine the presence or absence of any hazardous constituents.

3.2.1.2 Results

All samples from previous investigations were evaluated together and results of that evaluation are discussed in **Section 4.3**.

3.2.2 Additional Munitions Response Site Investigation – 0 to 1,500 ft Radius (2010 Parsons)

3.2.2.1 Description

A focused site investigation was conducted by Parsons ES in 2010 and included analysis of soil samples from test pits and surface soil locations. The objectives of the site investigation included determining MC/COPCs concentrations in sub-surface and surface soils in or adjacent to the OD Hill and assessing the potential leachability of certain compounds found on the site.

3.2.2.2 Results

All samples from previous investigations were evaluated together and results of that evaluation are discussed in **Section 4.3**.

3.2.3 Perchlorate Sampling (2018 Parsons)

3.2.3.1 Description

Parsons conducted groundwater and soil sampling at the OD Grounds in June 2018 to evaluate the presence or absence of perchlorate in the vicinity of the OD Hill. A well condition survey was initially conducted to evaluate the condition of nine existing wells proposed for perchlorate sampling at the OD and OB Grounds. Based on this survey, the Army determined it was necessary to replace five of the existing monitoring wells that were no longer in good condition. New wells were installed using a truck mounted auger rig and samples were collected at nine well locations using low flow sampling methods. Soil samples were collected from two depths at ten locations, for a total of 20 samples. The sample locations were identified based on the areas most likely to be impacted based on the site history. All samples were analyzed by TestAmerica – Denver using USEPA Method 6860.

3.2.3.2 Results

Perchlorate was detected in 16 of the 20 soil samples, though none of the soil samples contained concentrations of perchlorate exceeding the USEPA Regional Screening Level (RSL) for Residential Soil (5,500 µg/kg). The highest concentration of perchlorate in the soil samples was found in the OD mound at a depth of 1.5-2 feet below ground surface.

Perchlorate was detected in eight of the nine groundwater samples, and two of the samples contained perchlorate at concentrations exceeding the guidance value of 1.4 µg/L based on the USEPA RSL for tap water (noncarcinogenic Hazard Quotient [HQ] of 0.1), which includes ingestion, dermal contact, and inhalation from use of groundwater as tap water. However, this comparison value for perchlorate is conservative and was used so the comparison was consistent with the HHRA results. Perchlorate guidance values commonly used in NYS range from 10 µg/L to 20 µg/L, based on EPA RSLs. The wells that demonstrated exceedances of the USEPA RSL for tap water (noncarcinogenic HQ of 0.1) were MW45-2 and MW45-3, both of which are located east of the OD Hill; however, these values were compared against criterion more conservative than the expected land use warrants.

All samples from previous investigations were evaluated together and results of that evaluation are discussed in **Section 4.3**.

CHAPTER 4
COMPILATION OF RESULTS AND REVISED CONCEPTUAL SITE MODEL

4.1 NATURE AND EXTENT OF MUNITIONS AND EXPLOSIVES OF CONCERN

4.1.1 Extent of Munitions and Explosives of Concern

MPPEH/MEC items have been found in all areas of the OD Grounds Munitions Response Site (MRS). **Figure 4.1** show the location of all MPPEH/MEC found to date. The MPPEH/MEC item found the greatest distance from the OD Hill was a M103 Fuze found approximately 2,555 feet from the center of the OD Hill. The rate of both MD and MPPEH/MEC finds generally decreases with greater distance from the OD Hill.

Based on the findings from each of the investigations and removal actions detailed in Section 3.1, **Table 4.1** summarizes the number of MD, MPPEH, and MEC items found by depth for each phase. **Table 4.2** summarizes the combined results and presents the percentage of finds by type at each depth interval. As discussed in Section 3.1.6 many of the deep MD, MPPEH, and MEC items found during the Munitions Response Action (Phase III) were found within fill areas.

Anomaly densities and derived MPPEH densities based on the distribution of anomalies and number of items identified during the intrusive investigation are presented in **Table 4.3**.

TABLE 4.1 DEPTH DISTRIBUTION OF MD, MPPEH, AND MEC BY TASK PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

DEPTH (INCHES BGS)	OE EECA		PHASE I		PHASE II		PHASE III		
	MD	MPPEH	MD	MPPEH	MD	MPPEH	MD	MPPEH	MEC
0	26	8	15	2	56	5	362	8	1
0.5 to 6	647	57	192	36	7075	627	43530	855	185
7 to 12	121	4	37	8	1338	192	25674	710	108
13 to 18	14	0	1	0	44	26	2408	31	11
19 to 24	2	0	2	0	9	2	1076	512	17
25 to 30	0	0	0	0	1	1	154	4	7
31 to 36	1	1	0	0	1	1	151	0	1
37 to 42	0	0	0	0	0	0	21	0	3
43 to 48	1	0	0	0	0	0	0	0	2
49 to 54	0	0	0	0	0	0	0	0	5
55 to 60	0	0	0	0	0	0	8	0	0
Total	**812**	**70**	**247**	**46**	**8,538**	**854**	**73,384**	**2,120**	**340**

TABLE 4.2 DEPTH DISTRIBUTION OF TOTAL MD, MPPEH, AND MEC PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

DEPTH (INCHES BGS)	MUNITIONS DEBRIS		MPPEH		CONFIRMED MEC		PERCENT OF MPPEH AND MEC AT OR ABOVE
	TOTAL	PERCENT	TOTAL	PERCENT	TOTAL	PERCENT	
0	459	0.55%	23	0.74%	1	0.29%	0.70%
0.5 to 6	51,444	61.99%	1,575	50.97%	185	54.41%	52.01%
7 to 12	27,170	32.74%	914	29.58%	108	31.76%	81.81%
13 to 18	2,467	2.97%	57	1.84%	11	3.24%	83.79%
19 to 24	1,089	1.31%	514	16.63%	17	5.00%	99.27%
25-30	155	0.19%	5	0.16%	7	2.06%	99.62%
31 to 36	153	0.18%	2	0.06%	1	0.29%	99.71%
37 to 42	21	0.03%	0	0.00%	3	0.88%	99.80%
43 to 48	1	0.00%	0	0.00%	2	0.59%	99.85%
49 to 54	0	0.00%	0	0.00%	5	1.47%	100.00%
55 to 60	8	0.01%	0	0.00%	0	0.00%	100.00%
Total	**82,981**	**100%**	**3,090**	**100%**	**340**	**100%**	**Total: 3,430**

TABLE 4.3 INTRUSIVE RESULTS BY AREA AND ANOMALY MAGNITUDE PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

COVERAGE		FINDINGS		RESULTS				
AREA	ACRES	ANOMALIES	COUNT	MPPEH	MPPEH PER TARGET	ANOMALIES PER ACRE	MPPEH PER ACRE	COMMENTS
<1,000 ft buffer of the OD Grounds Center	Total Acres: 72.3 DGM Acres: (Not Available)	6.3mV to 13mV	Identified: 89 Investigated: 0 Items: 0	--	--	--	--	No Anomalies within the 1,000-foot buffer where investigated.
		13mV to 50mV	Identified: 370 Investigated: 0 Items: 0					
		≥50mV	Identified: 634 Investigated: 0 Items: 0					
1,000 to 1,250 ft buffer of the OD Grounds Center	Total Acres: 40.6 DGM Acres: 20.8	6.3mV to 13mV	Identified: 769 Investigated: 0 Items: 0	--	--	37.0	--	Total Anomaly Density is 773 per acre[1]. Insufficient intrusive data to calculate reliable MPPEH densities at low and middle mV range. Middle MPPEH density may be biased by small data set. Total MPPEH Density is estimated at 78.7 per acre assuming a 3% MPPEH rate in the low mV range and 11% MPPEH rate in the middle range[2].
		13mV to 50mV	Identified: 5,294 Investigated: 1 Items: 1	1	--	254.5	--	
		≥50mV	Identified: 10,013 Investigated: 10,013 Items: 11,836	6 MPPEH from Phase II 564 MPPEH (thermally treated Phase III) 377 MPPEH (explosively perforated Phase III, no HE) 84 confirmed MEC Phase III)	10.2%	481.4	49.6	
1,250 to 1,500 ft buffer of the OD Grounds Center	Total Acres: 49.4 DGM Acres: 26.9	6.3mV to 13mV	Identified: 1,735 Investigated: 0 Items: 0	--	--	64.5	--	Total Anomaly Density is 484 per acre[1]. Insufficient intrusive data to calculate reliable MPPEH densities at low mV range. Middle MPPEH density may be biased by small data set. Total MPPEH Density is estimated at 42.8 per acre assuming a 3% MPPEH rate in the low mV range[2].
		13mV to 50mV	Identified: 6,552 Investigated: 18 Items: 18	2	11%	243.6	26.8	
		≥50mV	Identified: 4,727 Investigated: 4,725 Items: 5,056	17 MPPEH from Phase II 193 MPPEH (thermally treated Phase III) 149 MPPEH (explosively perforated Phase III, no HE) 20 confirmed MEC Phase III)	8.0%	175.7	14.1	
1,500 to 1,750 ft buffer of the OD Grounds Center	Total Acres:58.6 DGM Acres: 38.2	6.3mV to 13mV	Identified: 2,262 Investigated: 124 Items: 127	4	3.1%	59.2	1.8	Total Anomaly Density is 281 per acre. Total MPPEH Density is 40 per acre.
		13mV to 50mV	Identified: 5,438 Investigated: 484 Items: 551	64	13%	142.4	18.5	
		≥50mV	Identified: 3,040 Investigated: 1,594 Items: 2,268	395	25%	79.6	19.9	
1,750 to 2,000 ft buffer of the OD Grounds Center	Total Acres: 67.6 DGM Acres: 39.6	6.3mV to 13mV	Identified: 3,503 Investigated: 102 Items: 104	2	2.0%	88.5	1.8	Total Anomaly Density is 182 per acre. Total MPPEH Density is 12 per acre.

COVERAGE		FINDINGS		RESULTS				COMMENTS
AREA	ACRES	ANOMALIES	COUNT	MPPEH	MPPEH PER TARGET	ANOMALIES PER ACRE	MPPEH PER ACRE	
		13mV to 50mV	Identified: 2,350 Investigated: 638 Items: 679	54	8.5%	59.3	4.7	
		≥50mV	Identified: 1,364 Investigated: 917 Items: 1,164	133	15%	34.4	5.2	
2,000 to 2,250 ft buffer of the OD Grounds Center	Total Acres: 76.6 DGM Acres: 47.6	6.3mV to 13mV	Identified: 2,579 Investigated: 2 Items: 2	0	--	54.2	--	Total Anomaly Density is 138 per acre. Insufficient intrusive data to calculate reliable MPPEH densities at low mV range. Total MPPEH Density is estimated at 4.3 per acre assuming a 3% MPPEH rate in the low mV range.
		13mV to 50mV	Identified: 3,130 Investigated: 852 Items: 920	18	2.1%	65.8	1.4	
		≥50mV	Identified: 868 Investigated: 393 Items: 451	29	7.4%	18.2	1.3	
2,250 to 2,500 ft plus buffer of the OD Grounds Center	Total Acres: 85.6 DGM Acres: 48.6	6.3mV to 13mV	Identified: 2,254 Investigated: 23 Items: 23	0	--	46.4	--	Total Anomaly Density is 125 per acre. Total MPPEH Density is estimated at 2.7 per acre assuming a 3% MPPEH rate in the low mV range.
		13mV to 50mV	Identified: 2,941 Investigated: 753 Items:819	11	1.5%	60.5	0.88	
		≥50mV	Identified: 876 Investigated: 523 Items: 553	13	2.5%	18.0	0.45	

(1) The Final Site-Specific Project Report (Weston, 2005) described the area between 1,000 and 1,500 ft of the OD grounds center as being "saturated" (i.e., having closely spaced and overlapping anomalies). Therefore, it is assumed that target selection in these areas was impacted by the high density of metal and that the anomaly densities are biased low in this area.

(2) To derive the MPPEH density, the MPPEH rate from the intrusive results was multiplied by the anticipated number of anomalies in each zone. Intrusive results were biased toward larger anomalies more likely to represent MPPEH (100% of intrusively investigated anomalies were over 50mV in amplitude). Therefore, the MPPEH per anomaly estimates may bias the MPPEH density to be higher than the actual density. However, because the total number of anomalies are expected to be biased lower due to anomaly density in this area, the calculated MPPEH densities may also be biased low. Therefore, there is a significant level of uncertainty in the MPPEH rates in areas closer to the OD Hill.

4.1.2 Nature of Munitions and Explosives of Concern

A wide variety of munitions have been identified at the OD Grounds during previous investigations and removal actions. **Table 4.4** summarizes the types of munitions found and **Table 4.5** summarizes the types of MPPEH or MEC found within the OD Ground MRS.

TABLE 4.4 MUNITIONS TYPES IDENTIFIED
PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

CATEGORY	IDENTIFIED MUNITIONS TYPES
Bomb	4-lb (Fragmentation [M83 Butterfly] and Incendiary)
	20-lb (Fragmentation and unspecified type)
	250-lb (concrete-filled)
	Unspecified type and size
Fuze	Adapter
	Base Detonating Fuze (Mk221, M68, M66, M62/M92, M60, M48, M46, M38, unspecified)
	Bomb Fuze (type and model unspecified)
	Bomb Fuze, Nose (Mk271, M104, M103, unspecified type)
	Booster (fly-k type)
	Burster
	Dispenser
	Mine Fuze (M16, unspecified type)
	Nose Fuze (unspecified type)
	Point Detonating Fuze (M54, M52, M48, M46, M4, M104, unspecified type)
	Prime Detonator (M14)
	Projectile Fuze, Variable Time
	Rifle Grenade Fuze (M9)
	Tail Fuze (M123 series)
	Variable Time Fuze (unspecified)
	Fuze (M66, M51 series [T-bar], M4A, M47, M103, unspecified)
Grenade	Grenade, Rifle, 40mm
	Grenade, Hand, Fragmentation, MkII
	Undetermined, foreign rifle grenade (HE and type unspecified)
	Grenade, Rifle, Cartridge
	Grenade, Rifle, unidentified fuze
	Grenade, Rifle, Anti-Tank, (M9A1, M9)
Mine	Mine, AP Bouncing Betty (M2A1 and type unspecified)
	Mine, AP, (M16 and M2)
Mortar	Mortar, 4.2 inch, type unspecified
	Mortar, 60mm, type unspecified
	Mortar, 81mm, type unspecified
	Mortar, Unknown type/size
Other	Cartridge, .50 caliber, with 20mm case
	1.1" anti-aircraft Mk1 Mod 14

TABLE 4.4 MUNITIONS TYPES IDENTIFIED
PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

CATEGORY	IDENTIFIED MUNITIONS TYPES
	155mm RAP Round Tail
	155mm Smoke Pot
	Cartridge, 20mm, HEI, MK 1
	Activator, Flare, M48
	Cartridge, Flare, multiple fuzed together items
	Booster cup
	Candle, Flare, M48
	Flare, Trip, Parachute, M48
	Booster, with wire
	Canister, HC Smoke
	Canister, split open, possible HE
	Burster adapter
	Burster tube
	Burster tube assembly
	Cartridge case with intact primer
	Smoke pot
	5 inch RAP Base Plate
Projectile	Projectile, 20mm, (HE, HEI, unspecified type) (MK1 and M97)
	25mm Projectiles
	Projectile, 1.1 inch, Mk 1 series
	Projectile, 2.75 inch, possible residue
	Projectile, 30mm, (HE [T328], TP [T328], Unspecified)
	Projectile, 37mm, (AP, APHE [M80], Drill Round [M54/M63], HE [M74, M54/M63], unspecified type)
	Projectile, 3 inch, Mk 31
	Projectile, 40mm, (HE [Mk II, unspecified model], Practice [M382/M385], unspecified type)
	Projectile, 57mm, (HE [T-18E1, M306A1, unspecified model], WP [M308 series], unspecified type)
	Projectile, 75mm, (APC-T [M61], APHE [M61A1, unspecified model], HE [M41/M48, unspecified model], HEAT [M66], Recoilless [M309], Smoke, unspecified type)
	Projectile, 76mm, (APHE [unspecified model], unspecified type)
	Projectile, 81mm, High Explosive (HE), M374
	90mm Projectiles
	Projectile, 105mm, (HE, illumination, WP [M60 series], unspecified type)
	Projectile, 106mm, HEAT
	Projectile, 115mm
	Projectile, 120mm
	Projectile, 155mm
	Projectile, 6 inch, APHE
	Projectile, type undetermined
Rocket	Rocket, 2.36 inch, (HEAT, WP, unspecified type)

TABLE 4.4 MUNITIONS TYPES IDENTIFIED PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

CATEGORY	IDENTIFIED MUNITIONS TYPES
	Rocket, 2.75 inch, unspecified
	Rocket, 3 inch
	Rocket, 3.25 inch, Semi-Armor Piercing (SAP)
	Rocket, 3.5 inch, (HEAT [M28], WP, unspecified type)
	Rocket, 4.5 inch, type unspecified
	Rocket, 5 inch, HVAR
	Rocket, 66mm, LAW (M72A2 and M71A2)
	Rocket, 68mm, type undetermined
	Mini-Rocket
	Rocket Burster
	Rocket, size & type undetermined

TABLE 4.5 MEC/MPPEH TYPES IDENTIFIED PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

IDENTIFIED MEC AND MPPEH TYPES
3.5 inch
Bomb, 20lb, Fragmentation
Bomb, 4lb, Fragmentation, M83 (butterfly)
Flare, parachute
Fuze, Base Detonating, M46
Fuze, Base Detonating, M60
Fuze, Base Detonating, M62
Fuze, Base Detonating, M62/M92
Fuze, Base Detonating, M66
Fuze, Base Detonating, M68
Fuze, Bomb, Nose, M103
Fuze, Bomb, undetermined
Fuze, M103
Fuze, M51 series, T-bar
Fuze, M66
Fuze, Point Detonating, M104
Fuze, Point Detonating, M48
Fuze, Point Detonating, M52
Fuze, Point Detonating, M54
Fuze, Point Detonating, unspecified
Fuze, unspecified (base detonating [BD], variable timed [VT], point detonation [PT], T-bar
Grenade, AT, M9
Grenade, Hand, Fragmentation, MkII

IDENTIFIED MEC AND MPPEH TYPES
Grenade, Rifle, Anti-Tank, M9A1
Grenade, Rifle, HE, unknown foreign
Mine, M16
Mine, M2A1 AP
Miscellaneous (burster tube, booster cup, canister)
Mortar, 81mm
Projectile, 1.1 inch, Mk1 series
Projectile, 105mm
Projectile, 106mm (HEAT)
Projectile, 20mm (HE, HEI, MkI, unspecified)
Projectile, 25mm (unspecified)
Projectile, 37mm (HE, HE M54/M63, unspecified)
Projectile, 40mm (HE, HE Mk II, unspecified)
Projectile, 57mm (HE, HE M306A1, Smoke WP M308, unspecified)
Projectile, 75mm (APHE, HE M41/M48, M309, unspecified)
Projectile, 76mm (APHE, unspecified)
Projectile, undetermined
Rocket, 2.36 inch
Rocket, 2.75 inch
Rocket, 66mm, M72A2 LAW

4.1.3 MEC Conceptual Site Models

Based on the CSMs presented, MEC in the form of UXO and DMM are present in the surface and subsurface to a depth of 36 inches with 99% of the "MPPEH" and UXO/DMM occurring in the top 24 inches. Items at depths greater than 36 inches may occur in fill areas. A surface clearance was performed at the OD Hill (**Section 3.1.7**), therefore UXO/DMM are not expected on the surface in this area.

Table 4.2 summarizes the findings of MD/"MPPEH" and UXO/DMM during both digital and analog removals during the Phase I and II Investigations and the Munitions Response Action (2012-2014). From this dataset, all items containing sufficient data to be categorized by munitions type were categorized to support the development of a vertical CSM (a total of 3,041 records were identified). **Table 4.6** summarizes the maximum depth for MD, MPPEH, and UXO/DMM found in each munitions category and a description of the categories.

Table 4.7 summarizes the revised MEC conceptual site model (CSM) for the OD Grounds MRS. The revised CSM and vertical CSM are based on the results of the Phase I and II Investigations and the Munitions Response Action (2012-2014), with the depth distribution summarized in **Table 4.2**. **Figure 4.2** shows the vertical and horizontal distribution of excavated munitions items at the OD Grounds. While there may be some bias in the data due to variability in documentation, it is believed that as a general representation the vertical CSM has sufficient data quality to be accepted as a valid estimate of site conditions. **Figure 4.3** shows examples of the anomaly distribution within four example grids. It should be noted that the data represented in **Figures 4.2** and **4.3** include only digital data from multiple field efforts, each of which focused on different areas of the site and consisted of predominantly anomalies greater than 50mV (data from analog work is not presented). Both **Figures 4.2** and **4.3** show that the density of munitions items/anomalies decreases with distance from the OD Hill center. The Munitions Response Action performed in 2012-2014 removed only items from between 1,000 and 1,500 feet out from the OD Hill. This study was also the only action where UXO/DMM were confirmed based on post demolition conditions; therefore, no confirmed UXO/DMM are shown outside of the area of the Munitions Response Action footprint. As such, the lack of UXO/DMM at distances greater than 1,500 feet from the OD Hill is an artificial result of the data documentation, and not a reflection on the presence (or absence) of MEC at greater distances. The "MPPEH" shown on the table is designated as such because a final determination is not available and the "MPPEH" shown likely includes a mix of inert practice items as well as UXO and DMM. In addition, a certain level of bias should be expected in the intrusive results due to the selection of only anomalies over 50mV following Digital Geophysical Mapping (DGM). This would tend to bias the data toward larger items more likely to represent UXO/DMM but may also bias the data to shallower items which could have a larger amplitude anomaly due to the shorter distance to the sensor.

Based on previous analog investigations, fill areas were encountered in 1% of the area where analog surveys were conducted; MD, UXO, and DMM were often found at greater depths in these fill areas than they were in other parts of the site. **Figure 4.2** shows that the 99% Upper Tolerance Limit (UTL) of munitions-related item depth generally ranges between 12 inches and 18 inches. By comparison, 40% of the items recovered from these fill areas were found deeper than 24 inches, and 54% of recovered items in the fill areas were found deeper than 12 inches.

The CSM also shows that generally, the density of munitions related items decreases as the distance from the OD Hill and depth increases.

Figure 4.4 show the vertical distribution of identifiable munition-related items categorized by type. **Figure 4.5** shows a plan view map of the same data and includes all digs to help show the horizontal distribution of the data. This vertical CSM by munitions type shows only dig results containing sufficient data to be categorized by type (a total of 3,043 items were identified). The type categories shown on **Figure 4.4** correlates to the categories and descriptions shown in **Table 4.6**, which summarizes the maximum depth for MD, "MPPEH", and UXO/DMM for each category. **Table 4.8** summarizes that number of items found at each depth interval by munitions category and is simply a different representation of the same data shown on **Figure 4.4**.

TABLE 4.6 MUNITIONS CATEGORIES USED IN VERTICAL CSM AND RELATED MAXIMUM DEPTHS FOUND

MUNITIONS CATEGORY	DESCRIPTION	MAXIMUM DEPTH OF UXO/DMM (INCHES BGS) (1)	MAXIMUM DEPTH OF MPPEH (2) (INCHES BGS) (1)	MAXIMUM DEPTH OF MD (INCHES BGS) (1)
B1	Butterfly Bomblets	--	8	8
B2	20lb Fragmentation Bombs	--	2	3
F1	Very Small – approx. 2"x3" or smaller (e.g., small base fuzes, small Russian projectile fuzes, rocket base fuses, some land mine fuzes, etc.)	12	26	8
F2	Small - Between 2"x3" and 4"x6". (e.g., "T-bar" fuzes, artillery projectile fuzes, smaller rocket fuzes, etc.)	12	26	12
F3	Medium - 100 series bomb fuzes, larger rocket fuzes, etc.	5	18	12
F4	Large - M60 series base fuzes and similar very heavy, large fuzes.	7	9	--
G1	Hand Grenades	9	12	12
G2	Rifle Grenades	12	14	2
M1	M1 square mines and "bouncing betty" mines and flares.	9	12	12
P1	20mm/25mm/1.1" projectiles and similar	10	36	24
P2	30mm projectile without cartridge case	5	15	--
P3	37mm/40mm projectiles without cartridge case. 20mm with cartridge case, 30mm with cartridge case, etc.	12	18	12
P4	57mm projectiles, 2.36" rocket warheads, 2.36" rocket motors, etc.	12	24	16
P5	75mm/76mm projectiles, 90mm AP projectiles	10	25	21
P6	105mm projectiles, 3.5" rockets, etc.	--	18	10
P7	155mm projectiles/6" projectiles, 4.2" mortars, 120mm projectiles, etc.	--	15	6

(1) Data compiled from the Phase I and II Investigation and the Munitions Response Action (2012-2014).

(2) "MPPEH" here refers to a combination of MEC and MD that cannot be further differentiated based on the source information available.

TABLE 4.7 REVISED MEC CONCEPTUAL SITE MODEL SUMMARY
PHASE I AND II INVESTIGATION AND THE MUNITIONS RESPONSE ACTION (PHASE III)

	REVISED MEC CONCEPTUAL SITE MODEL SUMMARY						
MUNITIONS RESPONSE SITE	KNOWN OR SUSPECTED CONTAMINATION SOURCE(S)	LOCATION	CONFIRMED OR SUSPECTED CONTAMINATION SOURCE(S)	CONFIRMED LOCATION AND DISTRIBUTION	SOURCE OR EXPOSURE MEDIA	CURRENT AND FUTURE RECEPTORS	COMPLETE EXPOSURE PATHWAY
NAME: OD Grounds **Acreage:** 403 acres (420.55 acres inside the 2,500-foot buffer and excluding the OB Grounds) **Suspected Past DoD Activities (release mechanisms):** This MRS was used for open detonation (OD) to destroy munitions beginning in 1941 until 2000 as part of the military mission at the Seneca Army Depot. **Current and Future Land Use:** The OD Grounds are currently closed and the planned future use of the MRS is projected to be as conservation/recreation.	Known/Suspected MEC: MEC in the form of UXO and DMM have been confirmed and UXO/DMM are suspected to remain within the MRS. Various munitions and munitions component types have been identified including: • Projectiles ranging from 20mm to 155mm; • Bombs including 4-lbs and 20-lbs (also a single 250-lb inert concrete filled bomb identified) • Rockets ranging from 2.36-inch to 5-inch; • Mortars including 60mm, 81mm, and 4.2-inch. • Various Anti-personnel mines. • Anti- tank mines; • Hand and rifle grenades, including foreign rifle grenades. • Multiple types of fuzes, bursters, boosters, flares, smoke canisters, and smoke pots. • Various munitions components and other related devices.	OD Hill	Munitions and Explosives of Concern: UXO and DMM has been identified. Munitions types found at the site are summarized in Table 4.6.	Confirmed UXO/DMM on the surface and the subsurface. MEC was cleared from surface; therefore, the current distribution is expected to only be in the subsurface.	Subsurface soil	Current Receptors: Hunters (recreational users) and installation personnel (site workers). Future Receptors: Future use of the MRS is planned to be conservation/recreation and users will include, site visitors/tour participants, hunters, and conservation area workers.	YES Exposure to UXO/DMM in subsurface soil.
		Kickout Area		UXO/DMM are potentially present throughout the entire Kickout Area down to a depth of 36 inches bgs, with 99% of items being found within 24 inches of the surface. In addition, some fill areas are potentially present in at discrete locations at the site and these might contain items down to 60 inches bgs.	Surface or subsurface soil		YES Exposure to UXO/DMM in surface or subsurface soil.

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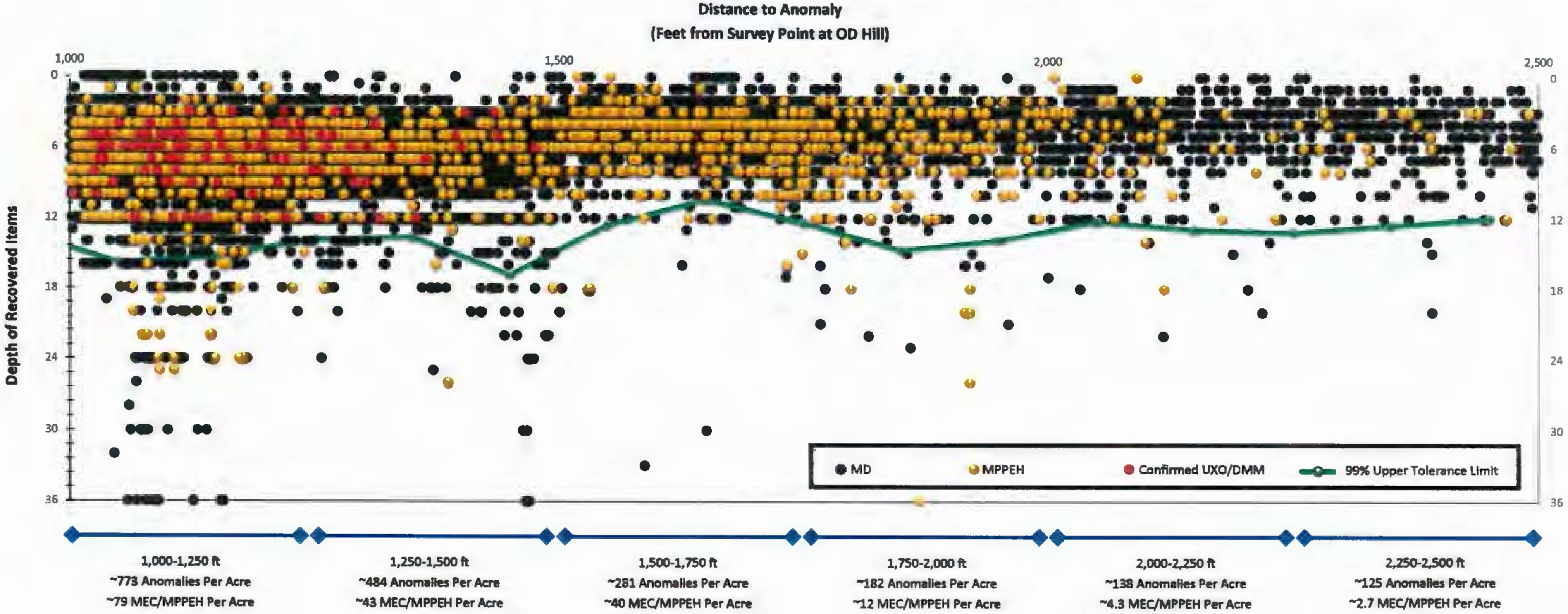
Figure 4.2

Vertical and Horizontal Distribution of Munitions Items Recovered from DGM Anomalies



Estimates of Anomaly Density Based on Phase I, Phase II, and Munitions Response (Phase III) Digital Geophysical Data

Notes:

-Data shown ONLY includes intrusive results from investigation of DGM anomalies during the Phase I Investigation (Weston, 2005), the Phase II Investigation (Weston, 2006) and the Munitions Response/Phase III (Parsons, 2016)

-UXO/DMM items were only confirmed based on post demolition evaluation for items disposed of during the Munitions Response Action (Phase III) between the 1,000 and 2,000 foot radius. As a result, confirmed UXO/DMM are only seen in the data for this portion of the site that was covered by the 2012-2014 action.

-MPPEH items were not given a final designation of UXO/DMM/MDAS; therefore, it can not be estimated how many of the MPPEH items found would be classified as UXO/DMM. Some training rounds can not be confirmed as MDAS without demolition.

-A tolerance interval was calculated on data grouped in 100 foot intervals. Based on the calculation of one-sided upper tolerance interval for normally distributed data (NIST/Sematech Engineering Statistics Handbook, Section 7.2.6.3) the data show 99% confidence that 99% of the MD/MPPEH/MEC are above the depth shown in green for each 100 foot evaluation interval.

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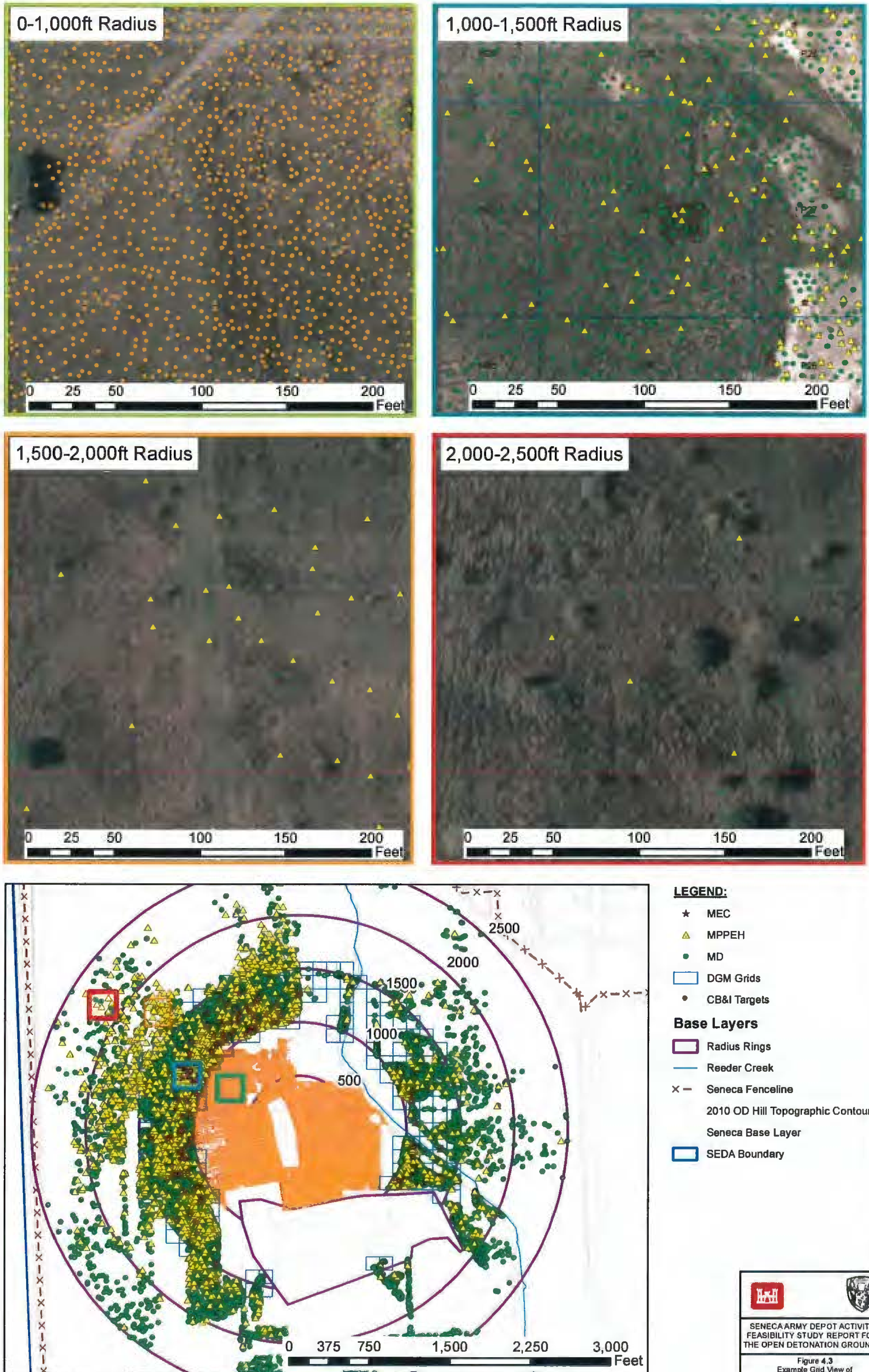

SENECA ARMY DEPOT ACTIVITY
FEASIBILITY STUDY REPORT FOR
THE OPEN DETONATION GROUNDS

Figure 4.3
Example Grid View of
Anomalies and Results

NOV. 2018 | 1 " = 800 ' | TIB

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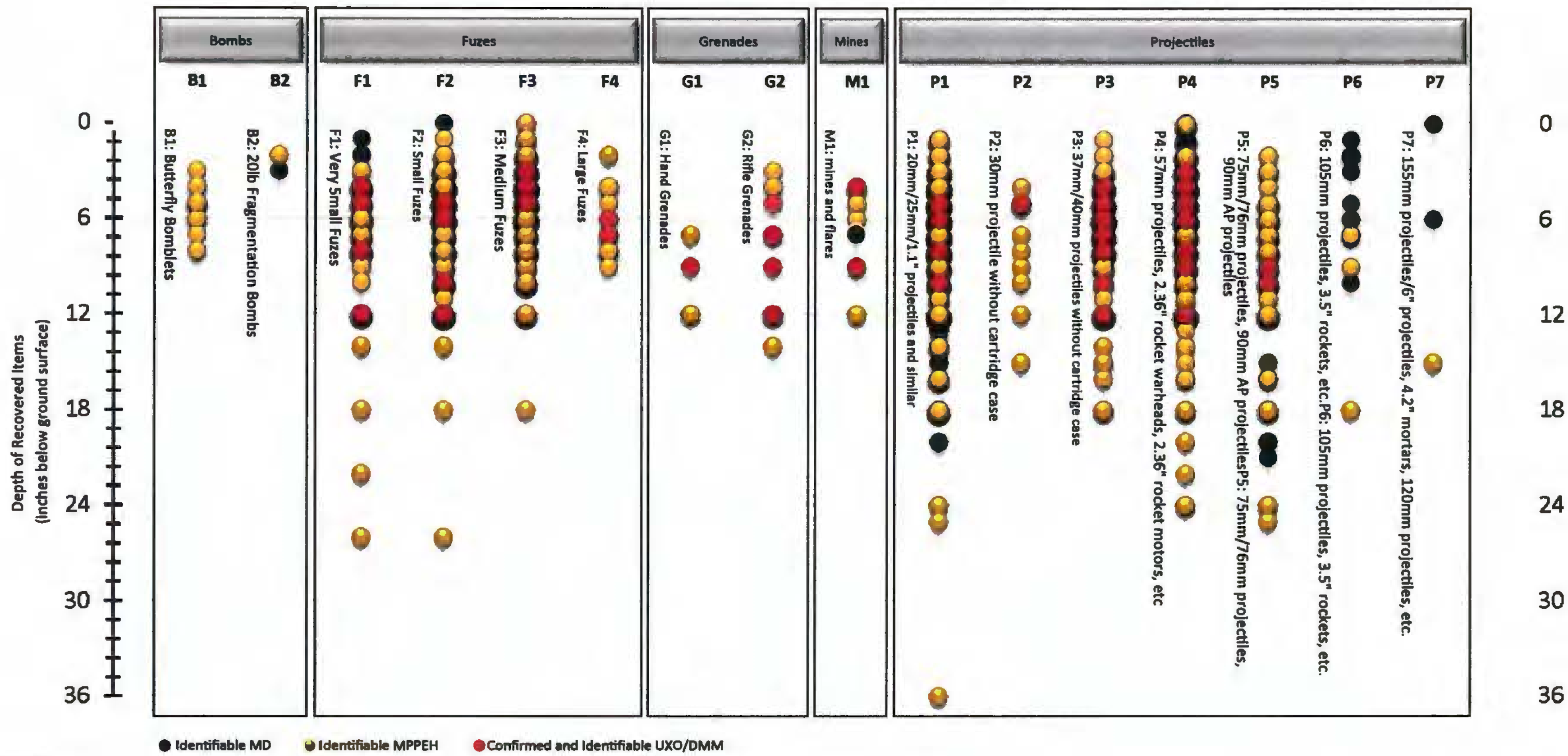
Figure 4.4

Vertical Distribution of Identifiable Items by Type

(Based on 3,041 DGM dig records with sufficient data to be categorized by type.)



Notes:

- Full descriptions of each munitions type subcategory can be found in Table 4.6
- UXO/DMM items were only confirmed based on post demolition evaluation for items disposed of during the Munitions Response Action (Phase III)
-"MPPEH" items were not given a final designation of UXO/DMM/MDAS; therefore, it can not be estimated how many of the MPPEH items may have been UXO/DMM. Some training rounds can not be confirmed as MDAS without demolition. "MPPEH" includes items that were burned to ensure any residual explosives were removed.

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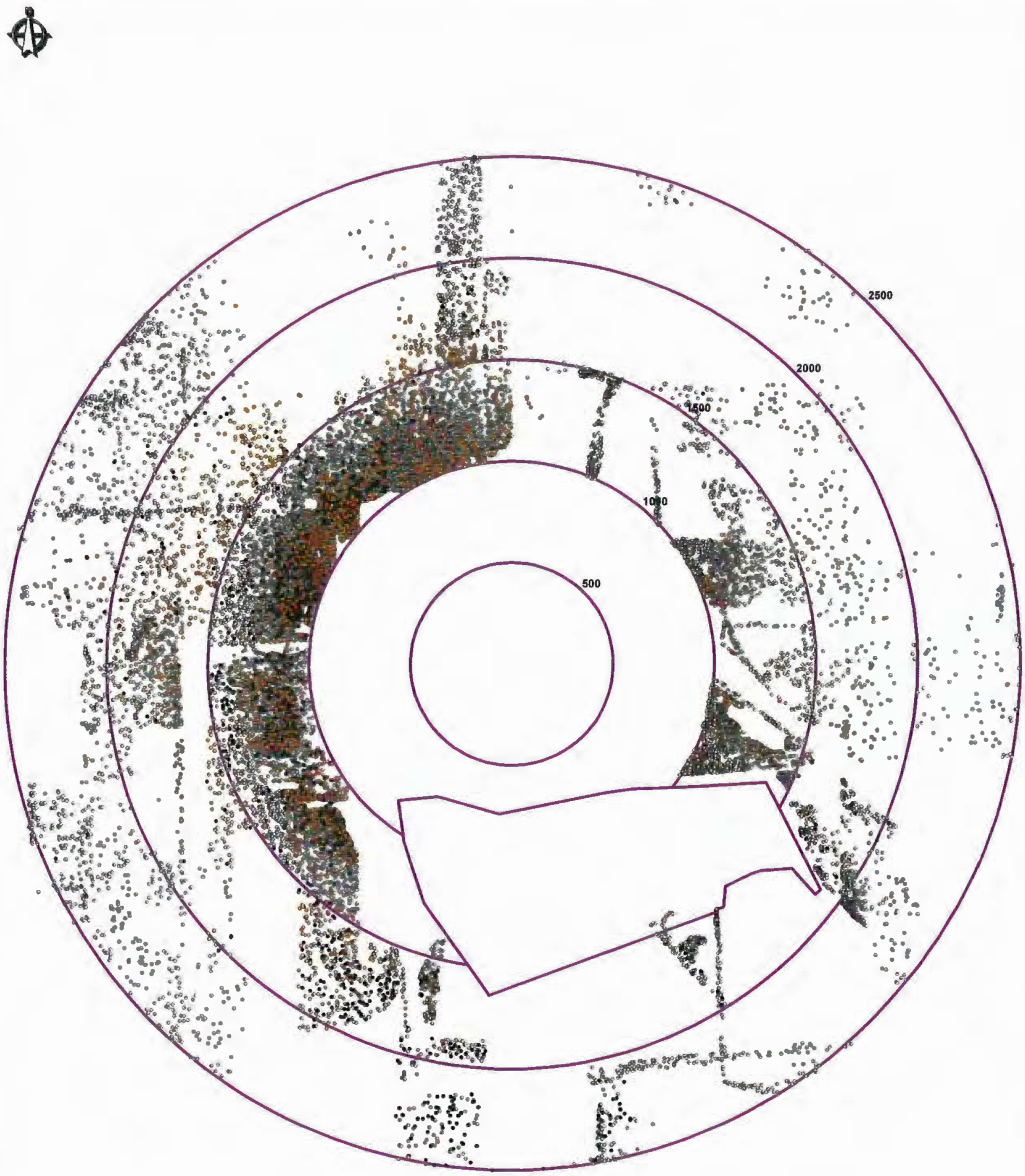

Legend

- MD
- MPPEH
- UXO/DMM
- All DGM digs (16,835)
- Radius Rings

0 200 400 800 1,200 1,600 Feet

SENECA ARMY DEPOT ACTIVITY
FEASIBILITY STUDY REPORT FOR
THE OPEN DETONATION GROUNDS

Figure 4.5
Horizontal Distribution of Data Points from the Vertical CSM

SEP. 2018	1 in = 500 ft	TB

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TABLE 4.8 VERTICAL DISTRIBUTION OF IDENTIFIABLE MUNITIONS ITEMS USED IN THE VERTICAL CSM

DEPTH (INCHES BGS)	BOMBS				FUZES		GRENADES		MINES	PROJECTILES/ROCKETS							TOTAL
	B1	B2	F1	F2	F3	F4	G1	G2	M1	P1	P2	P3	P4	P5	P6	P7	
0				1	2								14			1	18
1			1	1	4					9		1	19		1		36
2		1	2	7	19	1				15		2	45	2	4		98
3	1	1	2	33	40			1		56		9	91	5	1		240
4	2		13	68	67	3		2	4	127	1	27	90	2			406
5	5		10	63	49	1		1	2	151	3	40	68	11	1		405
6	3		22	85	73	2			2	257		53	68	15	2	1	583
7	1		9	27	23	3	1	2	1	151	1	38	38	10	2		307
8	2		16	55	31	4				167	1	35	39	12			362
9			2	10	7	1	1	1	2	75	1	8	21	8	1		138
10			1	18	12					50	1	4	15	10	1		112
11				1						11		1	3	2			18
12			9	22	9		3	4	2	93	1	17	49	16			225
13										5			1				6
14			1	1				1		8		1	2				14
15										3	1	2	1	2		1	10
16										7		1	3	2			13
17																	0
18			1	1	1					14		3	3	6	1		30
19																	0
20										2			1	3			6
21														1			1
22			1										1				2
23																	0
24										2			2	2			6
25										1				1			2
26			1	1													2
27-35																	0
36										1							1
Total	14	2	91	394	337	15	5	12	13	1,205	10	242	574	110	14	3	3,041

4.1.4 MEC Hazard Assessment

A Munitions and Explosives of Concern Hazard Assessment (MEC HA) was prepared to qualitatively assess the potential explosive hazards to human receptors associated with complete MEC exposure pathways at the OD Grounds. A detailed description of the MEC HA conducted for the OD Grounds was included in **Appendix C2** and summarized in Section 1.8 of the Feasibility Study (FS) Report.

4.1.5 MEC Risk Assessment

A MEC Risk Assessment was prepared to evaluate the risk from explosive hazards to human receptors associated with complete MEC exposure pathways at the OD Grounds. The MEC risk assessment technique used followed the "Decision Logic to Assess Risks Associated with Explosive Hazards, and to Develop RAOs for MRSs" (USACE, 2017) and evaluated the risk associated with MEC exposure considering both current land use conditions and planned future land use conditions at the Kickout Area and the OD Hill. A detailed description of the MEC Risk Assessment conducted for the OD Grounds, including the information and assumptions used for this assessment, was included in **Appendix C1** and summarized in Section 1.7 of the Feasibility Study (FS) Report.

4.2 NATURE AND EXTENT OF MUNITIONS CONSTITUENTS/ CONTAMINANTS OF POTENTIAL CONCERN

4.2.1 Chemicals of Potential Concern in Soil

Based on the previous investigations results described in **Section 3.2**, metals concentrations are elevated in the surface soil, with higher concentrations closer to the OD Hill. **Figure 4.6A** and **Figure 4.6B** show the approximate locations of the soil samples collected at the OD Grounds during the ESI (ES, 1995) and Additional Munitions Response SI (Parsons, 2010), and **Figure 4.7** shows the soil sample locations that were sampled for perchlorate during the 2018 sampling event. A summary of soil exceedances is presented in **Tables 4.9** through **4.11**. The full datasets are provided in **Appendices A-1, A-2** and **A-3**. Exceedances were defined as concentrations above the May 2018 USEPA Regional Screening Levels (RSL) for residential soil (HQ=0.1) (USEPA, 2018) as a screening value. In addition, NYS Remedial Program Soil Cleanup Objectives (SCOs) (6 CRR-NY 375-6.8) (NYSDEC, 2018a), effective June 2018, are also displayed in the summary tables below and in **Appendix A**. NYSDEC SCOs are developed for unrestricted use and restricted use scenarios (NYSDEC, 2018). Based on the future land uses described in **Section 1.2.2**, the NYSDEC restricted use SCOs for the commercial use scenario are considered to be the appropriate criteria for the OD Grounds. If a compound does not exceed its USEPA RSL, but does exceed its respective NYSDEC SCO, additional text is included below to discuss the differences.

4.2.1.1 Chemicals of Potential Concern in Surface Soil

Within the OD Grounds, 52 samples were collected within the 500-foot OD Hill radius. The remaining 25 samples were collected at locations between 500 and 2,000 feet from the OD Hill to delineate the extent of any impacts to the surface soil within the Kickout Area. Soil samples were collected during two investigations; one during the ESI in 1993 and one during the Additional Munitions Response Action in 2010.

Samples were analyzed for VOCs, SVOCs, explosives, metals, perchlorate, herbicides, pesticides, and PCBs. The list of analytes collected varied depending on the sampling round. VOCs were analyzed during the 1993 investigation and perchlorate was analyzed during a 2018 sampling event.

The VOC, pesticide, or perchlorate results were all below their respective screening criteria. In all cases where an analyte exceeded its NYSDEC SCO, it also exceeded the USEPA RSL. The COPCs identified in soil based on an exceedance of a screening value are MCPA (herbicide), nitroglycerine (explosive), 2,4-DNT (analyzed as an SVOC), Aroclor-1254 (PCB), and several metals.

Exceedances of MCPA, nitroglycerine, 2,4-DNT and Aroclor-1254 were limited to one or two detections which exceeded their respective USEPA RSL (**Table 4.9**). These exceedances are discussed in the HHRA (**Appendix B1**) where it was determined that none of these compounds were COCs.

During the perchlorate investigation in 2018, perchlorate was detected in eight of the ten surface soil (0-0.5 ft bgs) samples. The highest concentration of perchlorate in the surface soil samples was measured at 8.2 Micrograms per kilogram (µg/kg) and is located on the OD Hill (S45-ODG-SS-06) (**Figure 4.7**). None of the surface soil samples contained levels of perchlorate that exceeded the USEPA RSL for Residential Soil (HQ=0.1) value of 5,500 µg/kg (**Table 4.10**).

Metals which exceed USEPA RSLs and are considered COPCs include: aluminum, arsenic, cadmium, cobalt, copper, iron, lead, manganese, mercury, silver, thallium, and vanadium (**Table 4.9** and **Figures 4.8A** and **4.8B**). Cadmium, copper, and mercury were the only metals to exceed their respective NYS Commercial SCOs. Lead, silver and vanadium had one or two exceedances each over the RSL. The HHRA did not identify any COCs in surface soil (**Appendix B1**).

The evaluation of potential risk to human health and the environment posed by these metals concentrations in soils is discussed below in **Section 1.5** below. Samples collected for metals analysis were also sent for synthetic precipitation leaching procedure (SPLP) analysis during the 2010 Supplemental Work. The discussion of these results and samples are included in **Section 1.4.1**.

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Table 4.9
Summary of Surface Soil Samples
Compilation Report - OD Grounds
Seneca Army Depot Activity

					NYSDEC SCO Commercial Use[1]		EPA RSLs Industrial Soil[2]	
Parameter	Unit	Maximum Detected Value	Number of Times Detected	Number of Samples Analyzed	Criteria Value[1]	Number of Exceedances	Criteria Value[2]	Number of Exceedances
Volatile Organic Compounds		(No Detects)			-	-	-	-
Herbicides								
MCPA	UG/KG	9,400	2	29	NA	0	310,000	0
Explosives								
1,3,5-Trinitrobenzene	UG/KG	120	23	41	NA	0	27,000,000	0
2,4,6-Trinitrotoluene	UG/KG	1,400	32	41	NA	0	79,000	0
2,4-Dinitrotoluene	UG/KG	1,100	31	41	NA	0	5,500	0
2-amino-4,6-Dinitrotoluene	UG/KG	590	30	41	NA	0	2,000,000	0
4-amino-2,6-Dinitrotoluene	UG/KG	500	27	41	NA	0	1,900,000	0
HMX	UG/KG	190	26	41	NA	0	49,000,000	0
Nitroglycerine	UG/KG	1,500	1	31	NA	0	62,000	0
RDX	UG/KG	5,800	33	41	NA	0	24,000	0
Tetryl	UG/KG	330	3	41	NA	0	2,500,000	0
Semivolatile Organic Compounds								
2,4-Dinitrotoluene	UG/KG	2,500	7	29	NA	0	5,500	0
2,6-Dinitrotoluene	UG/KG	41	1	29	NA	0	620,000	0
Acenaphthylene	UG/KG	30	1	29	500,000	0	NA	0
Anthracene	UG/KG	18	1	29	500,000	0	170,000,000	0
Benzo(a)anthracene	UG/KG	50	3	29	5,600	0	2,100	0
Benzo(a)pyrene	UG/KG	82	3	29	1,000	0	210	0
Benzo(b)fluoranthene	UG/KG	55	4	29	5,600	0	2,100	0
Benzo(ghi)perylene	UG/KG	39	2	29	500,000	0	NA	0
Benzo(k)fluoranthene	UG/KG	58	2	29	56,000	0	21,000	0
Bis(2-Ethylhexyl)phthalate	UG/KG	740	7	29	NA	0	120,000	0
Chrysene	UG/KG	130	7	29	56,000	0	210,000	0
Di-n-butylphthalate	UG/KG	2,600	6	29	NA	0	62,000,000	0
Fluoranthene	UG/KG	66	6	29	500,000	0	22,000,000	0
Hexachlorobenzene	UG/KG	110	6	29	6,000	0	1,100	0
Hexachloroethane	UG/KG	21	1	29	NA	0	43,000	0
Indeno(1,2,3-cd)pyrene	UG/KG	52	1	29	5,600	0	2,100	0
Naphthalene	UG/KG	21	1	29	500,000	0	18,000	0
N-Nitrosodiphenylamine	UG/KG	320	3	29	NA	0	350,000	0
Phenanthrene	UG/KG	38	4	29	500,000	0	NA	0
Pyrene	UG/KG	100	6	29	500,000	0	17,000,000	0
Pesticides								
4,4'-DDD	UG/KG	2.4	2	19	92,000	0	7,200	0
4,4'-DDE	UG/KG	2	16	19	62,000	0	5,100	0
4,4'-DDT	UG/KG	2.2	13	19	47,000	0	7,000	0
Alpha-Chlordane	UG/KG	0.59	1	19	24,000	0	NA	0
Dieldrin	UG/KG	1.2	11	19	1,400	0	110	0
Endosulfan I	UG/KG	55	15	19	200,000	0	NA	0
Endosulfan II	UG/KG	0.88	1	19	200,000	0	NA	0
Endrin	UG/KG	3.6	1	19	89,000	0	180,000	0
Endrin ketone	UG/KG	0.58	1	19	NA	0	NA	0
Gamma-Chlordane	UG/KG	1.1	3	19	NA	0	NA	0
Methoxychlor	UG/KG	45	1	19	NA	0	3,100,000	0

Table 4.9
Summary of Surface Soil Samples
Compilation Report - OD Grounds
Seneca Army Depot Activity

					NYSDEC SCO Commercial Use[1]		EPA RSLs Industrial Soil[2]	
Parameter	Unit	Maximum Detected Value	Number of Times Detected	Number of Samples Analyzed	Criteria Value[1]	Number of Exceedances	Criteria Value[2]	Number of Exceedances
PCBs								
4,4'-DDE	UG/KG	4.2	4	10	62,000	0	5,100	0
4,4'-DDT	UG/KG	3.4	2	9	47,000	0	7,000	0
Alpha-Chlordane	UG/KG	2	3	9	24,000	0	NA	0
Aroclor-1254	UG/KG	2,000	2	28	1,000	1	740	1
Dieldrin	UG/KG	3.2	2	9	1,400	0	110	0
Endosulfan I	UG/KG	1.8	2	10	200,000	0	NA	0
Inorganics								
Aluminum	MG/KG	27,900	76	76	NA	0	990,000	0
Antimony	MG/KG	3.1	24	76	NA	0	410	0
Arsenic	MG/KG	12.6	76	76	16	0	1.6	76
Barium	MG/KG	365	76	76	400	0	190,000	0
Beryllium	MG/KG	1.2	74	76	590	0	2,000	0
Cadmium	MG/KG	1,100	59	76	9.3	6	800	1
Calcium	MG/KG	193,000	75	76	NA	0	NA	0
Chromium	MG/KG	446	76	76	1,500	0	NA	0
Cobalt	MG/KG	26.8	76	76	NA	0	300	0
Copper	MG/KG	4,180	76	76	270	39	41,000	0
Iron	MG/KG	118,000	76	76	NA	0	720,000	0
Lead	MG/KG	998	76	76	1,000	0	800	1
Magnesium	MG/KG	15,000	76	76	NA	0	NA	0
Manganese	MG/KG	5,040	76	76	10,000	0	23,000	0
Mercury	MG/KG	7	75	76	2.8	33	43	0
Nickel	MG/KG	59.3	71	71	310	0	20,000	0
Potassium	MG/KG	4,880	55	55	NA	0	NA	0
Selenium	MG/KG	0.92	3	76	1,500	0	5,100	0
Silver	MG/KG	205	47	76	1,500	0	5,100	0
Sodium	MG/KG	211	60	76	NA	0	NA	0
Thallium	MG/KG	0.27	4	76	NA	0	10	0
Vanadium	MG/KG	41.9	76	76	NA	0	NA	0
Zinc	MG/KG	1,350	71	71	10,000	0	310,000	0

Notes:
1) Criteria values are the NYSDEC Commerical SCOs (6 NYCRR Subpart 375-6).
2) Criteria values are the USEPA RSL Industrial Soil (HQ=1.0) from the USEPA's Region 9 Regional Screening Levels (HQ=1.0) - 11/30/2012

3) Number of Analyses is the number of detected and non-detected results excluding rejected results. Sample duplicate pairs were not averaged.

Table 4.10
Summary of Surface Soil Perchlorate Data
Compilation Report - OD Grounds Seneca
Army Depot Activity

Parameter	CAS Number	Maximum Detected Concentration Detection (mg/kg)	Number of samples with Detected Concentrations	Total Number of Samples	Frequency of Detection	Regional Screening Levels (RSL) [1] (mg/kg)	Number of Detected Samples Greater than RSL
Perchlorate	14797-73-0	0.041	17	22	77%	5.5	0

[1] USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites (TR = 1E-06; THQ = 0.1), May 2018 . Available at: https://semspub.epa.gov/work/HQ/197235.pdf.

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Table 4.11
Summary of Subsurface Soil Samples
Compilation Report - OD Grounds
Seneca Army Depot Activity

					NYSDEC SCO Commercial Use[1]		EPA RSLs Industrial Soil[2]	
Parameter	Unit	Maximum Detected Value	Number of Times Detected	Number of Samples Analyzed	Criteria Value[1]	Number of Exceedances	Criteria Value[2]	Number of Exceedances
Volatile Organic Compounds								
Tetrachloroethene	UG/KG	19	6	6	150,000	0	110,000	0
Herbicides		(No Detects)			-	-	-	-
Explosives								
1,3,5-Trinitrobenzene	UG/KG	190	5	6	NA	0	27,000,000	0
2,4,6-Trinitrotoluene	UG/KG	600	6	6	NA	0	79,000	0
2,4-Dinitrotoluene	UG/KG	190	5	6	NA	0	5,500	0
2-amino-4,6-Dinitrotoluene	UG/KG	680	6	6	NA	0	2,000,000	0
HMX	UG/KG	470	6	6	NA	0	49,000,000	0
RDX	UG/KG	4,300	6	6	NA	0	24,000	0
Tetryl	UG/KG	180	1	6	NA	0	2,500,000	0
Semivolatile Organic Compounds								
2,4-Dinitrotoluene	UG/KG	14,000	6	6	NA	0	5,500	1
2,6-Dinitrotoluene	UG/KG	700	1	6	NA	0	620,000	0
Acenaphthylene	UG/KG	19	2	6	500,000	0	NA	0
Anthracene	UG/KG	17	1	6	500,000	0	170,000,000	0
Benzo(a)anthracene	UG/KG	36	5	6	5,600	0	2,100	0
Benzo(a)pyrene	UG/KG	46	5	6	1,000	0	210	0
Benzo(b)fluoranthene	UG/KG	42	5	6	5,600	0	2,100	0
Benzo(ghi)perylene	UG/KG	66	5	6	500,000	0	NA	0
Benzo(k)fluoranthene	UG/KG	34	5	6	56,000	0	21,000	0
Bis(2-Ethylhexyl)phthalate	UG/KG	65	2	6	NA	0	120,000	0
Chrysene	UG/KG	51	5	6	56,000	0	210,000	0
Diethyl phthalate	UG/KG	35	1	6	NA	0	490,000,000	0
Di-n-butylphthalate	UG/KG	6,800	6	6	NA	0	62,000,000	0
Fluoranthene	UG/KG	68	5	6	500,000	0	22,000,000	0
Hexachlorobenzene	UG/KG	62	5	6	6,000	0	1,100	0
Hexachloroethane	UG/KG	1,100	5	6	NA	0	43,000	0
Indeno(1,2,3-cd)pyrene	UG/KG	37	3	6	5,600	0	2,100	0
Naphthalene	UG/KG	30	4	6	500,000	0	18,000	0
N-Nitrosodiphenylamine	UG/KG	1,600	4	6	NA	0	350,000	0
Phenanthrene	UG/KG	46	5	6	500,000	0	NA	0
Pyrene	UG/KG	110	6	6	500,000	0	17,000,000	0
Pesticides & PCBs								
4,4'-DDE	UG/KG	3.2	2	6	62,000	0	5,100	0
4,4'-DDT	UG/KG	2.9	2	6	47,000	0	7,000	0
Dieldrin	UG/KG	2.4	1	6	1,400	0	110	0
Endosulfan I	UG/KG	2.2	4	6	200,000	0	NA	0
Inorganics								
Aluminum	MG/KG	22,800	21	21	NA	0	990,000	0
Antimony	MG/KG	5.1	8	21	NA	0	410	0
Arsenic	MG/KG	8.7	21	21	16	0	1.6	21
Barium	MG/KG	248	21	21	400	0	190,000	0
Beryllium	MG/KG	1.1	21	21	590	0	2,000	0
Cadmium	MG/KG	13.4	18	19	9.3	5	800	0
Calcium	MG/KG	101,000	21	21	NA	0	NA	0
Chromium	MG/KG	39.2	21	21	1,500	0	NA	0
Cobalt	MG/KG	16.9	21	21	NA	0	300	0
Copper	MG/KG	7,310	21	21	270	13	41,000	0
Cyanide	MG/KG	0.7	2	6	27	0	140	0
Iron	MG/KG	60,900	21	21	NA	0	720,000	0
Lead	MG/KG	153	21	21	1,000	0	800	0
Magnesium	MG/KG	12,500	21	21	NA	0	NA	0
Manganese	MG/KG	1,380	21	21	10,000	0	23,000	0
Mercury	MG/KG	9.1	21	21	2.8	16	43	0
Nickel	MG/KG	54	21	21	310	0	20,000	0
Potassium	MG/KG	3,510	21	21	NA	0	NA	0
Selenium	MG/KG	0.56	1	21	1,500	0	5,100	0
Silver	MG/KG	53.7	19	21	1,500	0	5,100	0
Sodium	MG/KG	213	21	21	NA	0	NA	0
Thallium	MG/KG	0.25	2	21	NA	0	10	0
Vanadium	MG/KG	38	21	21	NA	0	NA	0
Zinc	MG/KG	1,470	21	21	10,000	0	310,000	0

Notes:
1) Criteria values are the NYSDEC Commerical SCOs (6 NYCRR Subpart 375-6).
2) Criteria values are the USEPA RSL Industrial Soil (HQ=1.0) from the USEPA's Region 9 Regional Screening Levels (HQ=1.0) - 11/30/2012
3) Number of Analyses is the number of detected and non-detected results excluding rejected results. Sample duplicate pairs were not averaged.

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Table 4.12
Summary of Ditch Soil Data
Compilation Report - OD Grounds
Seneca Army Depot Activity

Parameter	Units	Maximum Value	Criteria Value[1]	Number of Exceedances	Number of Times Detected	Number of Samples Analyzed
Explosives						
2,4,6-Trinitrotoluene	UG/KG	120		0	1	4
2,4-Dinitrotoluene	UG/KG	83		0	1	4
2-amino-4,6-Dinitrotoluene	UG/KG	260		0	1	4
RDX	UG/KG	210		0	1	4
Tetryl	UG/KG	140		0	1	4
Semivolatile Organic Compounds						
Benzo(a)anthracene	UG/KG	32	5,600	0	2	4
Benzo(a)pyrene	UG/KG	37	1,000	0	2	4
Benzo(b)fluoranthene	UG/KG	37	5,600	0	2	4
Benzo(ghi)perylene	UG/KG	48	500,000	0	1	4
Benzo(k)fluoranthene	UG/KG	28	56,000	0	2	4
Chrysene	UG/KG	50	56,000	0	3	4
Di-n-butylphthalate	UG/KG	25		0	1	4
Fluoranthene	UG/KG	60	500,000	0	3	4
Hexachlorobenzene	UG/KG	40	6,000	0	2	4
Indeno(1,2,3-cd)pyrene	UG/KG	32	5,600	0	1	4
Naphthalene	UG/KG	24	500,000	0	1	4
Phenanthrene	UG/KG	34	500,000	0	3	4
Pyrene	UG/KG	110	500,000	0	3	4
Pesticides/PCBs						
4,4'-DDE	UG/KG	12	62,000	0	2	4
Aldrin	UG/KG	2.2	680	0	1	4
Alpha-Chlordane	UG/KG	5.7	24,000	0	1	4
Aroclor-1254	UG/KG	580	1,000	0	2	4
Dieldrin	UG/KG	7.4	1,400	0	1	4
Endosulfan I	UG/KG	2.7	200,000	0	2	4
Endrin aldehyde	UG/KG	3.2		0	1	4
Inorganics						
Aluminum	MG/KG	35,000		0	4	4
Arsenic	MG/KG	16.1	16	1	4	4
Barium	MG/KG	308	400	0	4	4
Beryllium	MG/KG	1.4	590	0	4	4
Cadmium	MG/KG	25.6	9	2	4	4
Calcium	MG/KG	84,400		0	4	4
Chromium	MG/KG	48.4		0	4	4
Cobalt	MG/KG	19.7		0	4	4
Copper	MG/KG	814	270	2	4	4
Iron	MG/KG	50,500		0	4	4
Lead	MG/KG	101	1,000	0	4	4
Magnesium	MG/KG	10,200		0	4	4
Manganese	MG/KG	935	10,000	0	4	4
Mercury	MG/KG	5.3	3	2	4	4
Nickel	MG/KG	67.7	310	0	4	4
Potassium	MG/KG	4,680		0	4	4
Silver	MG/KG	5.8	1,500	0	3	4
Sodium	MG/KG	377		0	4	4
Vanadium	MG/KG	53.7		0	4	4

Table 4.12
Summary of Ditch Soil Data
Compilation Report - OD Grounds
Seneca Army Depot Activity

Parameter	Units	Maximum Value	Criteria Value[1]	Number of Exceedances	Number of Times Detected	Number of Samples Analyzed
Zinc	MG/KG	755	10,000	0	4	4

Notes:
1) Criteria values are the NYSDEC commerical SCOs (6 NYCRR Subpart 375-6).

4.2.1.2 Chemicals of Potential Concern in Subsurface Soil

A total of 31 subsurface soil samples were collected within the 500-foot OD Hill radius. Two of the perchlorate subsurface samples were collected between the 500- and 1,000-foot radii; however, none of the other subsurface soil samples were collected outside the 500-foot radius. Ten of the subsurface samples were analyzed for perchlorate and the remaining 21 samples were analyzed for inorganic metals. In addition to metals, six of the subsurface samples were analyzed for explosives, VOCs, SVOCs, herbicides, pesticides, and PCBs. None of the VOC, herbicide, pesticide, or explosive results exceeded their respective USEPA RSLs (**Table 4.11**).

Two explosives were detected in the SVOC analytical run at concentrations above USEPA RSLs and were identified as COPCs. 2,4-dinitrotoluene (2,4-DNT), was detected with a maximum concentration of 14,000 µg/kg, and 2,6-DNT, with a maximum concentration of 700 µg/kg. Both exceedances were detected in one sample (TP45-2), which was collected at a location on top of OD Hill. Note that in the explosives analytical run (Method SW8330), 2,4-DNT and 2,6-DNT were detected at concentrations below the RSLs.

Metals in subsurface soil that exceeded their respective USEPA RSLs and were identified as COPCs include: aluminum, antimony, arsenic, cadmium, copper, cobalt, copper, iron, manganese, mercury, silver, and thallium (**Figures 4.8A** and **4.8B**). Cadmium, copper and mercury exceeded their respective NYSDEC SCOs (**Table 4.11**).

Ten subsurface soil samples and two duplicates were analyzed for the presence of perchlorate during the 2018 sampling effort. Perchlorate was detected in eight samples and one duplicate. The highest level of perchlorate detected was measured at 41 µg/kg from a sample 1.5 to 2.0 feet bgs in the OD Hill. This sample location (S45-ODG-SS-06) contained the highest concentration of perchlorate in both surface and subsurface soil samples (**Table 4.11**, **Figure 4.7**). All of the detections of perchlorate were at levels below the USEPA RSL Residential Soil (HQ=0.1) value of 5,500 µg/kg. The HHRA did not identify any COCs in subsurface soil (**Appendix B1**).

4.2.1.3 Chemicals of Potential Concern in Ditch Soil

Four ditch soil samples were collected during the ESI. Three of the samples were collected from the drainage ditches located downgradient of the OD Hill and the fourth sample was collected from a low-lying area northwest of the OD Hill. Water within these features is ephemeral and the features are not recognized surface water bodies by the NYSDEC. The material at the base of the drainage swales is site soil. The ditch soil samples collected during the ESI are located approximately 500 ft to 600 ft from the OD Hill, or within or close to the OD Hill. These samples were analyzed for VOCs, SVOCs, metals, PCBs, pesticides, herbicides and nitrate/nitrite nitrogen (**Appendix A-3**). VOCs and herbicides were not detected in the samples (**Table 4.12**). Several explosives, SVOCs, nitroaromatics, pesticides, and PCBs were detected at low concentrations and below applicable screening criteria. One PCB (Aroclor-1254) was identified as a COPC with one exceedance of the USEPA RSL.

A summary of the ditch soil analytical results from the ESI and a comparison to the USEPA RSLs is presented in **Table 4.12**. Aluminum, arsenic, cadmium, cobalt, copper, iron, manganese, mercury, and vanadium were detected at concentrations above their respective RSL values and were identified as COPCs. The ditch soils are grouped with surface soil results within the risk assessment because extensive RI data for the OB Grounds showed that all drainage ditches and Reeder Creek sediment (at the time) were consistent with levels of metals in all the soil data, including background levels.

Therefore, there is no distinction between ditch soils and surface soils. The HHRA did not identify any COCs in the ditch soil data (**Appendix B1**).

4.2.2 Chemicals of Potential Concern in Groundwater

There were two main groundwater events at the OD Grounds: the ESI in 1994, and June 2018 for perchlorate; one well at the OD Grounds (MW45-4, located west of the OD Hill), was sampled an additional three times between 1997 and 1999 as part of OB Grounds groundwater investigations (**Appendix A-4**). Water quality screening criteria used for comparison in this FS report are USEPA RSLs for tap water, based on a noncarcinogenic HQ of 0.1. Groundwater results were also compared against NY Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations (6 CRR-NY 703.5; June 2018) (NYSDEC, 2018b). A consolidated summary of groundwater exceedances from these reports is presented in **Table 4.13**.

The groundwater data were presented in the 1995 ESI, and the evaluation in the ESI did not suggest impacts from MC/COPCs on the groundwater within the OD Grounds. Concentrations of VOCs, herbicides, pesticides, and PCBs were below the groundwater screening values. Two explosives were detected in the groundwater one time each. Both explosives (1,3-Dinitrobenzene and Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine [HMX]) were detected below their respective groundwater criteria (**Table 4.13**).

One SVOC [Bis(2-Ethylhexyl)phthalate] was detected in four groundwater samples at concentrations above its RSL and it was identified as a COPC; however, this is a common laboratory contaminant associated with plastics. Ten metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium [exceedance of NYS GA and USEPA chromium VI values], cobalt, copper, lead, manganese, mercury, nickel, sodium [exceedance of NYS GA], thallium, and vanadium) were found in one or more the groundwater samples at concentrations above the screening values. Except for iron and sodium, all of these compounds were identified as COPCs in the HHRA. Calcium, iron, magnesium, potassium, and sodium were not evaluated in the HHRA because they are essential nutrients and are generally not expected to pose an unacceptable risk to human receptors.

Nine groundwater samples and one duplicate were analyzed during the perchlorate sampling event in 2018. Perchlorate was detected in eight samples and one duplicate, with a maximum concentration of 4.1 micrograms per liter (µg/L) (MW45-3) (**Figure 4.7**). Two of the wells contained perchlorate levels above the guidance value of 1.4 µg/L identified in the perchlorate Work Plan (Parsons, 2018). The wells that contained exceedances of perchlorate included MW45-2 and MW45-3 and were both located east of the OD Hill. A summary of perchlorate levels in groundwater samples are presented in **Table 4.14** and **Appendix A-4**.

No COCs were identified after analysis of the groundwater data in the HHRA.

Table 4.13
Summary of Groundwater Data
Compilation Report - OD Grounds
Seneca Army Depot Activity

Parameter	Unit	Maximum Value	Criteria Source[1]	Criteria Level	Number of Exceedances	Number of Times Detected	Number of Samples Analyzed
Volatile Organic Compounds							
Tetrachloroethene	µG/L	1	GA	5	0	1	8
Semivolatile Organic Compounds							
Bis(2-Ethylhexyl)phthalate	µG/L	33	GA	5	4	4	8
Explosives							
1,3-Dinitrobenzene	µG/L	0.067	GA	5	0	1	8
HMX	µG/L	0.5				1	8
Inorganics							
Aluminum	µG/L	63,300				9	12
Antimony	µG/L	52.1	GA	3	7	7	12
Arsenic	µG/L	9.5	MCL	10	0	3	12
Barium	µG/L	751	GA	1,000	0	12	12
Beryllium	µG/L	5	MCL	4	1	3	12
Cadmium	µG/L	3.8	GA	5	0	4	12
Calcium	µG/L	660,000				12	12
Chromium	µG/L	106	GA	50	1	5	12
Cobalt	µG/L	94.4				4	12
Copper	µG/L	123	GA	200	0	7	12
Iron	µG/L	113,000	GA	300	5	10	12
Iron+Manganese	µG/L	117,640	GA	500	6	12	12
Lead	µG/L	75.6	MCL	15	2	8	12
Magnesium	µG/L	77,900				12	12
Manganese	µG/L	4,640	GA	300	4	12	12
Mercury	µG/L	1.8	GA	0.7	1	3	12
Nickel	µG/L	209	GA	100	1	5	12
Potassium	µG/L	18,700				9	12
Selenium	µG/L	2.5	GA	10	0	5	12
Silver	µG/L	4.6	GA	50	0	2	12
Sodium	µG/L	40,000	GA	20,000	1	12	12
Thallium	µG/L	3.4	MCL	2	1	1	12
Vanadium	µG/L	93.1				3	12
Zinc	µG/L	321				12	12

Notes:
1) Criteria action levels include the values from the NYS GA Standard and EPA MCL.

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Table 4.14
Summary of Groundwater Perchlorate Data
Compilation Report - OD Grounds Seneca
Army Depot Activity

Parameter	CAS Number	Maximum Detected Concentration Detection (µg/L)	Number of samples with Detected Concentrations	Total Number of Samples	Frequency of Detection	Regional Screening Levels (RSL) [(1)] (mg/kg)	Number of Detected Samples Greater than RSL
Perchlorate	14797-73-0	4.1	9	10	90%	1.4	3

[(1)] USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites (TR = 1E-06; THQ = 0.1), May 2018 . Available at: https://semspub.epa.gov/work/HQ/197235.pdf.

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4.2.3 Chemicals of Potential Concern in Surface Water

During the ESI, four surface water samples were collected from the drainage ditches within the OD Grounds. These four samples were collocated with the ditch soil samples described above. Three of the surface water samples were collected from drainage ditches located downgradient of the OD Hill and the fourth sample was collected from a low-lying area northwest of the OD Hill. The surface water samples were collected from drainage swales that were typically dry and the water sampled likely represented surface runoff from a recent precipitation event, rather than site surface water. The four surface water samples collected were from ephemeral drainage ditches and a low-lying swale. These on-site surface water pools are not classified by NYSDEC as surface water bodies and therefore NYS surface water criteria do not apply but are provided for reference. Sample results were compared against USEPA RSLs for Tap Water as well as NYS Class D surface water criteria (**Appendix A-5.1**) (USEPA, 2018; NYSDEC, 2018b). Surface water data from the ESI is summarized in **Table 4.15**.

No VOC, SVOC, pesticide, PCB, herbicide compounds were detected in the samples collected. Fourteen metals (aluminum, arsenic, barium, cadmium, cobalt, copper, cyanide, iron, lead, manganese, mercury, nickel, vanadium, and zinc) were detected at concentrations above the associated criteria values and were identified as COPCs. In addition, nitroaromatic compounds were detected in two of the surface water samples collected. One detection of RDX exceeded the USEPA RSL and was identified as a COPC. No COCs were identified in the onsite surface water during analysis in the HHRA (**Appendix B1**).

During the 1994 OB Grounds RI, surface water sampling was conducted within Reeder Creek (Parsons, 1994). Reeder Creek is a recognized surface water body and therefore NYS Class C criteria would apply to human and ecological receptors (NYSDEC, 2018b). Surface water samples were collected from Reeder Creek up- and down-gradient of the OB Grounds (**Appendix A-5.2**). Reeder Creek serves as drainage for much of the OD Grounds; therefore, these samples were downgradient of various portions of the OD Grounds. Results from Reeder Creek were compared to USEPA RSLs for Tap Water as well as NYS Class C surface water criteria (**Appendix A-5.2**) (USEPA, 2018; NYSDEC, 2018b). COPCs identified in the Reeder Creek surface water include: one VOC (1,2-dichloroethane), one explosive (RDX) and nine metals (aluminum, arsenic, barium, beryllium, cyanide, lead, manganese, mercury, vanadium). Surface water data from the sampling conducted at Reeder Creek is summarized in **Table 4.16**.

4.2.4 Chemicals of Potential Concern in Sediment

In conjunction with surface water samples collected during the OB Grounds RI, collocated sediment samples were collected from within Reeder Creek (**Figure 3.6**) (Parsons, 1994). Arsenic, copper, lead, manganese, mercury, nickel and zinc exceeded NY Sediment Criteria values. These exceedances were for a "to be considered" (TBC), therefore sediment was retained as a medium of interest in the OB Grounds FS. As part of the OB Grounds remedial action, impacted sediment was excavated and removed from the creek. Since the removal of sediment, the inspections of Reeder Creek have found minimal sediment in various sections. Recent inspections of Reeder Creek observed that the streambed contained exposed bedrock and fractured shale pieces and thin organic/sediment layers which appear to be from decomposition of fallen leaves and the migration of tree material stockpiles by beavers in previous seasons and not the result of active erosion of the site soil and soil transport (Parsons, 2017). Evidence for excessive erosion into the creek was not found. Monitoring at OB Grounds suggests no visual impacts to Reeder Creek.

Table 4.15
Summary of Surface Water Data
Compilation Report - OD Grounds
Seneca Army Depot Activity

Parameter	Unit	Maximum Value	Criteria Level[1]	Number of Exceedances	Number of Times Detected	Number of Samples Analyzed
Explosives						
HMX	UG/L	0.49			2	4
RDX	UG/L	2			2	4
Inorganics						
Aluminum	UG/L	37,500		0	4	4
Arsenic	UG/L	2.3	360	0	1	4
Barium	UG/L	439			4	4
Beryllium	UG/L	1.5		0	2	4
Cadmium	UG/L	11.2		0	1	4
Calcium	UG/L	194,000			4	4
Chromium	UG/L	50.8	4270	0	3	4
Cobalt	UG/L	18.2		0	2	4
Copper	UG/L	612	50	3	4	4
Cyanide	UG/L	47.7	22	1	1	4
Iron	UG/L	60,400	300	4	4	4
Lead	UG/L	68.7	330	0	4	4
Magnesium	UG/L	24,300			4	4
Manganese	UG/L	1,250			4	4
Mercury	UG/L	3			4	4
Nickel	UG/L	74.2	4250	0	4	4
Potassium	UG/L	9,670			4	4
Sodium	UG/L	4,340			4	4
Vanadium	UG/L	54.9	190	0	3	4
Zinc	UG/L	883	800	1	4	4

Notes:
1) Criteria source are the NYS AWQS Class D Values.

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Table 4.16
Summary of Reeder Creek Surface Water Data
Feasibility Study Report - OD Grounds
Seneca Army Depot Activity

Parameter	Unit	Maximum Detected Value	Qualifier	Location ID of Maximum Detect	Number of Times Detected	Number of Samples Analyzed	NYS CLASS C (HUMAN HEALTH)[1] Criteria Level	NYS CLASS C (HUMAN HEALTH)[1] Number of Exceedances	NYS CLASS C (AQUATIC)[1] Criteria Level	NYS CLASS C (AQUATIC)[1] Number of Exceedances	2018-05 RSL Tap Water (HQ=0.1)[2] Criteria Level	2018-05 RSL Tap Water (HQ=0.1)[2] Number of Exceedances
Volatile Organic Compounds												
1,2-Dichloroethane	UG/L	2	J	SW-140	1	9	NA	0	NA	0	0.17	1
Methylene chloride	UG/L	8	J	SW-300	1	9	200	0	NA	0	11	0
Explosives (No Detects)												
Semivolatile Organic Compounds (No Detects)												
Inorganics												
Aluminum	UG/L	402	J	SW-120	2	7	NA	0	100	2	2,000	0
Barium	UG/L	114.6	J	SW-120	8	9	NA	0	NA	0	380	0
Beryllium	UG/L	4.9	J	SW-120	1	9	NA	0	11	0	2.5	1
Calcium	UG/L	210,000	J	SW-120	9	9	NA	0	NA	0	NA	0
Cyanide	UG/L	14.9		SW-300	2	9	NA	0	NA	0	0.15	2
Iron	UG/L	1,474		SW-150	6	6	NA	0	NA	0	1,400	1
Lead	UG/L	2.2	J	SW-150	1	9	NA	0	NA	0	15	0
Magnesium	UG/L	31,000	J	SW-120	9	9	NA	0	NA	0	NA	0
Manganese	UG/L	466		SW-150	8	8	NA	0	NA	0	43	5
Mercury	UG/L	0.19	J	SW-150	1	9	0.0007	1	0.77	0	0.063	1
Potassium	UG/L	6,270	J	SW-150	6	6	NA	0	NA	0	NA	0
Selenium	UG/L	1.6	J	SW-310	3	9	NA	0	4.6	0	10	0
Sodium	UG/L	59,100	J	SW-196	8	9	NA	0	NA	0	NA	0
Vanadium	UG/L	39.2	J	SW-196	1	9	NA	0	14	1	8.6	1
Zinc	UG/L	13.4	J	SW-196	1	5	NA	0	NA	0	600	0

Notes:
1) Criteria values are the NYS Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations (6 CRR-NY 703.5; June 2018).
2) Criteria values are the USEPA RSLs for Tap Water (HQ=0.1) from the USEPAs Regional Screening Levels - May 2018.
3) Number of analyses is the number of detected and non-detected results excluding rejected results. Sample duplicate pairs were not averaged.

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4.3 FATE AND TRANSPORT MUNITIONS CONSTITUENTS/ CONTAMINANTS OF POTENTIAL CONCERN

This section presents an overview of the fate and transport characteristics for site contaminants that may have an impact on the applicable matrix at the OD Grounds. COPCs may be selected because of their intrinsic toxicological properties, because they are present in large quantities, or because they are presently in or potentially may move into critical exposure pathways (e.g., drinking water supply) (USEPA, 1988). MEC is also identified as a contaminant to be addressed at the site because of the associated explosive hazards.

Understanding the fate of the MEC and MC/COPCs potentially present in, or released to, the environment is important to evaluate the potential hazards or risks posed by those contaminants to human health and/or the environment. For example, MEC may be found on the ground surface or below grade; however, it is possible for natural processes (e.g., erosion) to result in the movement, relocation, or unearthing of the MEC, thereby increasing the chance of its subsequent exposure to human receptors. Furthermore, COPCs may have been released to the environment during operational activities, or they might remain inside intact munitions and be released to the environment subsequently as those munitions degrade.

The following paragraphs discuss potential migration processes for, the persistence of, and the potential migration routes of MEC/MD and MC/COPCs.

Many different environmental processes act upon MC, which may influence or alter their availability to interact with receptors. These processes depend on the media in which the source (MEC or MD) exists and the exposure of MC/COPCs to the processes. These processes work through the different media: air, soil, surface water, groundwater, or biota. The following are short descriptions of these processes as described in Hewitt, et al. (2003).

- **Advection** – the passive movement of a solute with flowing water.
- **Dispersion** – the observed spreading of a solute plume, generally attributed to hydrodynamic dispersion and molecular diffusion.
- **Adsorption/desorption** – the process by which dissolved, chemical species accumulate (adsorption) at an interface or are released from the interface (desorption) into solution.
- **Diffusion** – the migration of solute molecules from regions of higher concentration to regions of lower concentration.
- **Biotic transformation** – the modification of a chemical substance in the environment by a biological mechanism.
- **Oxidation/reduction** – reactions in which electron(s) are transferred between reactants.
- **Covalent binding** – the formation of chemical bonds with specific functional groups in soil organic solids.
- **Polymerization** – the process by which the molecules of a discrete compound combine to form larger molecules with a molecular weight greater than that of the original compound, resulting in a molecule with repeated structural units.
- **Photolysis** – the chemical alteration of a compound due to the direct or indirect effects of light energy.
- **Infiltration** – the process by which water enters the soil at the ground surface and moves into deeper horizons.

- **Evapotranspiration** – the collective processes of evaporation of water from water bodies, soil and plant surfaces, and the transport of water through plants to the atmosphere.
- **Plant root uptake** – the transport of chemicals into plants through the roots.
- **Sedimentation** - The removal from the water column of suspended particles by gravitational settling.

4.3.1 Metals Transport from Soil to Water

In order to quantify the potential transport of metals COPCs from soil to groundwater, eight samples were selected for leachability determinations using the SPLP (USEPA SW-846 Method 1312) in combination with USEPA SW-846 Method 6010 and 7471, as appropriate for the RCRA eight metals (i.e., arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) and other metals of interest (e.g., antimony, cobalt, copper, vanadium, and zinc). The SPLP method was implemented in an effort to determine the ability of a material in the soil to potentially impact the groundwater or surface water, and, therefore, is relevant to the discussion of fate and transport. These samples were representative of the conditions within a 500-foot distance from the center of the OD Hill. The results of these analyses are presented in **Appendix A-6**. Total metal analysis results presented were compared to the USEPA RSLs for residential soils and NYS Commercial SCO values, while the SPLP results are compared to NYS GA Groundwater Effluent values. A detailed evaluation of the data is provided in the Completion Report for Additional MRS Investigation at Seneca Army Depot (Parsons, 2010).

A review of the data indicates that all of the metals detected show some potential to leach to groundwater. While metals can be described by a range of mobilities, their transport abilities can generally be characterized by the same underlying principles. The mobility of metals within a soil system is primarily associated with the movement of water through that system. This mobility is affected by the solubility of the metal and its compounds, as well as chemical parameters affecting the oxidation state of the metal in solution. Metals associated with the aqueous phase of soil are subject to movement with soil, water, and may be transported through the vadose zone to groundwater. However, the rate of migration of the metal usually does not equal the rate of water movement through the soil due to fixation and adsorption reactions (Dragun, 1988). Metals, unlike organic compounds, cannot be degraded (McLean and Bledsoe, 1992). Metals become immobile due to mechanisms of adsorption and precipitation. Metal-soil interactions are such that when metals are introduced at the soil surface, downward transportation does not occur to any great extent unless the metal retention capacity of the soil is overloaded, or metal interaction with the associated waste matrix enhances mobility.

4.3.2 Munitions and Explosives of Concern (UXO/DMM)

The primary natural process that can result in the migration or exposure of MEC items that might be present at the OD Grounds is erosion. Natural erosion of soil over time by the wind or by water (surface water or precipitation) can result in the exposure of MEC below grade by the removal of the overlying soil. In some cases, if soil is unstable and the erosive force is sufficient to act on items(s) the size of the MEC present, this process can result in the movement of MEC from its original position to another location (typically somewhere downstream of the wash). This is not anticipated to be the case at the OD Grounds as there has been no visual indication of this occurring on-site.

4.4 HUMAN HEALTH RISK ASSESSMENT

A HHRA and a HHRA Supplement were conducted for the OD Grounds and is presented as an appendix to this FS in **Appendix B1**. The objectives of the risk assessments were to:

- Assess the OD Grounds conditions for protectiveness of human health and the environment;
- Determine whether additional response actions are necessary at OD Grounds;
- Identify COPCs and provide a basis for determining levels of COPCs that are adequately protective of human health and the environment; and
- Provide a basis for comparing potential health impacts of various remedial alternatives and evaluate selection of the No-Action remedial alternative, where appropriate.
- Evaluate the potential for human health effects as a result of potential exposures to perchlorate in soil and groundwater at the OD Grounds.

To meet these objectives, the risk assessments generally follow USEPA guidance [the Risk Assessment Guidance for Superfund (RAGS) series of guidance documents] and incorporates exposure scenarios and assumptions that are appropriate for current and anticipated future land use at this site (USEPA, 1989). The HHRA provides an evaluation of the potential risks to human health posed by constituents detected in surface soil, combined surface and subsurface soil, groundwater and surface water associated with the OD Grounds at SEDA.

This risk assessment divides the OD Grounds into two areas for assessment purposes based on differing potential risk observed during previous investigations. The density of potential MEC is highest at the center of the OD Grounds, in the vicinity of the OD Hill where the demolition activities took place and areas in the immediate vicinity that received most of the "kickouts" from those activities. This area is referred to as the "OD Hill" in this risk assessment. The second area includes areas further away from the OD Hill that received kickouts, but in lower densities. This second assessment area is referred to as the "Kickout Area".

4.4.1 Baseline Human Health Risk Assessment

A conceptual site model (CSM) is used to qualitatively define the type of potential exposures to contaminants at or migrating from a site (i.e., to systematically evaluate the effect of chemicals in relevant media on potential receptors). The CSM is used to summarize existing site characterization data, including assumptions about land and groundwater use, and to complete the qualitative exposure pathway assessment. An exposure pathway evaluation describes how a receptor could be exposed to COPCs at, or migrating from, a site. The site-specific CSM for potential human exposures is depicted in **Figure 4.9A** (OD Hill) and **Figure 4.9B** (Kickout Area). In accordance with the site-specific CSM, risk was quantitatively or qualitatively evaluated for the following potential human exposure scenarios to contaminants found within the OD Hill and Kickout Area:

- Exposure of hypothetical future residents;
- Exposure of hypothetical future excavation / construction workers;
- Exposure of future park workers; and
- Exposure of current and future recreational users.

Exposure scenarios selected for evaluation are anticipated to account for the range of reasonably anticipated exposures under current and future conditions at SEDA. The exposure assumptions used for estimating constituent intake are presented in **Appendix B**, Table 2.6 (soil), Table 2.7 (groundwater), and Table 2.8 (surface water). There are no complete exposure pathways for sediment.

The exposure areas evaluated in this risk assessment were defined considering the results of the source area investigation and activity patterns of the potential receptors being evaluated in the HHRA. For evaluation of soil, the OD Hill and the Kickout Area were evaluated as separate exposure areas. All groundwater wells were located within the OD Hill area or the OB Grounds. Groundwater evaluation was conducted on a combined data set, including data from all wells, as well as data from each well individually. For surface water, three exposure areas were evaluated, the on-site drainage ditches at the OD Hill, the portion of Reeder Creek upstream of the Kickout Area, and the portion of Reeder Creek that passes through the Kickout Area and all downstream locations. Once Reeder Creek enters the Kickout Area, all locations downstream from that point are potentially affected by munitions activities at the OD Grounds and considered together.

Exposure point concentrations are the concentrations of chemicals in a given medium to which a receptor may be exposed at a specific location known as the 'exposure point'. Each groundwater sampling location was considered an exposure point. Therefore, a groundwater exposure point concentration (EPC) was identified as the maximum detected concentration of each COPC in each well. Surface water EPCs were the maximum detected concentration of each COPC. Risk for each surface water exposure area was estimated using the maximum detected concentration from each area. For receptors potentially exposed to soil, an EPC was calculated for soil intervals 0 - < 2 feet bgs and 0 - ≤ 15 feet bgs. EPCs were calculated for each soil COPC using the USEPA's statistical program ProUCL, version 5.0.00 (USEPA, 2013).

Cumulative carcinogenic risks and noncarcinogenic hazards estimated for the four receptor groups at the site are shown in **Exhibit 1.5-1**. The cumulative risk/hazard estimates described below include chromium(III). The cumulative risk/hazard estimates that include chromium(VI) show similar patterns (**Exhibit 1.5-2**). Chromium(VI) is not expected to be present at the site based on past munitions-related activities and is not summarized below.

4.4 HUMAN HEALTH RISK ASSESSMENT

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EXHIBIT 1.5-1
HUMAN HEALTH QUANTITATIVE CUMULATIVE RISK SUMMARY FOR ALL MEDIA
SENECA ARMY DEPOT ACTIVITY

ALL COPCS INCLUDING CHROMIUM(III)

RECEPTOR AND MEDIUM	EXPOSURE PATHWAYS	TOTAL CARCINOGENIC RISK (1)	CARCINOGENIC RISK DRIVERS (4)	TOTAL HAZARD INDEX - CHILD (1)	NON-CARCINOGENIC RISK DRIVERS (CHILD) (4)	TOTAL HAZARD INDEX - ADULT (1)	NON-CARCINOGENIC RISK DRIVERS (ADULT) (4)
Receptor: Hypothetical Future Resident							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	2.8E-05	--	5.8	Aroclor-1254 31% Cadmium 30%	0.60	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	5.8E-05	--	5.3	Aroclor-1254 33% Cadmium 25%	0.55	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	1.8E-04	Arsenic 100%	51	Cobalt 31% Manganese 21% Thallium 33%	30	Cobalt 31% Manganese 22% Thallium 33%
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	6.7E-07	--	3.0	MCPA 10% Cobalt 63%	0.32	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	4.6E-07	--	0.63	--	0.22	--
Receptor: Hypothetical Future Excavation/ Construction Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	8.2E-08	--	--	--	0.14	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	6.3E-08	--	--	--	0.046	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	1.9E-08	--	--	--	0.13	--
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	1.6E-08	--	--	--	0.025	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	1.5E-09	--	--	--	0.032	--
Receptor: Future Park Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	5.6E-06	--	--	--	0.37	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	9.8E-05	--	--	--	19	Cobalt 32% Manganese 20% Thallium 34%
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	2.9E-06	--	--	--	0.19	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	1.0E-07	--	--	--	0.026	--
Receptor: Current and Future Recreational User							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	1.8E-06	--	0.39	--	0.039	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	1.3E-05	--	3.4	Cobalt 32% Manganese 20% Thallium 35%	2.0	Cobalt 32% Manganese 20% Thallium 34%
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	1.0E-06	--	0.000017	--	0.0000016	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	6.3E-08	--	0.086	--	0.030	--

EXHIBIT 1.5-2
HUMAN HEALTH QUANTITATIVE CUMULATIVE RISK SUMMARY FOR ALL MEDIA
SENECA ARMY DEPOT ACTIVITY

ALL COPCS INCLUDING CHROMIUM(VI)

RECEPTOR AND MEDIUM	EXPOSURE PATHWAYS	TOTAL CARCINOGENIC RISK [1]	CARCINOGENIC RISK DRIVERS [4]	TOTAL HAZARD INDEX - CHILD [1]	NON-CARCINOGENIC RISK DRIVERS (CHILD) [4]	TOTAL HAZARD INDEX - ADULT [1]	NON-CARCINOGENIC RISK DRIVERS (ADULT) [4]
Receptor: Hypothetical Future Resident							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	6.5E-05	--	6.0	Aroclor-1254 29% Cadmium 29%	0.62	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	9.1E-05	--	5.5	Aroclor-1254 32% Cadmium 24%	0.57	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	1.2E-03	Arsenic 16%	54	Cobalt 30% Manganese 20% Thallium 32%	32	Cobalt 30% Manganese 21% Thallium 32%
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	2.2E-05	--	3.1	MCPA 10% Cobalt 57% Manganese 12%	0.33	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	7.5E-05	--	0.87	--	0.32	--
Receptor: Hypothetical Future Excavation/ Construction Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	2.1E-07	--	--	--	0.15	--
Combined Surface and Subsurface Soil (0 - ≤ 15 feet bgs)	Ingestion, Dermal Contact, Inhalation	9.7E-08	--	--	--	0.048	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	5.1E-07	--	--	--	0.15	--
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	4E-08	--	--	--	0.026	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	2.6E-07	--	--	--	0.043	--
Receptor: Future Park Worker							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	1.3E-05	--	--	--	0.39	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	5.0E-04	Arsenic 20%	--	--	20	Cobalt 31% Manganese 19% Thallium 33%
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	7.0E-06	--	--	--	0.20	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	1.6E-06	--	--	--	0.0289	--
Receptor: Current and Future Recreational User							
Surface Soil (0 - ≤ 2 feet bgs) - OD Hill	Ingestion, Dermal Contact, Inhalation	4.4E-06	--	0.41	--	0.041	--
Groundwater - MW 45-4 (2)	Ingestion, Dermal Contact	6.3E-05	--	3.6	Cobalt 31% Manganese 19% Thallium 34%	2.1	Cobalt 31% Manganese 19% Thallium 33%
Surface Soil (0 - ≤ 2 feet bgs) - Kickout Area	Ingestion, Dermal Contact, Inhalation	2.5E-06	--	0.0083	--	0.00080	--
Surface Water - On site drainage ditches (3)	Ingestion, Dermal Contact	1.0E-05	--	0.120	--	0.0437	--

(1) Cancer Risks and Hazard Indices were calculated by summing across exposure routes for each receptor.
(2) The greatest risk associated with groundwater is from MW 45-4. For a summary of risk associated with individual wells, see **Appendix B-1**, Table 2.59.
(3) The surface water most likely to be encountered at the site is from the drainage ditches onsite. For a summary of risk associated with other surface water bodies, see **Appendix B-1**, Table 2.79.
(4) Percent contribution was calculated by dividing the cancer risk or hazard index of each COPC by the total risk or total HI. COPCs with less than 10% contribution are not shown.
-- = Cumulative Hazard not calculated for a child for this receptor.

4.4.2 Human Health Risk Summary

Hypothetical future resident exposed to surface soil, combined surface and subsurface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 2×10^{-4} (groundwater in MW45-4) to 7×10^{-7} (surface soil in Kickout Area). The highest cumulative carcinogenic risk, which is outside USEPA's acceptable carcinogenic risk range of 1×10^{-4} to 1×10^{-6}, is due to exposure to groundwater as potable water in the center of the OD Hill.
- Cumulative noncarcinogenic hazards for a child range from 0.6 (surface water) to 51 (groundwater in MW45-4). The highest cumulative hazard index (HI) greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill.
- Cumulative noncarcinogenic hazards for an adult range from 0.2 (surface water) to 30 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill.
- There were no estimated noncarcinogenic hazards greater than the target Hazard Quotients (HQ) of 1, indicating that there was no unacceptable hazard associated with exposure to perchlorate at the OD Grounds.

Hypothetical construction workers exposed to surface soil, combined surface and subsurface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 2×10^{-8} (surface soil in Kickout Area) to 2×10^{-9} (surface water onsite). All carcinogenic risks are less than USEPA's acceptable carcinogenic risk range of 1×10^{-4} to 1×10^{-6}.
- Cumulative noncarcinogenic hazards for an adult range from 0.03 (surface soil in Kickout Area) to 0.1 (surface soil in OD Hill). All noncarcinogenic hazard HIs are less than 1.
- Perchlorate was not detected in soil at concentrations greater than the screening level. Therefore, perchlorate is not expected to result in an unacceptable hazard to receptors at the OD Grounds.

Future park workers exposed to surface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 1×10^{-4} (groundwater in MW45-4) to 1×10^{-7} (surface water onsite). All carcinogenic risks are within or less than USEPA's acceptable carcinogenic risk range of 1×10^{-4} to 1×10^{-6}.
- The cumulative noncarcinogenic hazards for an adult range from 0.03 (surface water onsite) to 19 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill.

Current and future recreational users exposed to surface soil, groundwater as potable water, and surface water:

- Cumulative carcinogenic risks range from 1×10^{-5} (groundwater in MW45-4) to 6×10^{-8} (surface water onsite). All carcinogenic risks are within or less than USEPA's acceptable carcinogenic risk range of 1×10^{-4} to 1×10^{-6}.
- Cumulative noncarcinogenic hazards for a child range from 0.09 (surface water onsite) to 3 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill.

- Cumulative noncarcinogenic hazards for an adult range from 0.03 (surface water) to 2 (groundwater in MW45-4). The highest cumulative HI greater than 1 is due to exposure to groundwater as potable water in the center of the OD Hill.

Based on the conclusions of the risk assessment, there is an unacceptable noncarcinogenic hazard to the hypothetical child resident associated with exposure to soil at the OD Hill within the OD Grounds. This hazard is driven primarily by the concentrations of Aroclor-1254 and cadmium found in soil. Each of these analytes has an HQ greater than 1, indicating a potential hazard. The conclusions of the risk assessment also indicate there is an unacceptable noncarcinogenic hazard to the hypothetical child resident associated with exposure to soil at the Kickout Area within the OD Grounds. This hazard is driven by the concentrations of cobalt found in soil. Cobalt has an HQ greater than 1, indicating a potential hazard.

Groundwater at the site presents both a carcinogenic risk and noncarcinogenic hazard to hypothetical future residents, future park workers, and current and future recreational users who might use groundwater as a source of potable water. Carcinogenic risk associated with exposure to groundwater is driven primarily by the observed concentrations of arsenic in the groundwater. Noncarcinogenic hazards are driven by the presence of aluminum, antimony, arsenic, chromium, cobalt, lead, manganese, thallium, and vanadium.

Uncertainties may result in overestimated current risks/hazards. Most notably, onsite groundwater currently is not used as a potable drinking water source, so the risk/hazard estimates herein may be overestimated. The estimated risks/hazards associated with potable groundwater would apply only if a well were installed for potable water. Further, there are no buildings currently onsite and there are no plans for development of the site in the future. Therefore, near- and long-term residential scenarios are hypothetical and conservative since there are no residential properties onsite currently and it is unlikely the site would be developed as residential property. Therefore, based on the exposure scenarios evaluated in this risk assessment, there are no unacceptable risks/hazards expected for any receptor as a result of exposure to soil, groundwater, or surface water based on current, or reasonably anticipated future land use. However, in the unlikely event that development of the site was to occur, exposure to surface and subsurface soil by residential receptors could result in an unacceptable risk. Similarly, in the unlikely event that groundwater at the site is developed as a potable water supply, an unacceptable risk is possible to residents, park workers, and recreational users that are exposed to groundwater as a drinking water supply.

4.5 BASELINE ECOLOGICAL RISK ASSESSMENT

A Baseline Ecological Risk Assessment (BERA) was conducted for the OD Grounds and is presented as **Appendix B2** in this FS. The objectives of the BERA were to:

- Assess the OD Grounds conditions for the potential for adverse effects on ecological receptors;
- Determine whether additional response actions are necessary at OD Grounds;
- Identify Chemicals of Potential Ecological Concern (COPECs) and provide a basis for determining levels of COPECs that are adequately protective of human health and the environment; and
- Provide a basis for comparing potential health impacts of various remedial alternatives, and evaluate selection of No-Action remedial alternative, where appropriate.

To meet these objectives, the BERA preparation followed Ecological Risk Assessment Guidance for Superfund (ERAGS) methodology (USEPA 1992, 1997) and supplemental guidance (USEPA 2009, 2018). The initial phase of the ERAGS process is the screening of constituents that require further evaluation as a potential concern for exposure of ecological receptors. Subsequent elements of the ERAGS process characterize the potential ecological risk on biological communities.

4.5.1 Ecological Conceptual Site Model

The Ecological Conceptual Site Model (ECSM) is used to qualitatively define the type of potential exposures to contaminants at or migrating from a site (i.e., to systematically evaluate the effect of chemicals in relevant media on potential receptors). The ECSM describes onsite release points, affected physical media, types of contaminant transport that may be involved at the site, each group of potentially exposed populations or receptors, and how each receptor group may contact site-related contamination. The ECSM is also used to summarize existing site characterization data, and to select representative ecological receptors. The site-specific ECSM for potential exposure of ecological receptors in the OD Grounds is depicted in **Appendix B2, Figure 4**.

The primary pathways for exposure of organisms to on-site surface soil contamination are:

- Vegetation at the site may be exposed to soil contaminants through root contact, and some contaminants may be taken up into the plant tissues. Similarly, invertebrates potentially residing in contaminated soil would contact it and potentially incorporate these contaminants.
- Wildlife may be exposed to the COPECs at the site via the consumption of food items (e.g., plants, and invertebrates), and by incidental ingestion of soil.

Secondary possible routes for direct exposure, considered far less significant in terms of risk than dietary ingestion, are dermal contact exposure and exposure via inhalation. Potential ecological risks associated with these secondary pathways are not quantified in the BERA. Subsurface soil and groundwater were excluded as incomplete exposure routes for ecological receptors.

The only perennial surface water feature located within the OD Grounds is Reeder Creek, which flows north through the Kickout Area. Aquatic organism exposure along the stream segment is expected by direct contact and transfer along the food chain.

4.5.2 Wildlife Receptor Species

Representative ecological receptor species were used to assess potential ecological risk through the food/prey ingestion exposure pathway. Wildlife species from various trophic levels were selected as representative ecological receptors for the risk evaluation to help identify the potential for adverse effects on biological communities. When potential adverse effects are identified for a specific ecological receptor, a potential ecological risk can also be inferred for other wildlife species having similar diet composition and mobility. The following species, whose presence or potential habitat is found onsite or in the vicinity, were selected as representative ecological receptors:

- Short-tailed shrew (*Blarina brevicauda*), mammalian insectivore
- Song sparrow (*Melospiza melodia*), avian insectivore
- Deer mouse (*Peromyscus maniculatusi*), mammalian omnivore
- American robin (*Turdus migratorius*), avian omnivore
- White-tailed deer (*Odocoileus virginianus*), large mammalian herbivore

- Red fox (*Vulpes vulpes*), mammalian carnivore
- Red-tailed hawk (*Buteo jamaicensis*), avian carnivore

Small mammal populations likely to be present at the risk assessment area include mice, shrews, and other rodents. The short-tailed shrew is a carnivore and subsisting primarily on soil invertebrates. The shrew may be directly exposed to contaminants during burrowing activities and indirectly through prey. For this reason, the shrew was considered representative of maximum exposures and was used to evaluate potential risk for small carnivorous mammals. The song sparrow was also selected to evaluate insectivorous bird species.

The deer mouse was selected as the herbivorous mammalian receptor to account for potential contaminant uptake by plants. This species subsists almost entirely on vegetative matter. The white-tailed deer, whose population is managed at SEDA, was also evaluated as a large herbivore. Species at the top of the food web could be affected by bioaccumulative compounds present in prey captured on-site. The red fox and the red-tailed hawk were selected to evaluate carnivore species. Red-tailed hawk exposure is almost entirely through the food chain.

4.5.3 Characterization of Ecological Effects

The BERA provides an evaluation of the potential risks to ecological receptors posed by constituents detected in surface soil and surface water associated with the OD Grounds at SEDA. Assessment endpoints were identified for the risk evaluation. The assessment endpoints selected for the BERA evaluation are the unaffected or low potential for adverse effect on growth and reproduction of each type of ecological receptor (plant species, soil invertebrates, and wildlife species), as well as the overall maintenance of ecological community structure and function (aquatic organisms). Surrogate measuring endpoints in the ecological risk evaluation are the toxicity reference values (TRVs). Data on two types of test endpoints were used in evaluating the potential for adverse effects on wildlife ecological receptors:

- A no-observed adverse effect level (NOAEL) endpoint that reflects the highest exposure level that does not cause a statistically significant difference in effect compared to the test control organisms.
- The lowest-observable adverse effect level (LOAEL) endpoint that indicates the lowest exposure level shown to cause some adverse effect in a test species.

4.5.4 Ecological Risk Summary

This BERA was conducted to evaluate the potential for adverse effects on ecological receptors as a result of exposure to chemicals in surface soil at the OD Grounds and in surface water within the Reeder Creek segment adjacent to the site. A screening assessment was initially made to select COPECs in both exposure media for subsequent evaluation. No COPECs were identified for surface water on the basis of water quality standards and a comparison of data from the upstream and downstream segments of Reeder Creek along the OD Grounds.

In surface soil, most metals and ten organic compounds were screened as COPECs for evaluation of the potential for adverse effects on ecological receptors. Both a direct exposure and the exposure by dietary intake were evaluated. Surface soil exposure was evaluated separately for the OD Hill area and the Kickout Area. The ecological risk evaluation was based on Hazard Quotients (HQs) calculated as the quotient between an exposure point concentration (EPC) and a toxicity reference value (TRV) for either direct exposure or food ingestion.

OD Hill Area

The OD hill is made up of clay soil pushed onto the hill for noise control. The clay has little organic content and is not conducive to vegetative growth. Because of this, the OD Hill Area has a limited vegetative cover and relatively low-quality habitat. HQs for OD Hill are summarized in Tables 5.1, 5.2 and 5.3 in **Appendix B2**.

- A potential for adverse effects was not identified for exposure of the large herbivore and carnivore species to any of the metals or organic compounds evaluated as COPEC (NOAEL-based HQs less than 1).
- A minimum or no potential for adverse effects was also identified for exposure of the small herbivore and insectivore mammals to most metals and all organic compounds, and for exposure of the omnivore and insectivore avian species to six metals and eight of ten organic compounds evaluated as COPECs.
- For exposure to metals, NOAEL-based HQs higher than 1 but not exceeding the LOAEL-based threshold were limited to the exposure of mammalian and/or avian species antimony, cadmium, chromium, nickel, vanadium and zinc. In most cases, calculated exposure concentrations were only moderately above the no-effects reference values and are not likely to represent a significant risk for exposure of small foraging-range species when actual onsite bioavailability is taken into consideration.
- A potential for unacceptable ecological risks may be associated with COPECs that have exposure concentrations above a low-effects threshold (LOAEL-based HQs higher than 1). In the OD Hill area, those COPECs are copper for exposure of small mammals and copper, lead, mercury, bis(2-ethylhexyl)phthalate and di-n-butylphthalate for exposure of bird species. The risk for adverse effects for exposure to these two organic compounds may not be significant given their low frequency of detection and use of the maximum concentration to derive their dietary exposure values.

Kickout Area

An established herbaceous cover intermixed with wooded vegetation is present in the Kickout Area providing a more diversified wildlife habitat than the OD Hill where COPEC concentrations were also higher. HQs for the Kickout Area are summarized in Tables 5.4, 5.5 and 5.6 in **Appendix B2**.

- In terms of direct exposure of plants and invertebrates, a potential for adverse effects on ecological receptors was not identified for aluminum, antimony, cadmium, lead, selenium, silver, vanadium, bis(2-ethylhexyl)phthalate and RDX (HQs less than 1).
- Compounds with HQs moderately above one included barium, cobalt, copper, iron, manganese and zinc. Because HQ calculations assumed a 100% metals bioavailability, exposure concentrations are not likely indicative of adverse effects on plants or soil invertebrates.
- Relatively elevated HQs, higher than 10, were calculated only for direct exposure to mercury and endosulfan. Detected concentrations of mercury may have a potential for adverse effects on soil invertebrates. The extent and likelihood of adverse effects, however, are highly dependent on site-specific soil conditions that determine bioavailability such as pH, Redox potential, and the presence of binding compounds. Endosulfan, evaluated based on maximum

concentration, had a low detection frequency (25%) which make it unlikely for the pesticide to pose a significant risk to soil invertebrates throughout the Kickout Area.

- The potential dietary exposure of seven representative wildlife species to soil constituents in the Kickout Area was evaluated for sixteen metals and three detected organic compounds.
    - For all these COPECs, the calculated NOAEL-based HQs were less than 1 for exposure of the large herbivore receptor (white-tailed deer) and two carnivore species (red fox and red-tailed hawk).
    - NOAEL-based HQs were also less than 1 for exposure of the small herbivore and insectivore mammalian species to ten metals and three organic compounds and for exposure of omnivore and insectivore avian species to seven metals and endosulfan.
    - NOAEL-based HQs higher than 1 but not exceeding the LOAEL-based threshold were limited to the exposure of small mammalian and/or avian species antimony, cadmium, mercury, nickel, vanadium, zinc and the explosive compound RDX. In all cases, calculated exposure concentrations were only moderately above the no-effect reference values. Those COPECs are not likely to represent a significant risk to small foraging-range species when onsite bioavailability in soil is taken into consideration.
    - Copper, lead and bis(2-ethylhexyl)phthalate were the only COPECs with calculated dietary exposure concentrations marginally higher than the low-effect threshold for birds (LOAEL-based HQs of 1.1, 1.8 and 1.5, respectively). Exposure concentrations for those COPECs may indicate a potential for adverse effects on omnivore and insectivore avian receptors. The extent and likelihood of adverse effects is highly dependent on site-specific soil conditions that determine their bioavailability. For bis(2-ethylhexyl)phthalate, the potential for an unacceptable risk is likely not significant because of its low frequency of detection and use of the maximum concentration for EPC derivation.

CHAPTER 5
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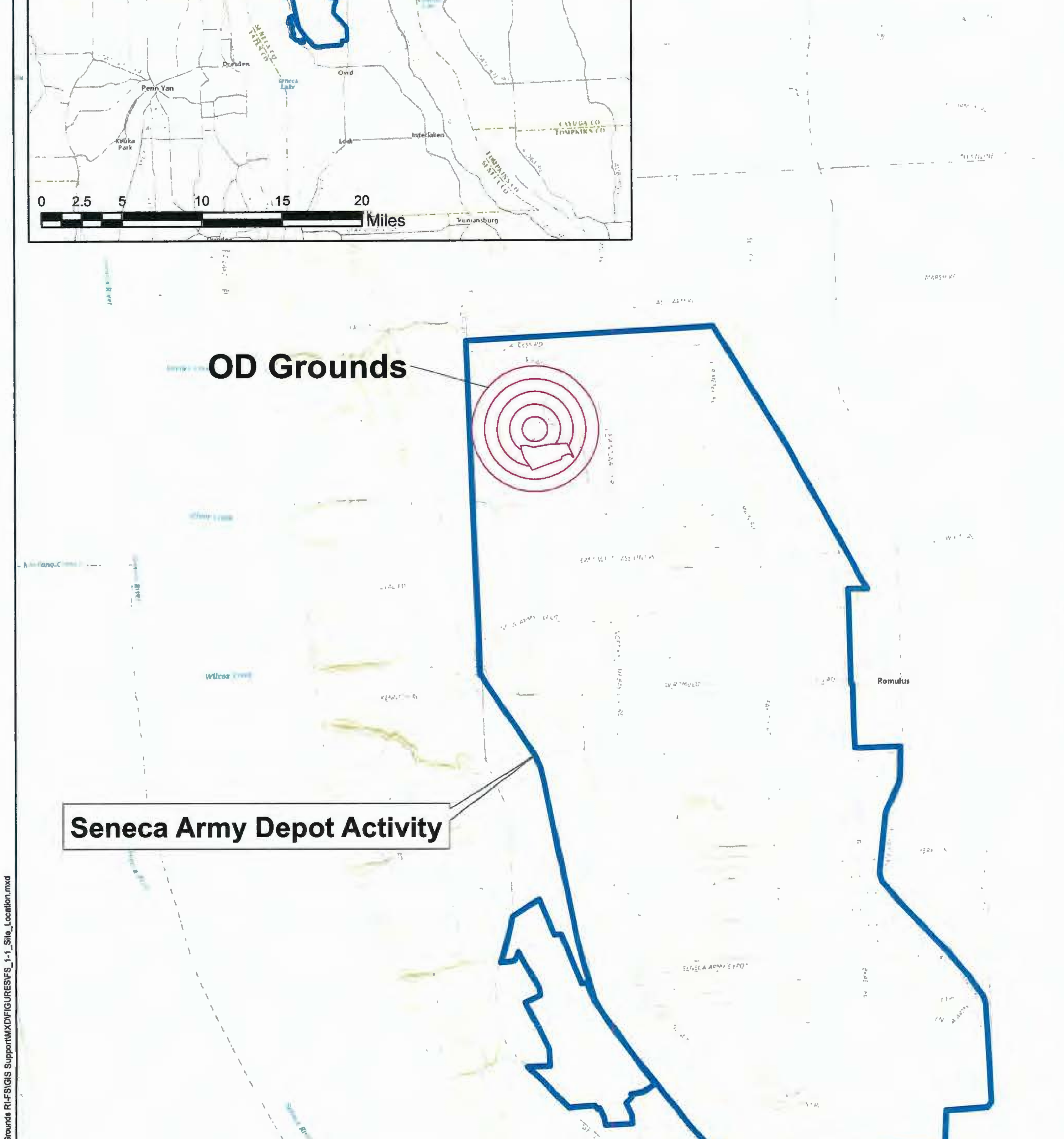
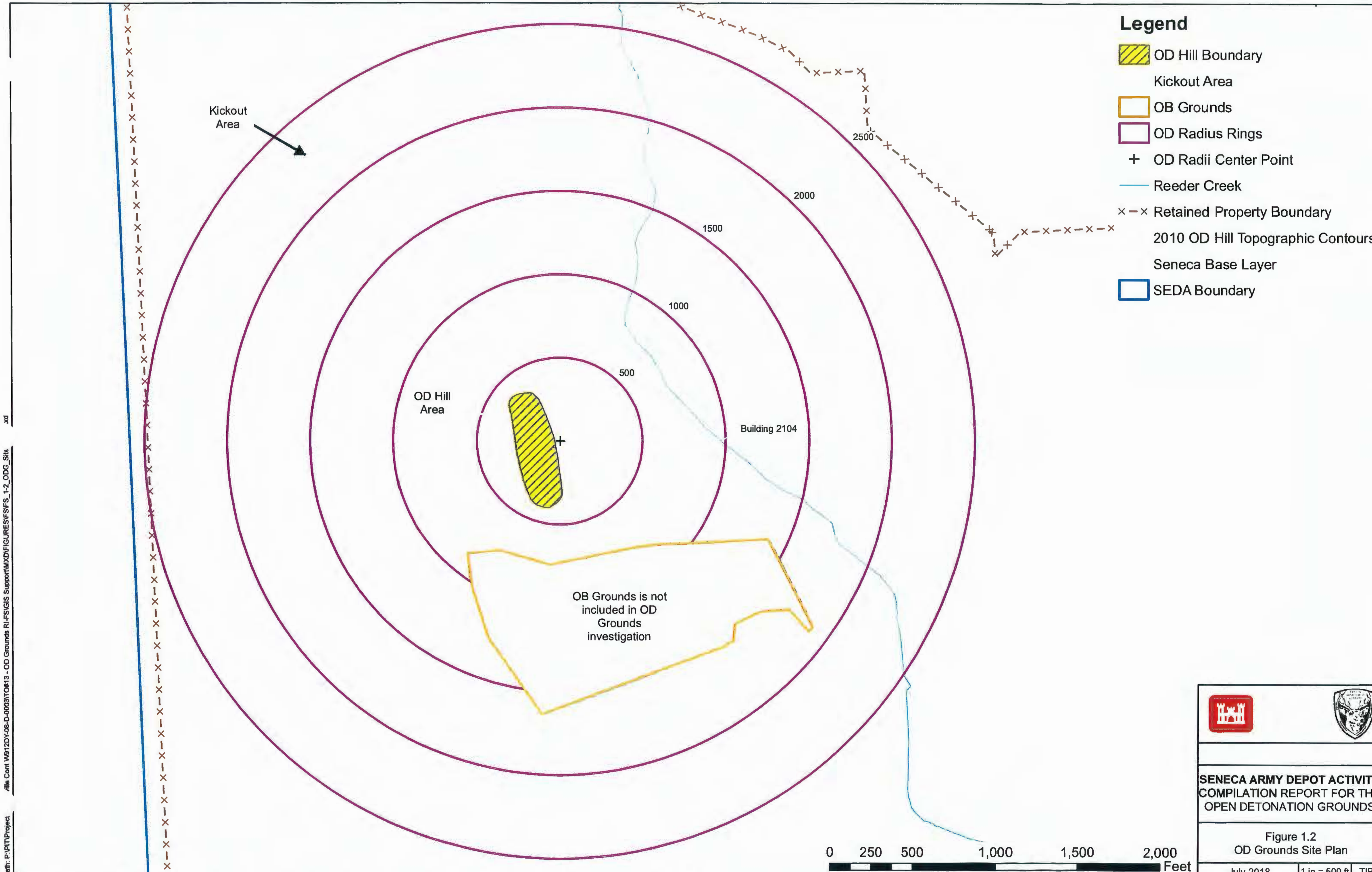


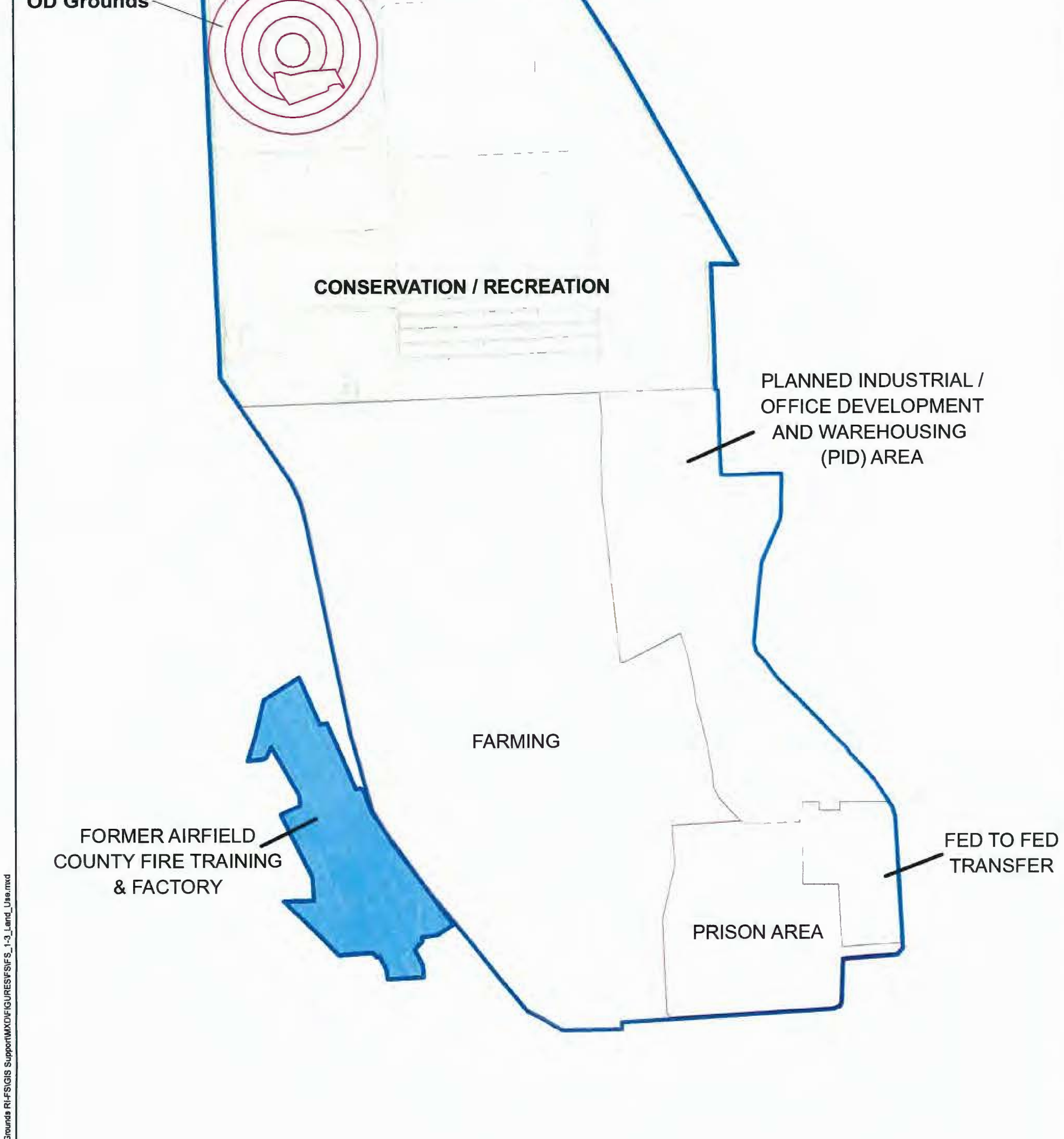
Grounds RI-FS\GIS Support\MXD\FIGURES\FS_1-1_Site_Location.mxd



SENECA ARMY DEPOT ACTIVITY
COMPILATION REPORT FOR THE OPEN DETONATION GROUNDS

Figure 1.2
OD Grounds Site Plan

July 2018 | 1 in = 500 ft | TIB



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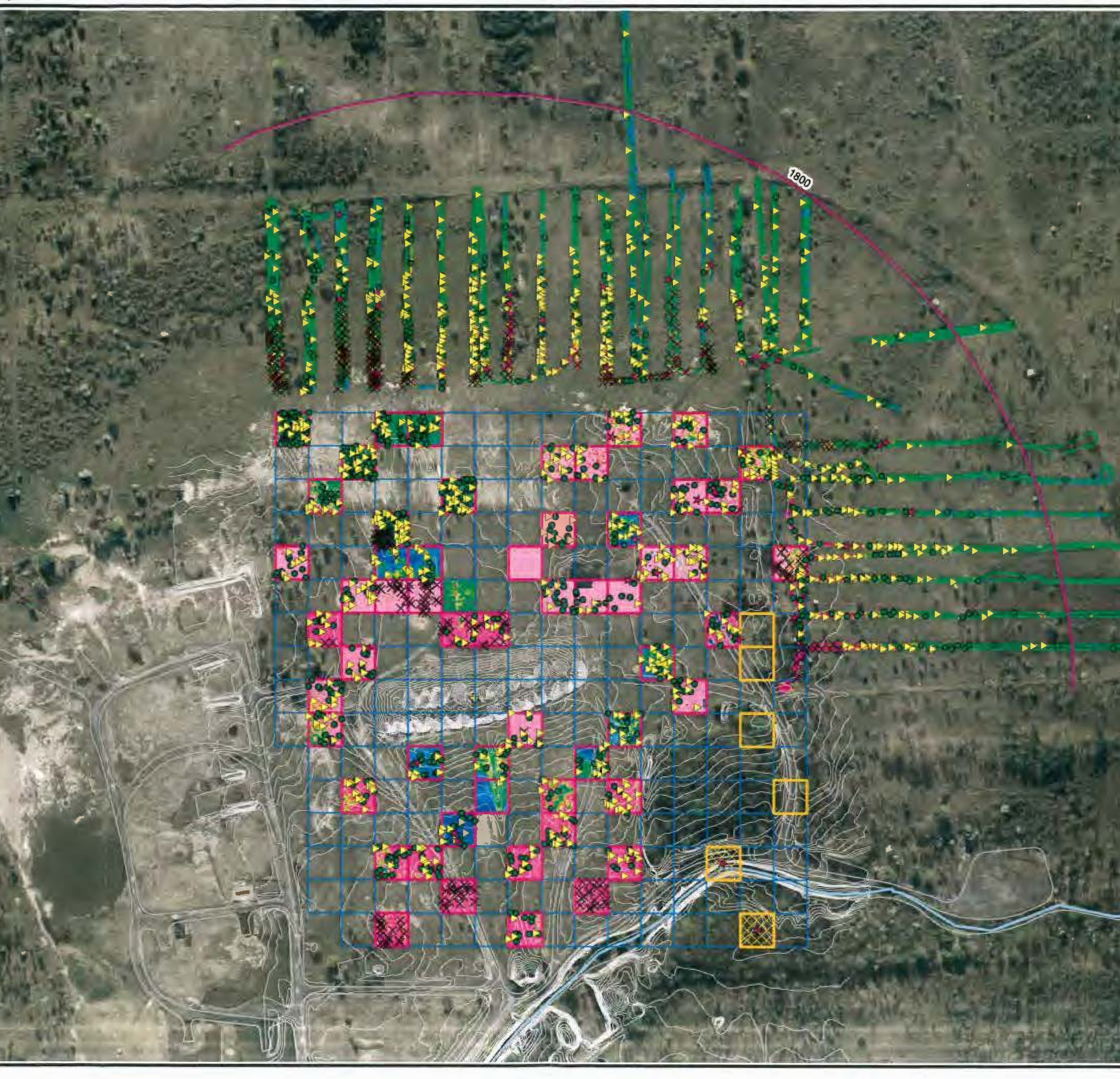
1000
500

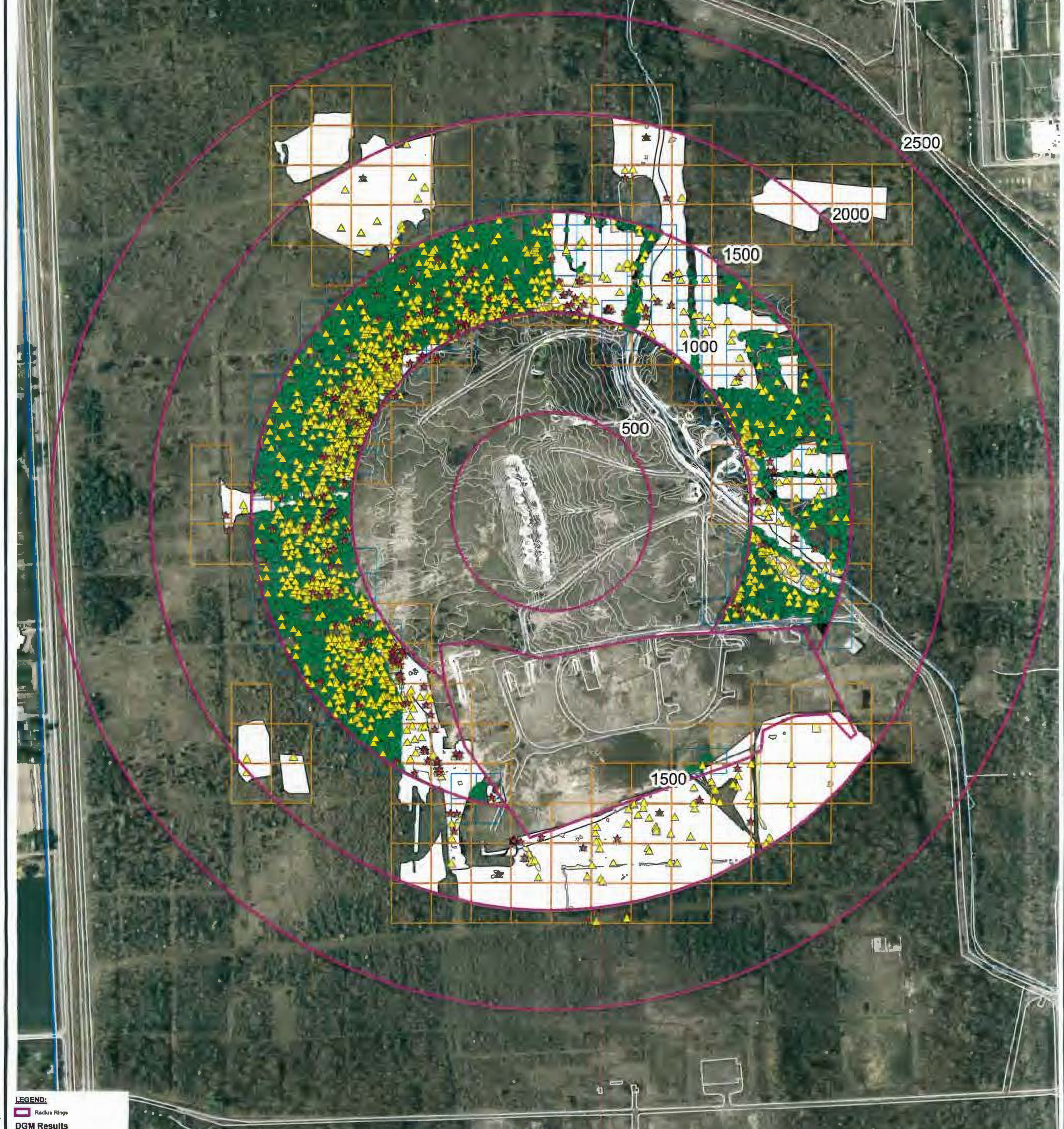
\Figure 1-6.mxd




2500
2000
1500
1000
500
1500


2500
2000
1500
1000
500
1500


2500
2000
1500
1000
500
1500


2500
2000
1500
1000
500
1500
LEGEND:
Radius Rings
DGM Results

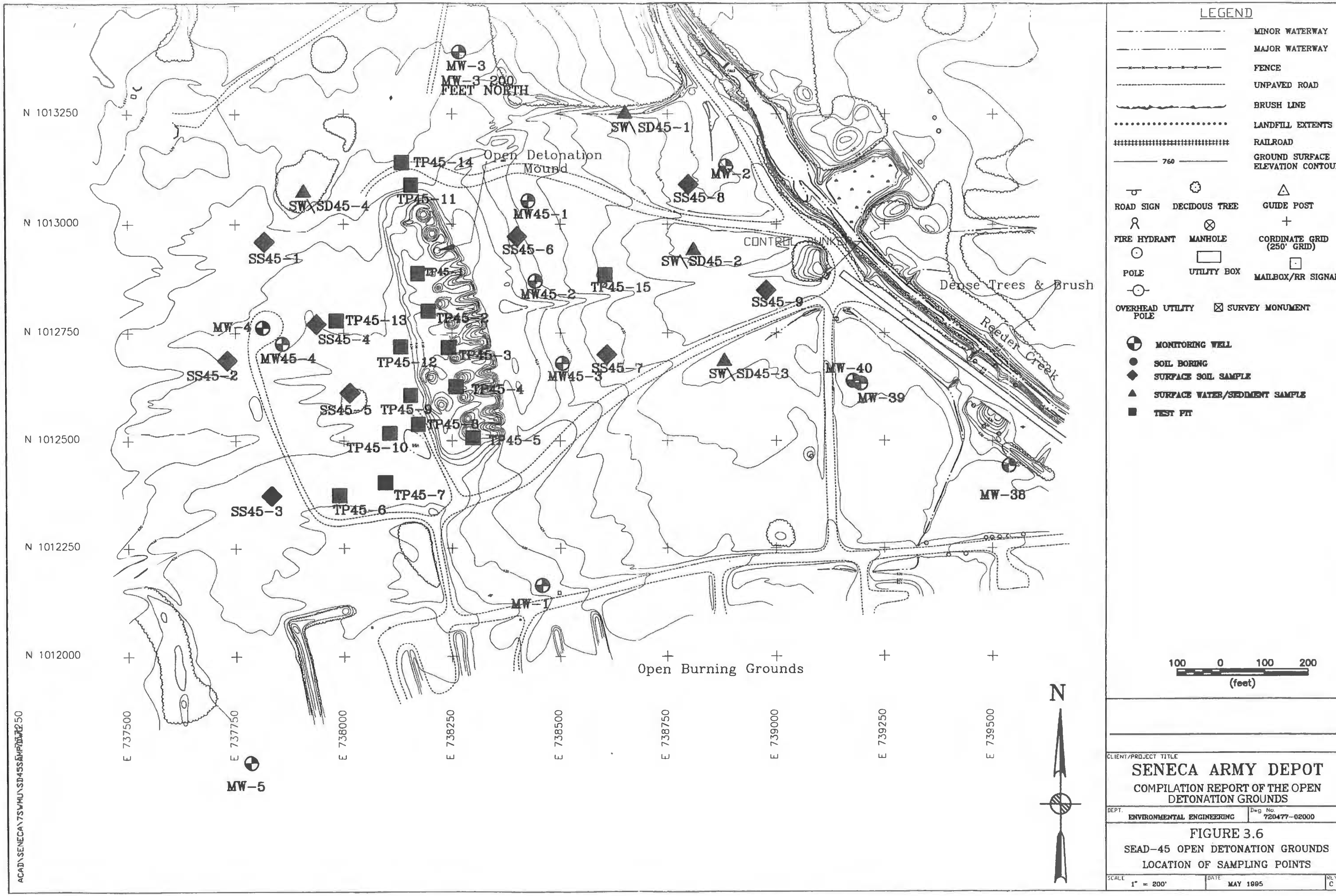
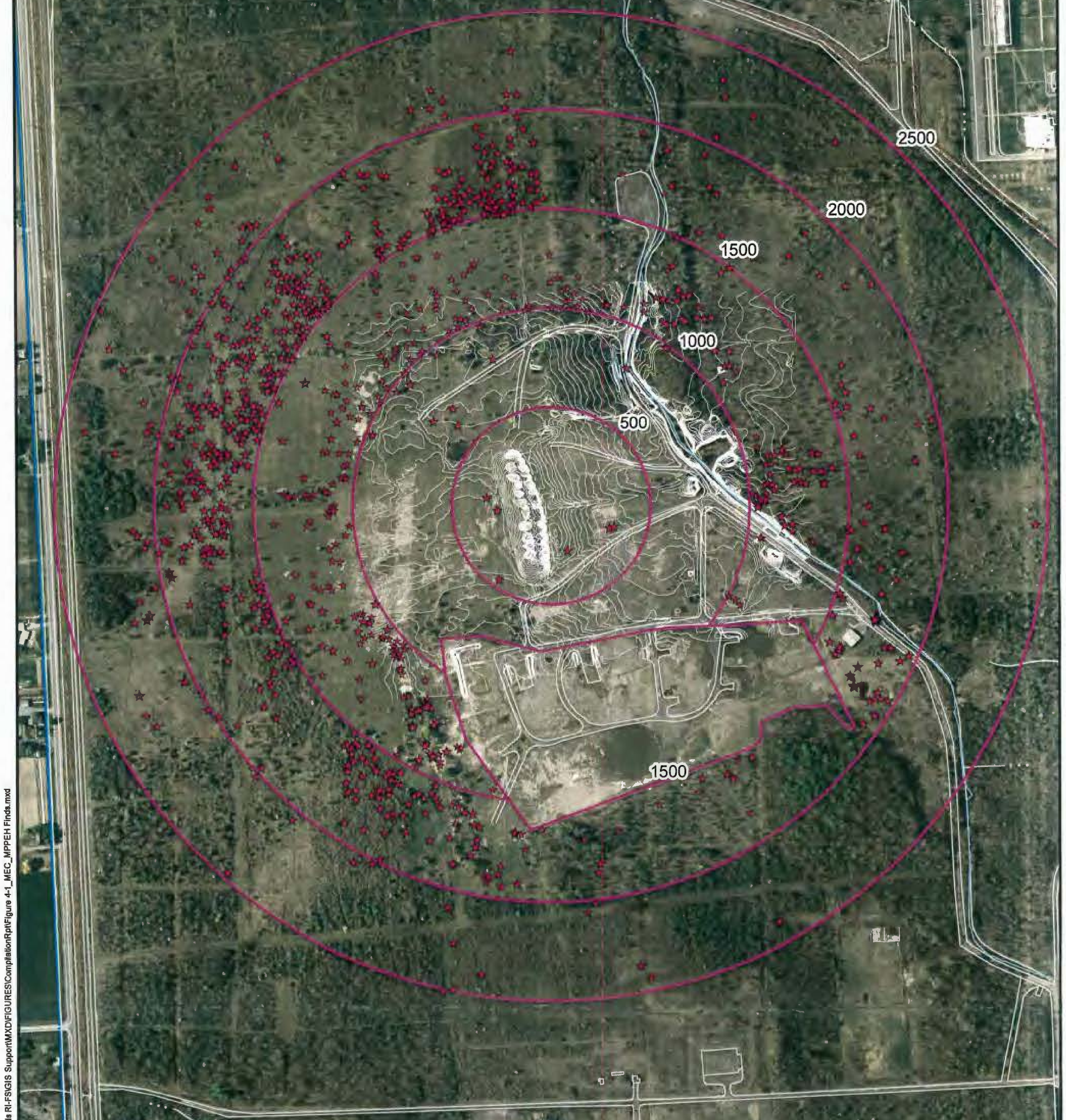


FIGURE 3.6
SEAD-45 OPEN DETONATION GROUNDS
LOCATION OF SAMPLING POINTS



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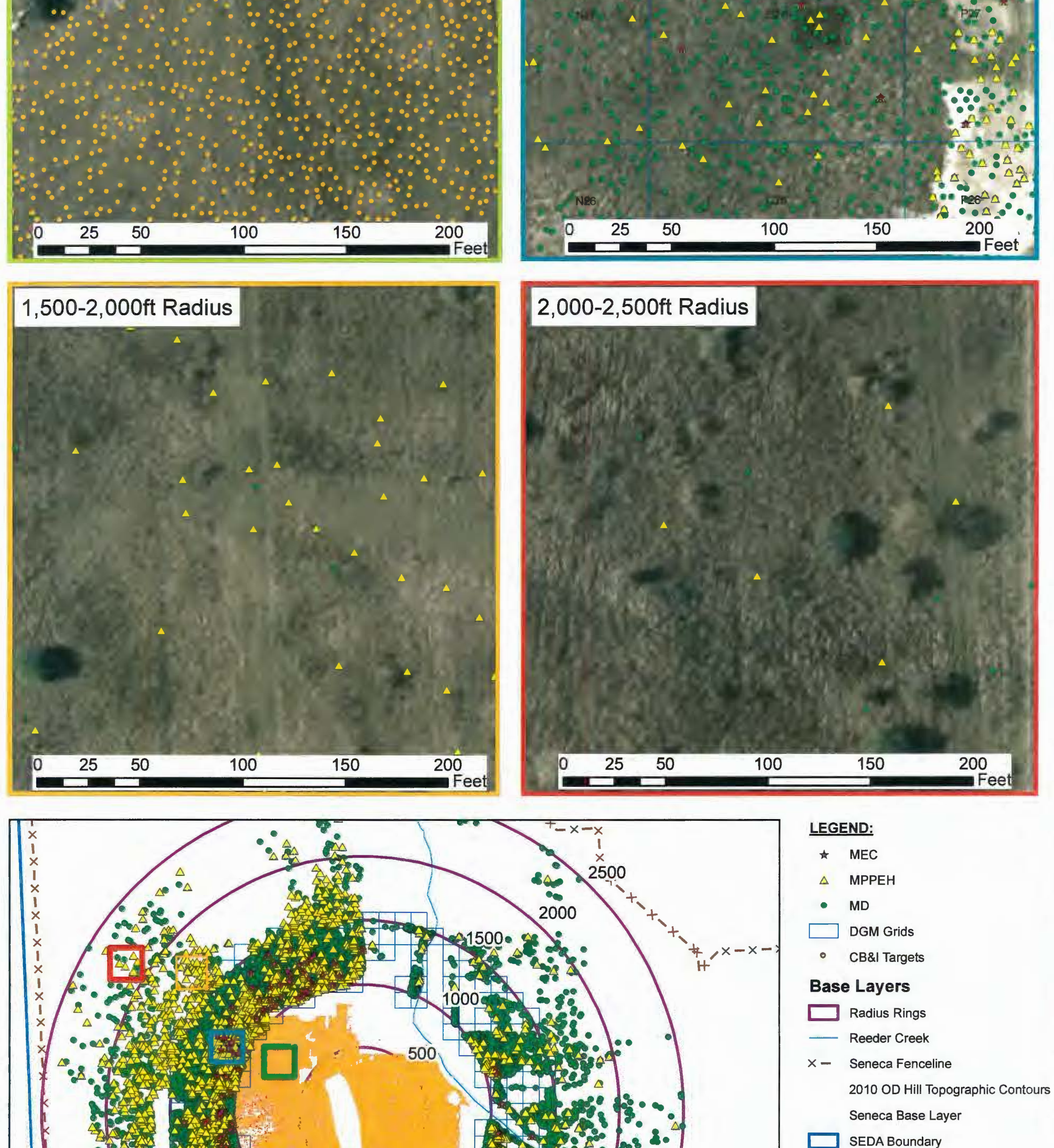

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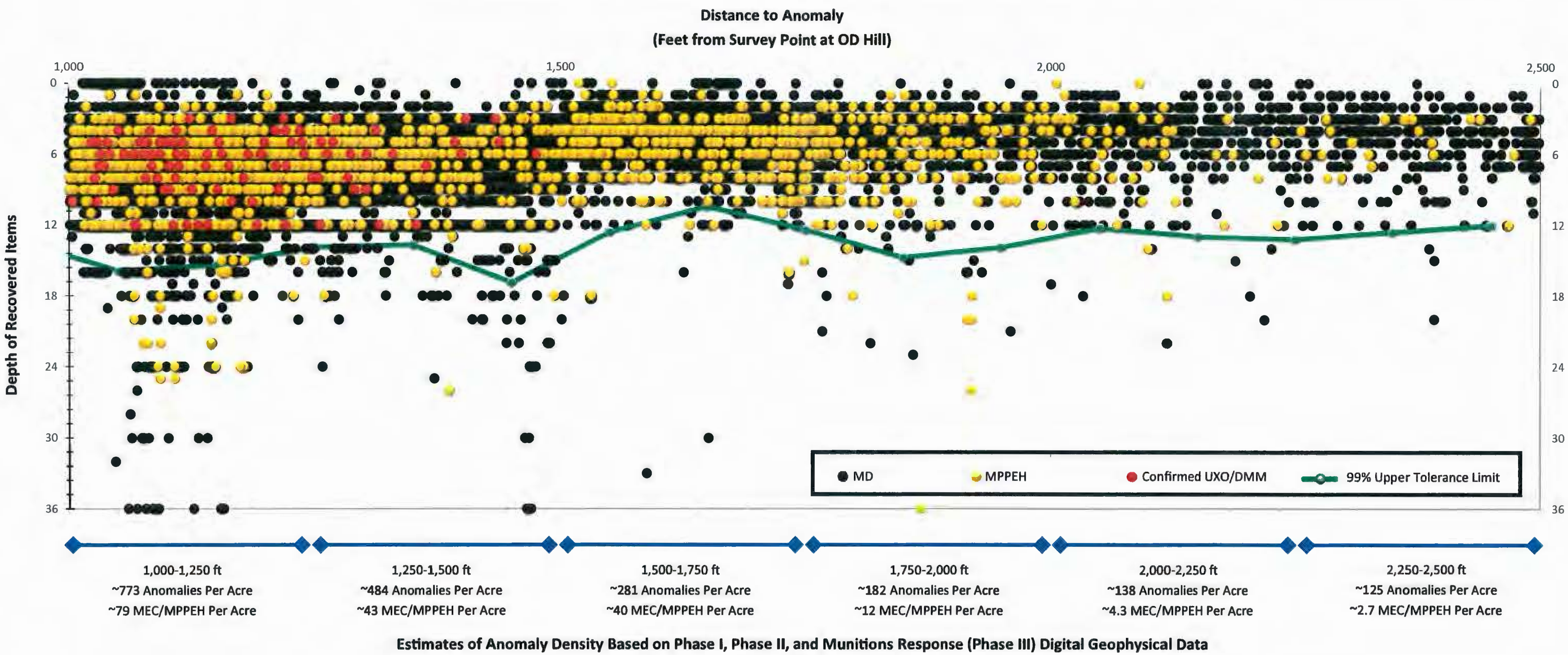
Figure 4.2

Vertical and Horizontal Distribution of Munitions Items Recovered from DGM Anomalies



Estimates of Anomaly Density Based on Phase I, Phase II, and Munitions Response (Phase III) Digital Geophysical Data

Notes:

-Data shown ONLY includes intrusive results from investigation of DGM anomalies during the Phase I Investigation (Weston, 2005), the Phase II Investigation (Weston, 2006) and the Munitions Response/Phase III (Parsons, 2016)

-UXO/DMM items were only confirmed based on post demolition evaluation for items disposed of during the Munitions Response Action (Phase III) between the 1,000 and 2,000 foot radius. As a result, confirmed UXO/DMM are only seen in the data for this portion of the site that was covered by the 2012-2014 action.

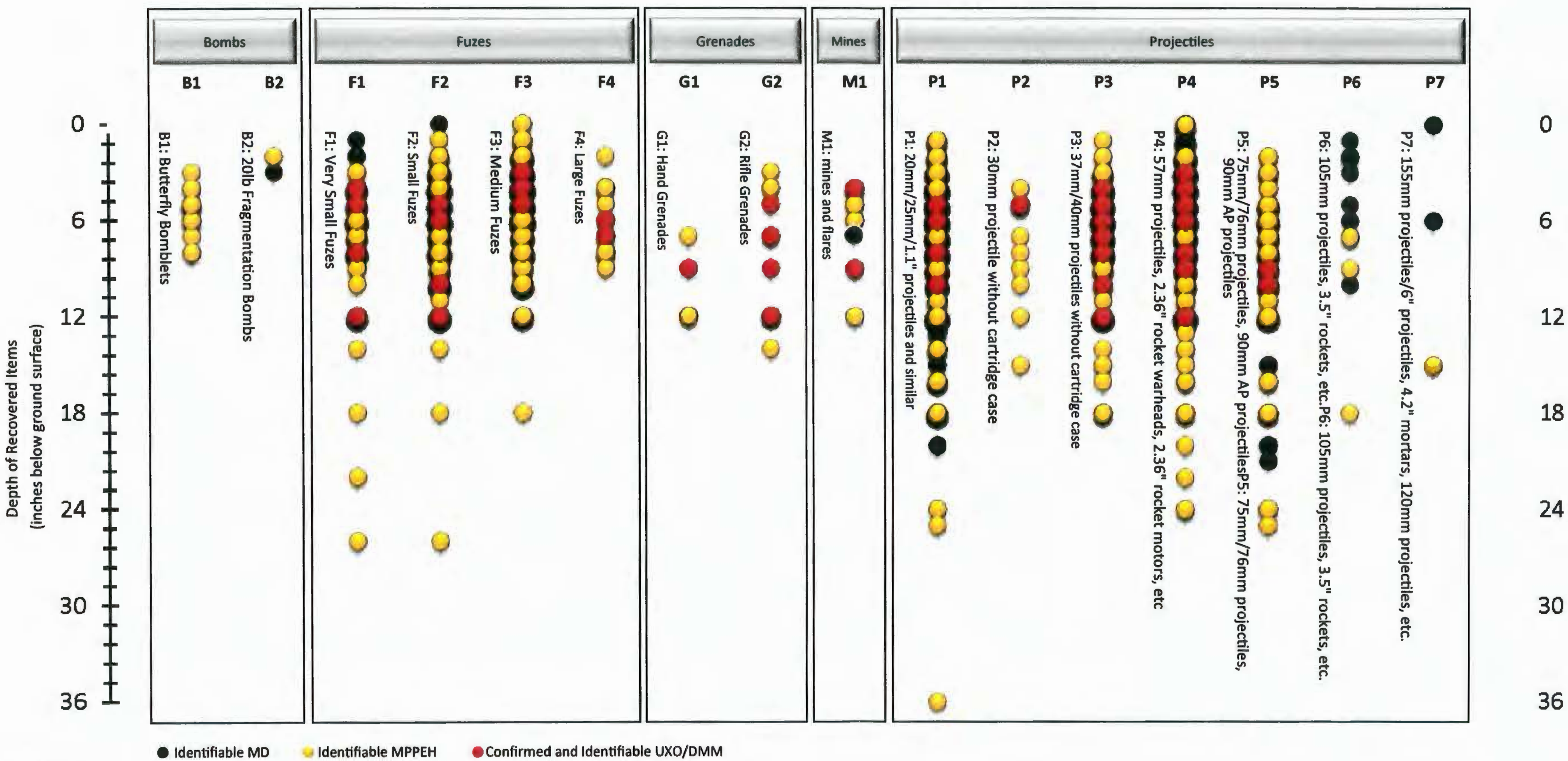
-MPPEH items were not given a final designation of UXO/DMM/MDAS; therefore, it can not be estimated how many of the MPPEH items found would be classified as UXO/DMM. Some training rounds can not be confirmed as MDAS without demolition.

-A tolerance interval was calculated on data grouped in 100 foot intervals. Based on the calculation of one-sided upper tolerance interval for normally distributed data (NIST/Sematech Engineering Statistics Handbook, Section 7.2.6.3) the data show 99% confidence that 99% of the MD/MPPEH/MEC are above the depth shown in green for each 100 foot evaluation interval.

Figure 4.4

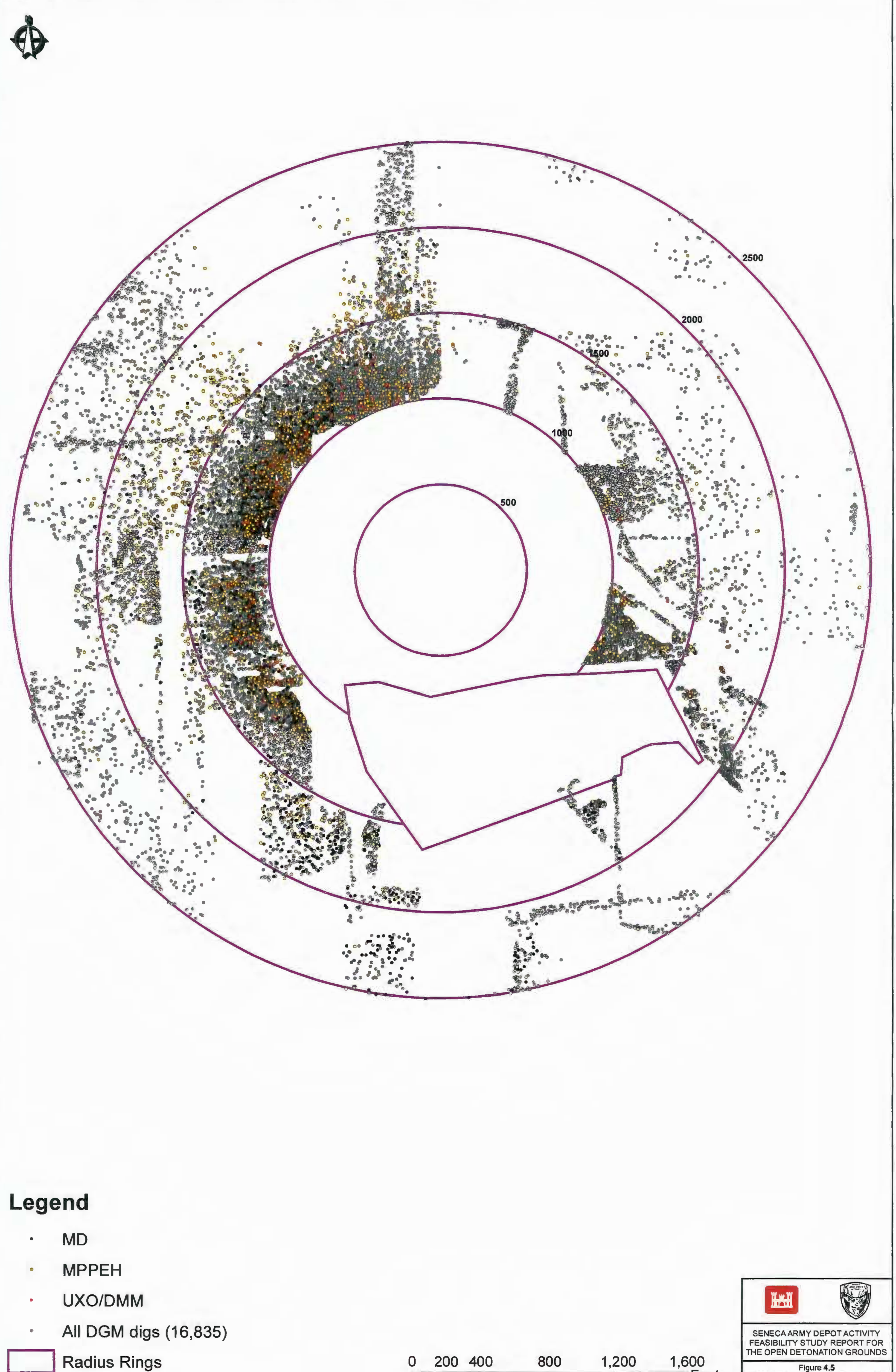
Vertical Distribution of Identifiable Items by Type

(Based on 3,041 DGM dig records with sufficient data to be categorized by type.)



Notes:

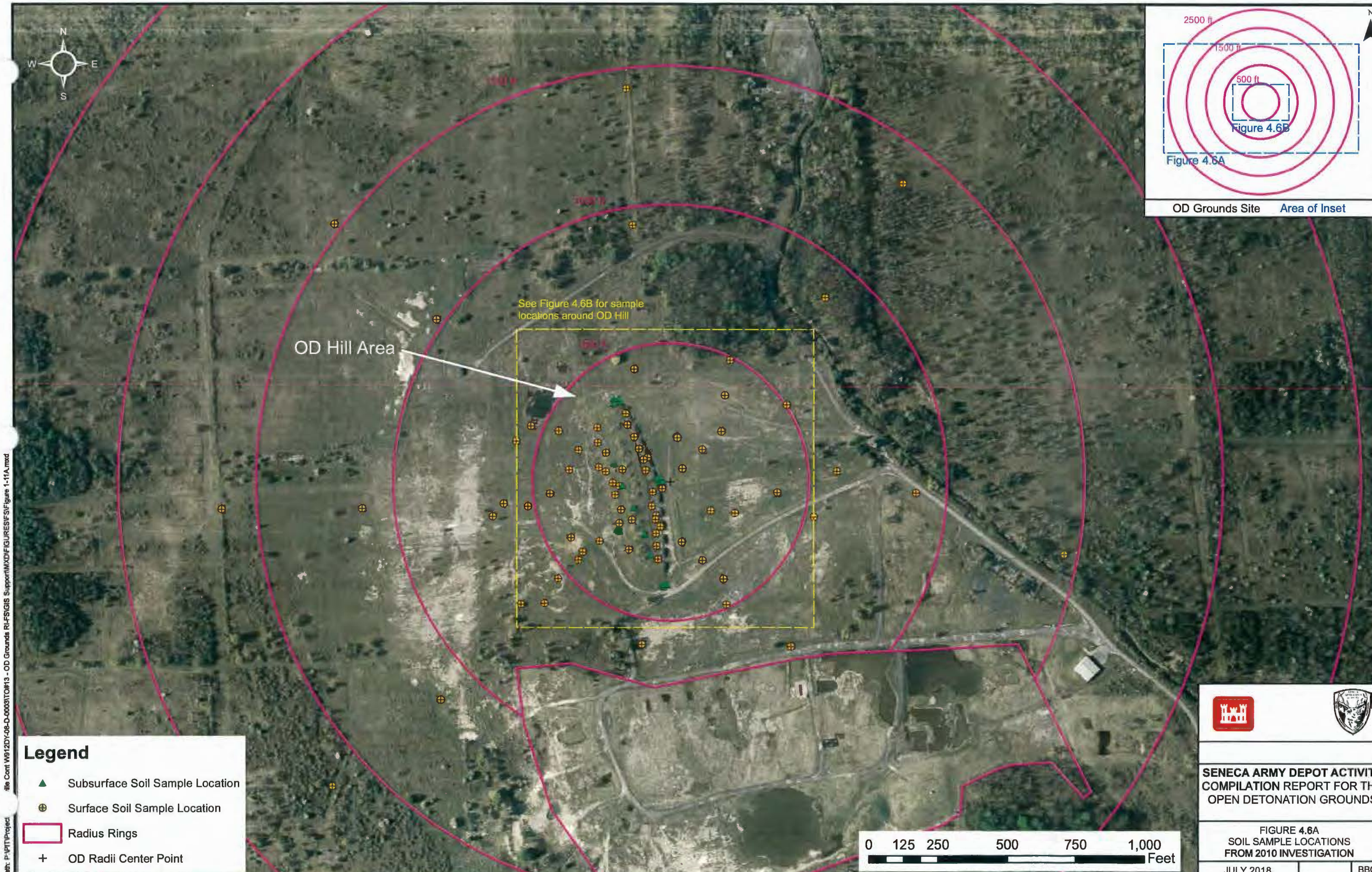
- Full descriptions of each munitions type subcategory can be found in Table 4.6
- UXO/DMM items were only confirmed based on post demolition evaluation for items disposed of during the Munitions Response Action (Phase III)
-"MPPEH" items were not given a final designation of UXO/DMM/MDAS; therefore, it can not be estimated how many of the MPPEH items may have been UXO/DMM. Some training rounds can not be confirmed as MDAS without demolition. "MPPEH" includes items that were burned to ensure any residual explosives were removed.

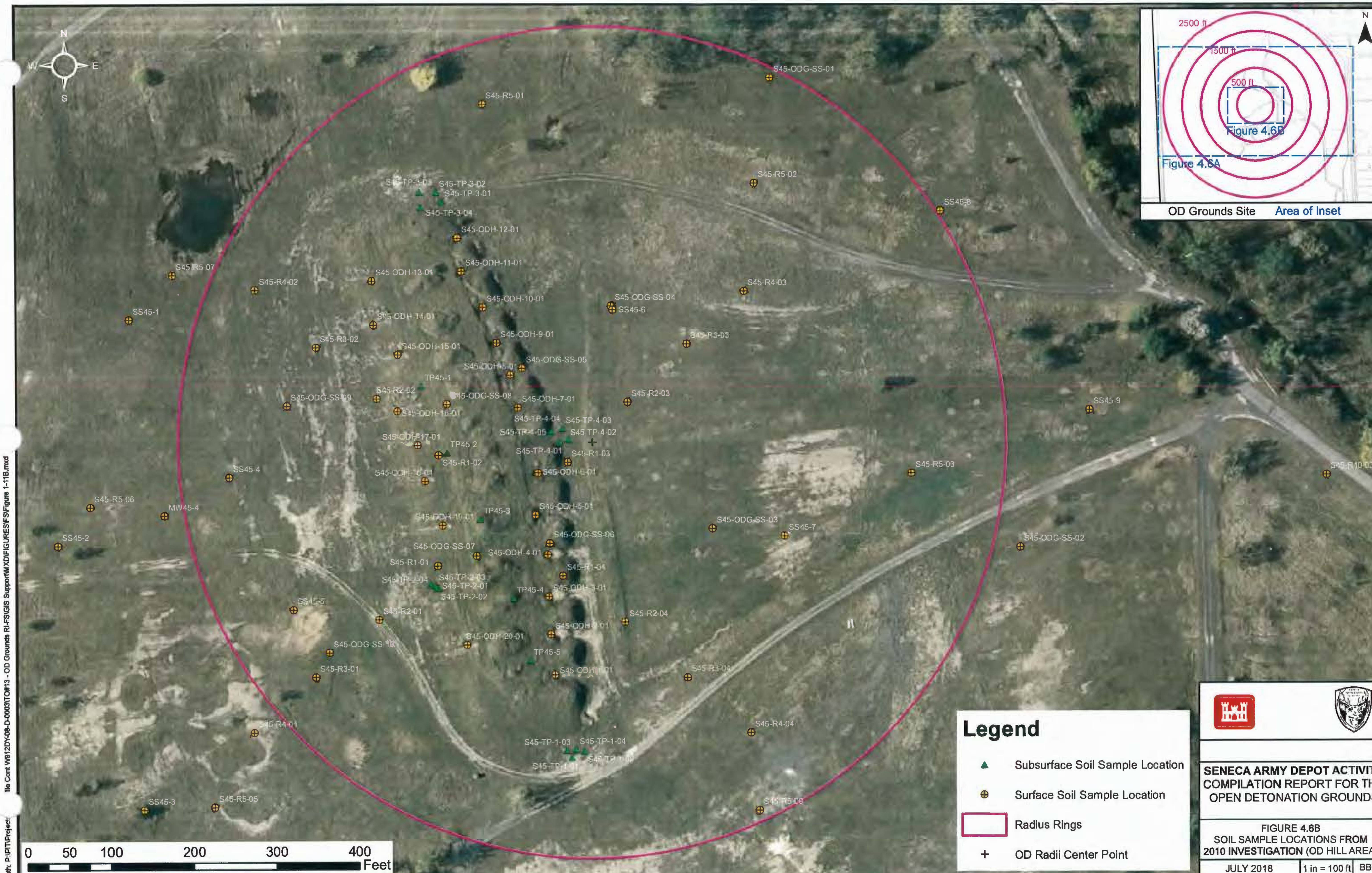


SENECA ARMY DEPOT ACTIVITY
FEASIBILITY STUDY REPORT FOR
THE OPEN DETONATION GROUNDS

Figure 4.5
Horizontal Distribution of Data Points from the Vertical CSM

SEP. 2018	1 in = 500 ft	TB


N
W
E
S
See Figure 4.6B for sample
locations around OD Hill
OD Hill Area
2500 ft
1500 ft
500 ft
Figure 4.6B
Figure 4.6A
N
OD Grounds Site
Area of Inset
Legend
Subsurface Soil Sample Location
Surface Soil Sample Location
Radius Rings
OD Radii Center Point
0 125 250 500 750 1,000
Feet
SENECA ARMY DEPOT ACTIVITY
COMPILATION REPORT FOR THE
OPEN DETONATION GROUNDS
FIGURE 4.6A
SOIL SAMPLE LOCATIONS
FROM 2010 INVESTIGATION
JULY 2018
BBO



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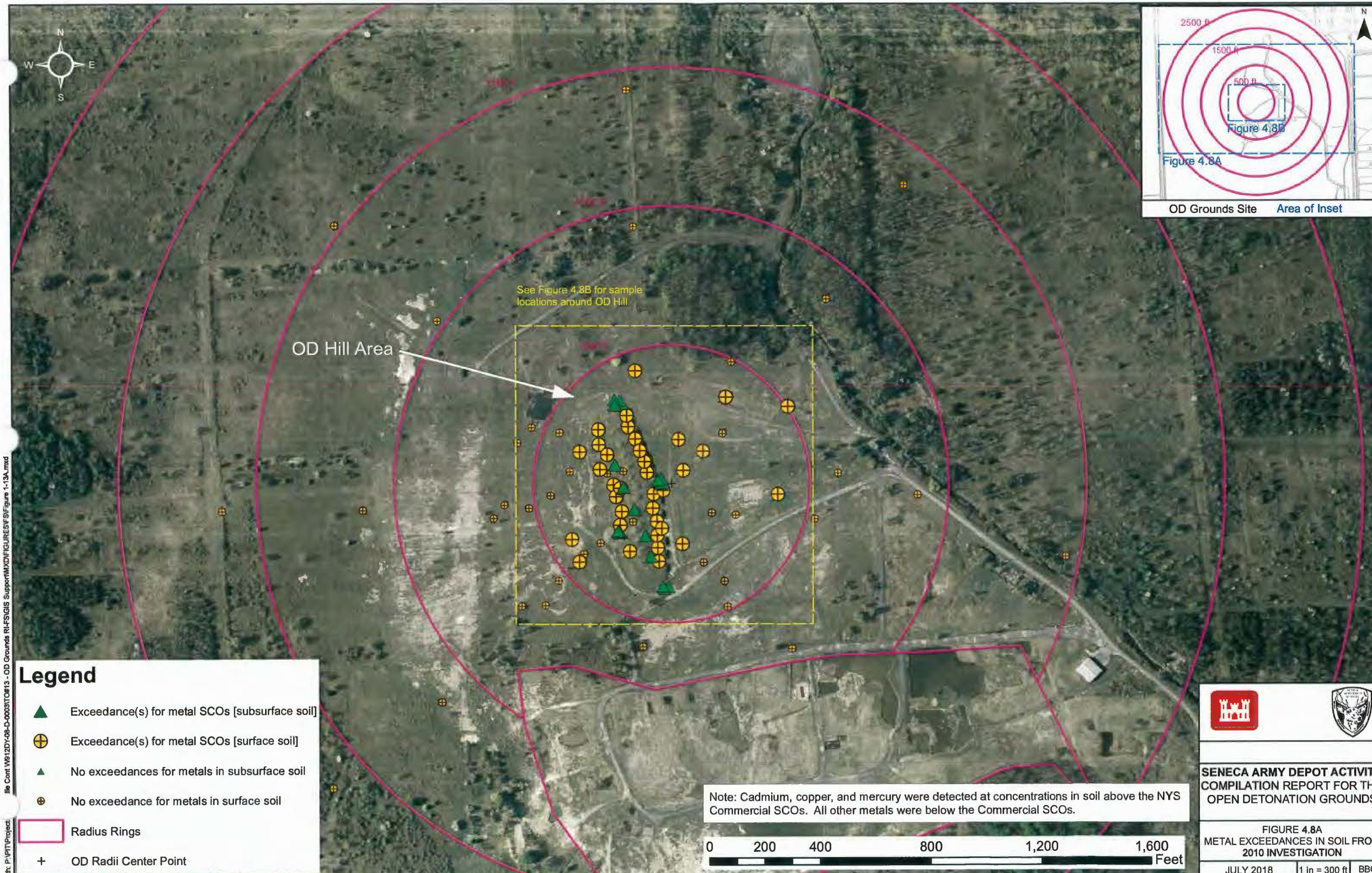
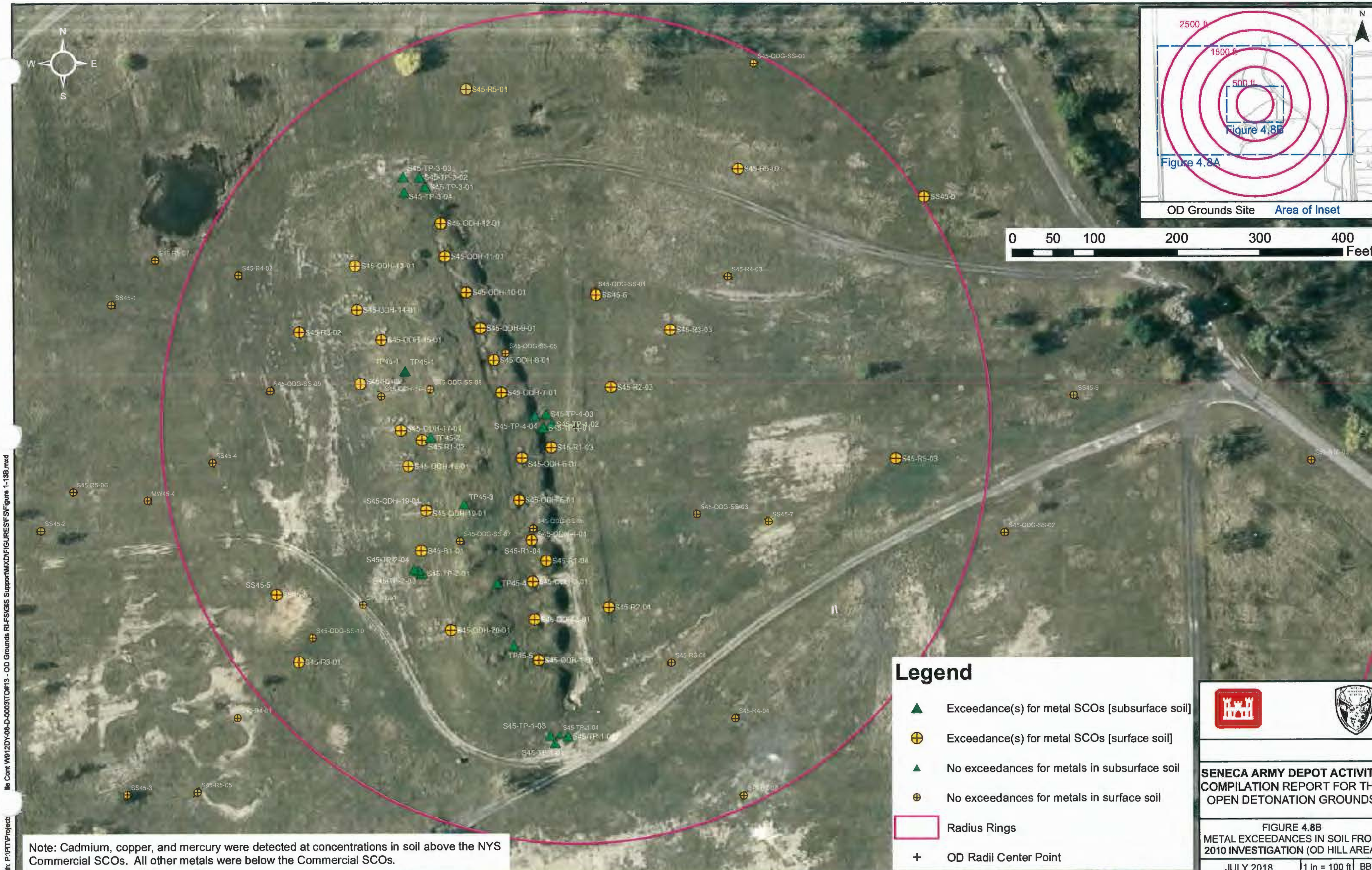
SENECA ARMY DEPOT ACTIVITY
COMPILATION REPORT FOR THE OPEN DETONATION GROUND

FIGURE 4.7
PERCHLORATE SAMPLE LOCATIONS AT OD GROUNDS

JULY 2018 | 1" = 300' | TIB



N
W
E
S
2500 ft
1500 ft
500 ft
Figure 4.8B
Figure 4.8A
OD Grounds Site
Area of Inset
See Figure 4.8B for sample locations around OD Hill
OD Hill Area
Legend
Exceedance(s) for metal SCOs [subsurface soil]
Exceedance(s) for metal SCOs [surface soil]
No exceedances for metals in subsurface soil
No exceedance for metals in surface soil
Radius Rings
OD Radii Center Point
Note: Cadmium, copper, and mercury were detected at concentrations in soil above the NYS Commercial SCOs. All other metals were below the Commercial SCOs.
0
200
400
800
1,200
1,600
Feet
SENECA ARMY DEPOT ACTIVITY
COMPILATION REPORT FOR THE OPEN DETONATION GROUNDS
FIGURE 4.8A
METAL EXCEEDANCES IN SOIL FROM 2010 INVESTIGATION
JULY 2018
1 in = 300 ft
BBO

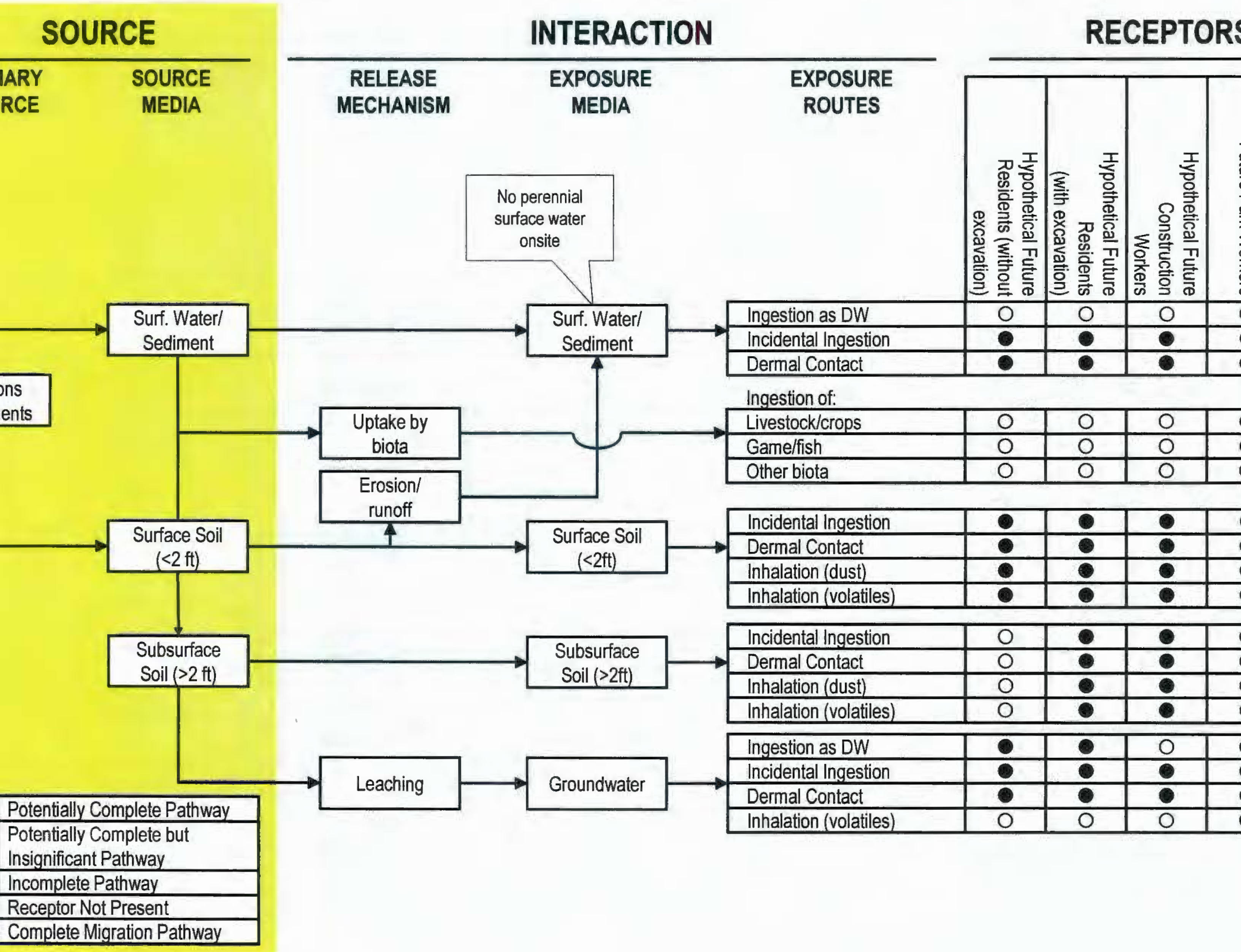


N
S
W
E
OD Grounds Site
Area of Inset
2500 ft
1500 ft
500 ft
Figure 4.8B
Figure 4.8A
0 50 100 200 300 400
Feet
S45-R5-01
S45-ODG-SS-01
S45-R5-02
SS45-8
S45-TP-3-03
S45-TP-3-02
S45-TP-3-01
S45-TP-3-04
S45-ODH-12-01
S45-ODH-11-01
S45-ODH-13-01
S45-R4-02
S45-R4-03
SS45-1
S45-ODH-10-01
S45-ODG-SS-04
SS45-6
S45-ODH-14-01
S45-R1-02
S45-ODH-9-01
S45-R3-03
S45-ODH-15-01
S45-ODG-SS-05
S45-ODH-8-01
TP45-1
S45-ODG-SS-09
S45-ODG-SS-08
S45-ODH-7-01
S45-R2-03
SS45-9
S45-TP-4-03
S45-TP-4-04
S45-TP-4-02
S45-ODH-17-01
TP45-2
S45-R1-03
S45-R5-03
SS45-4
S45-ODH-6-01
S45-ODH-18-01
S45-R5-06
MW45-4
TP45-3
S45-ODH-19-01
S45-ODH-5-01
S45-ODG-SS-03
SS45-7
SS45-2
S45-ODG-SS-07
S45-ODG-SS-02
S45-R1-01
S45-R1-04
S45-TP-2-04
S45-TP-2-01
TP45-4
SS45-5
S45-R2-04
S45-ODG-SS-10
S45-ODH-20-01
TP45-5
S45-R3-01
S45-R4-04
S45-TP-1-03
S45-TP-1-04
SS45-3
S45-R5-05
Note: Cadmium, copper, and mercury were detected at concentrations in soil above the NYS Commercial SCOs. All other metals were below the Commercial SCOs.
Legend
Exceedance(s) for metal SCOs [subsurface soil]
Exceedance(s) for metal SCOs [surface soil]
No exceedances for metals in subsurface soil
No exceedances for metals in surface soil
Radius Rings
OD Radii Center Point
SENECA ARMY DEPOT ACTIVITY
COMPILATION REPORT FOR THE OPEN DETONATION GROUNDS
FIGURE 4.8B
METAL EXCEEDANCES IN SOIL FROM 2010 INVESTIGATION (OD HILL AREA)
JULY 2018
1 in = 100 ft
BBO

e 4.9A Human Health Conceptual Site Model Diagram

S Name: Open Detonation (OD) Hill Area, OD Grounds, Seneca Army Depot Activity (SEDA), Seneca County, New York

ised By: Jill Noel **Last Revision Date:** September 1

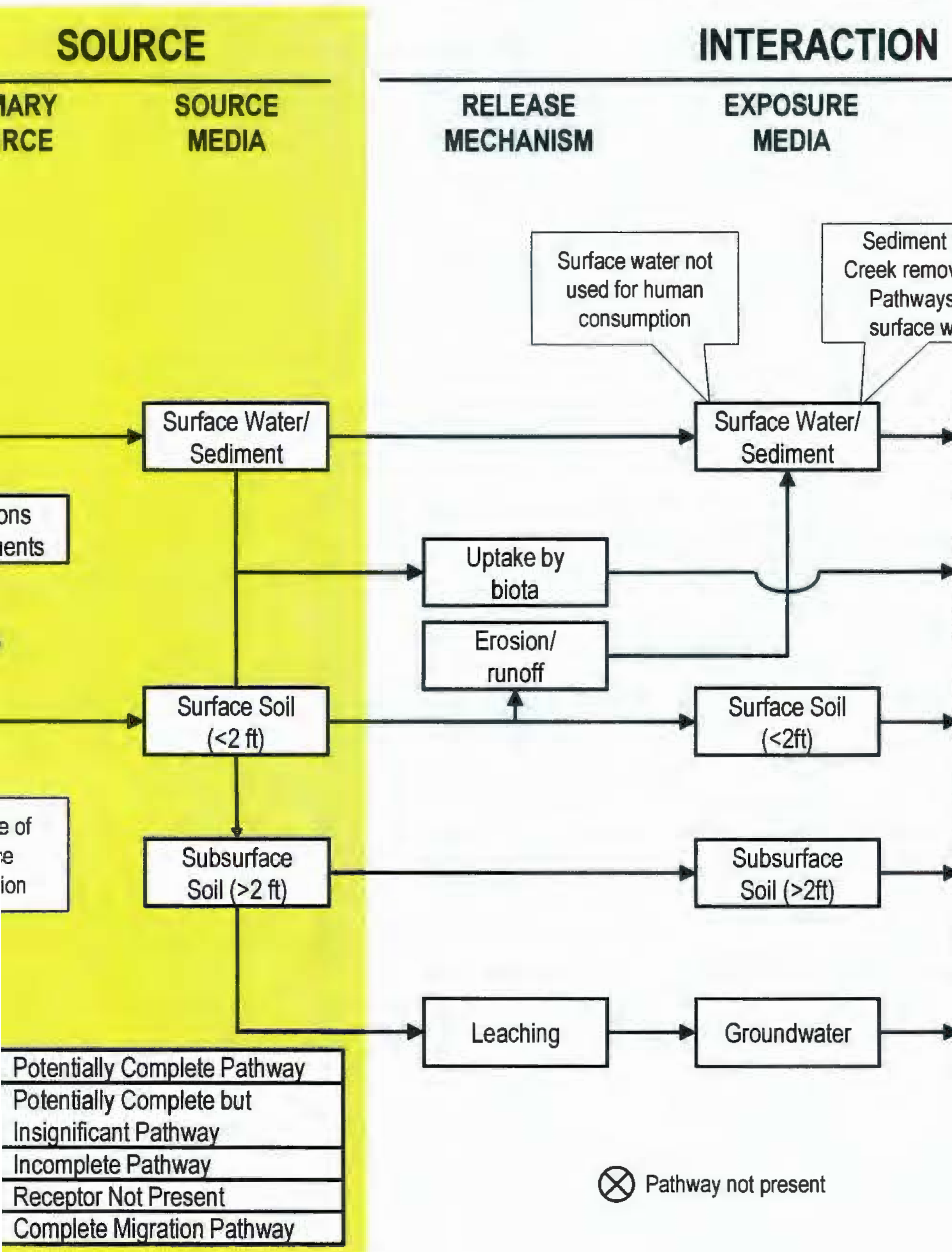


[illegible]e 4.9B Human Health Conceptual Site Model Diagram

[illegible]S Name: Kickout Area, (OD) Grounds, Seneca Army Depot Activity (SEDA), Seneca County, New York

[illegible]vised By: Jill Noel

Last Revision Date: September 12[illegible]



RECEPTORS

Exposure Routes	Hypothetical Future Residents (without excavation)	Hypothetical Future Residents (with excavation)	Hypothetical Future Construction Workers
Ingestion as DW	○	○	○
Incidental Ingestion	●	●	●
Dermal Contact	●	●	●
Ingestion of:			
Livestock/crops	○	○	○
Game/fish	○	○	○
Other biota	○	○	○
Incidental Ingestion	●	●	●
Dermal Contact	●	●	●
Inhalation (dust)	●	●	●
Inhalation (volatiles)	●	●	●
Incidental Ingestion	○	○	○
Dermal Contact	○	○	○
Inhalation (dust)	○	○	○
Inhalation (volatiles)	○	○	○
Ingestion as DW	●	●	○
Incidental Ingestion	●	●	●
Dermal Contact	●	●	●
Inhalation (volatiles)	○	○	○

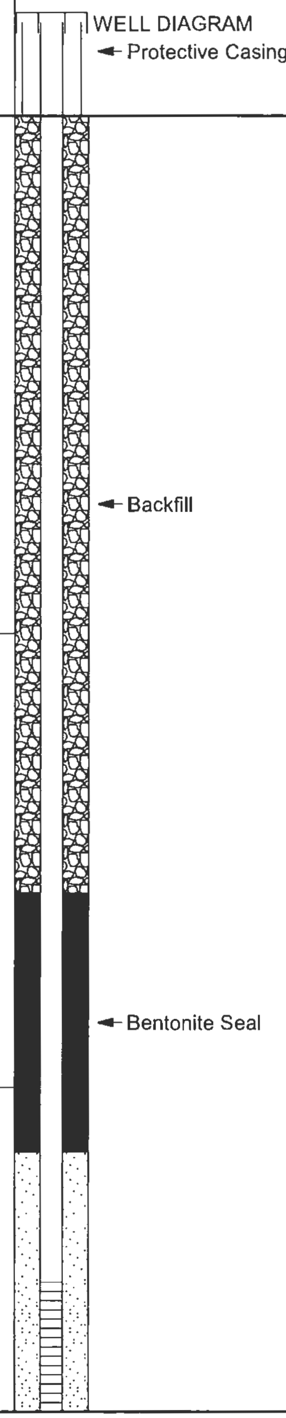
APPENDIX F
PERCHLORATE BORING AND MONITORING WELLS CONSTRUCTION LOGS

BORING NUMBER MW1R

CLIENT U.S Army Corps of Engineers
PROJECT NAME OD Grounds - Perchlorate Sampling
PROJECT NUMBER 748268.03200
PROJECT LOCATION Romulus, New York
DATE STARTED 5/30/18 11:30 **COMPLETED** 5/31/18 8:40
GROUND ELEVATION **HOLE SIZE** 6 inches
DRILLING CONTRACTOR NYEG Drilling
GROUND WATER LEVELS:
DRILLING METHOD Truck Mounted Auger
AT TIME OF DRILLING ---
LOGGED BY Cory Mahony **CHECKED BY** Todd Belanger
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG		MATERIAL DESCRIPTION
0.0	45-FS-SS-MW1R-10015-0-0.5			Dry, brown fine SAND and SILT, trace fine gravel, no odor or stains
2.5				
			4.0	Dry, black fractured weathered SHALE, no odor or stains
5.0				
7.5			7.5	Dry, gray SILT and GRAVEL, no odor or stains
10.0	45-FS-SB-MW1R-10016-9.5-10			

WELL DIAGRAM



(Continued Next Page)

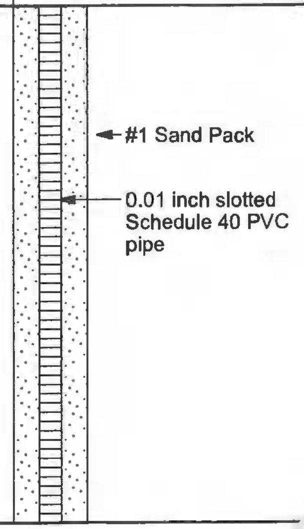
CLIENT U.S Army Corps of Engineers

PROJECT NUMBER 748268.03200

PROJECT NAME OD Grounds - Perchlorate Sampling

PROJECT LOCATION Romulus, New York

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG		MATERIAL DESCRIPTION	WELL DIAGRAM
10.0				Dry, gray SILT and GRAVEL, no odor or stains *(continued)*	
12.5					
			14.0		



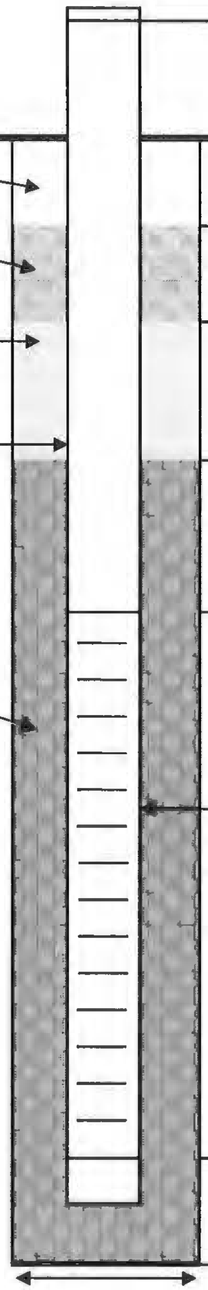
Bottom of borehole at 14.0 feet.

Well Construction Detail (Single Cased - Stickup)

Client: USACE

Well ID: MW1R

Date Well Installed: 5/31/2018 Location: OD Grounds



Label	Item	Depth Below Ground Surface (ft)
	Top of Well Casing: + 3 ft	
Ground Surface		0.0
Cement	Top of Backfill	0.0 ft
Backfill	Top of Bentonite	6.0 ft
Bentonite Type/Size:		
Well Riser Diameter: 2 inch Material: Schedule 40 PVC	Top of Sand Pack	8.0 ft
	Top of Screen	9.0 ft
Sand Pack Type: #1 Sand	**Well Screen** Diameter: 2 inch Slot Size: 0.01 inch Material: Schedule 40 PVC	
	Bottom of Screen	14.0 ft
	Bottom of Borehole	14.0 ft

6 inches

Top of Confining Unit (if present): Approximately 5 ft

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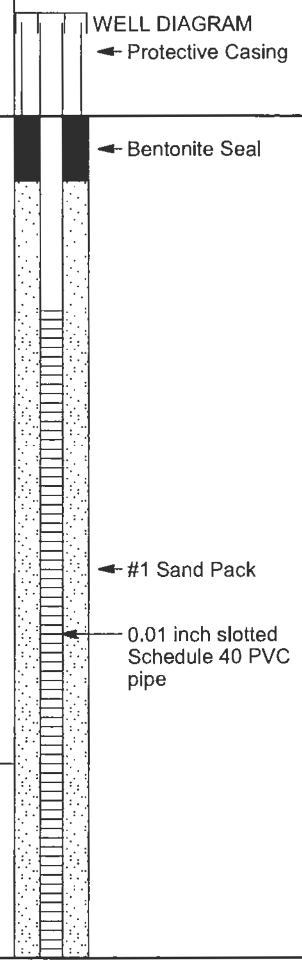
BORING NUMBER MW2R

CLIENT U.S Army Corps of Engineers
PROJECT NAME OD Grounds - Perchlorate Sampling
PROJECT NUMBER 748268.03200
PROJECT LOCATION Romulus, New York
DATE STARTED 5/30/18 9:20 COMPLETED 5/30/18 11:00
GROUND ELEVATION
HOLE SIZE 6 inches
DRILLING CONTRACTOR NYEG Drilling
GROUND WATER LEVELS:
DRILLING METHOD Truck Mounted Auger
AT TIME OF DRILLING 4.50 ft
LOGGED BY Cory Mahony CHECKED BY Todd Belanger
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG		MATERIAL DESCRIPTION
0.0	45-FS-SS-MW2R-10013-0-0.5			Moist, dark brown organic rich SILT, trace fine sand, no odor or stains
2.5				
5.0	45-FS-SB-MW2R-10014-4.5-5.0		5.0	
				Highly fractured SHALE
			6.5	

Bottom of borehole at 6.5 feet.



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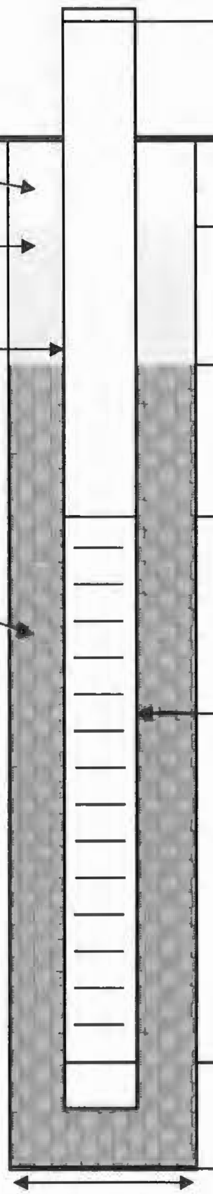
Well Construction Detail (Single Cased - Stickup)

Client: USACE

Well ID: MW2R

Date Well Installed: 5/30/2018

Location: OD Grounds



		Depth Below Ground Surface (ft)
	Top of Well Casing: + 3 ft	
Ground Surface		0.0
Cement		
Bentonite	Top of Bentonite	0.0 ft
Well Riser Diameter: 2 inch Material: Schedule 40 PVC	Top of Sand Pack	0.5 ft
	Top of Screen	1.5 ft
Sand Pack Type: #1 Sand	**Well Screen** Diameter: 2 inch Slot Size: 0.01 inch Material: Schedule 40 PVC	
	Bottom of Screen	6.5 ft
	Bottom of Borehole	6.5 ft

6 inches

Top of Confining Unit (if present): Approximately 5 ft

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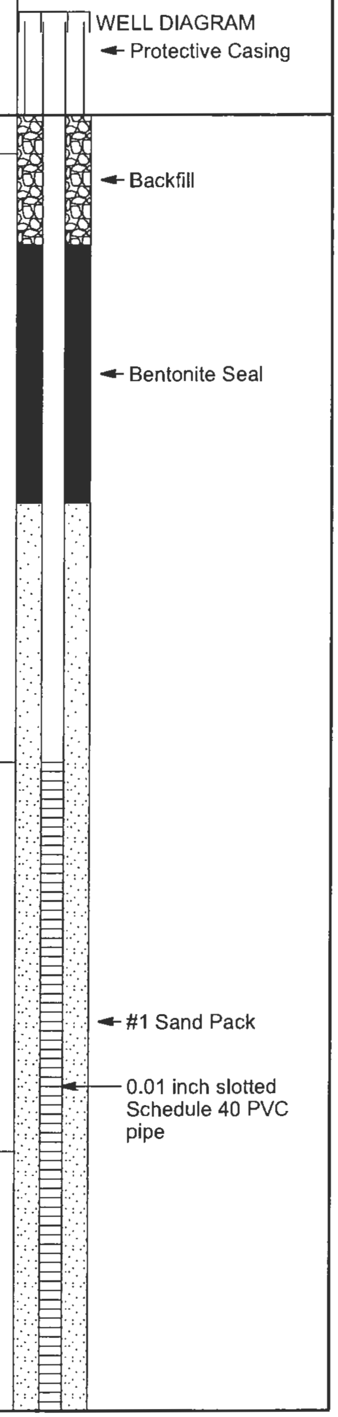
BORING NUMBER MW3R

CLIENT U.S Army Corps of Engineers	**PROJECT NAME** OD Grounds - Perchlorate Sampling
PROJECT NUMBER 748268.03200	**PROJECT LOCATION** Romulus, New York
DATE STARTED 5/31/18 11:00 **COMPLETED** 5/31/18 12:00	**GROUND ELEVATION** ______ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR NYEG Drilling	**GROUND WATER LEVELS:**
DRILLING METHOD Truck Mounted Auger	∇ **AT TIME OF DRILLING** 5.50 ft
LOGGED BY Cory Mahony **CHECKED BY** Todd Belanger	**AT END OF DRILLING** ---
NOTES	**AFTER DRILLING** ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	45-FS-SS-MW3R-10019-0-0.5		Topsoil and Moss
0.3			Dry, tan/gray SILT and FINE GRAVEL, no odor or stains
2.5			
5.0	45-FS-SB-MW3R-10020/10021-4.5-5.0		Moist, tan medium round GRAVEL, little silt, no odor or stains ∇
7.5			
8.0			Dry, gray highly weathered BEDROCK
10.0			



ENVIRONMENTAL OD GROUNDS - GINT STD US.GDT - 11/20/18 09:53 - C:\USERS\PUBLIC\DOCUMENTS\BENTLEY\GINT\PROJECTS\SENECA OD GROUNDS.GPJ

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BORING NUMBER MW3R

CLIENT U.S Army Corps of Engineers
PROJECT NAME OD Grounds - Perchlorate Sampling
PROJECT NUMBER 748268.03200
PROJECT LOCATION Romulus, New York

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	WELL DIAGRAM
10.0				
		11.0	Dry, gray highly weathered BEDROCK *(continued)*	

Bottom of borehole at 11.0 feet.

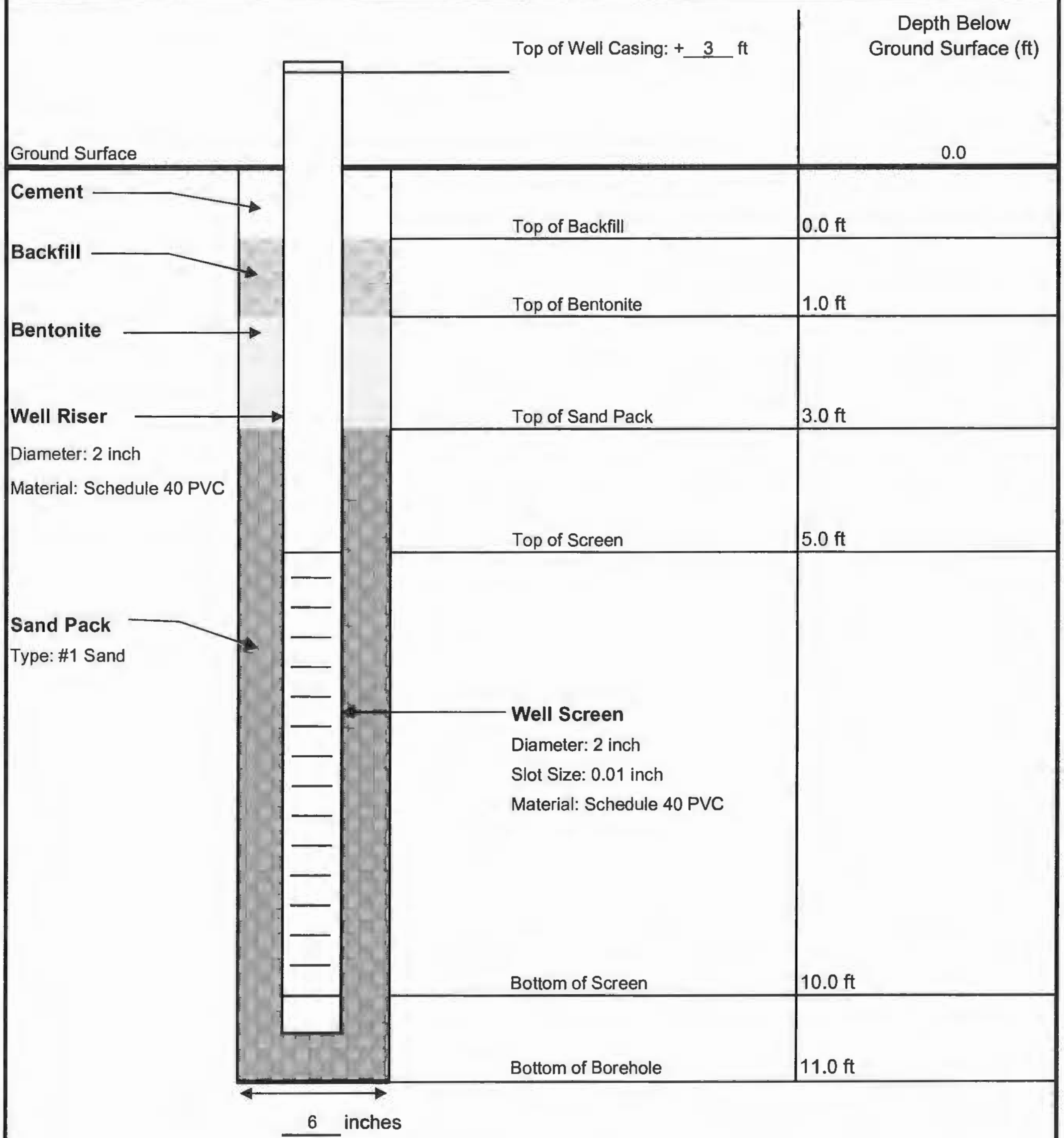
Well Construction Detail (Single Cased - Stickup)

Client: USACE

Well ID: MW3R

Date Well Installed: 5/30/2018

Location: OD Grounds



Top of Confining Unit (if present): Approximately 8 ft.

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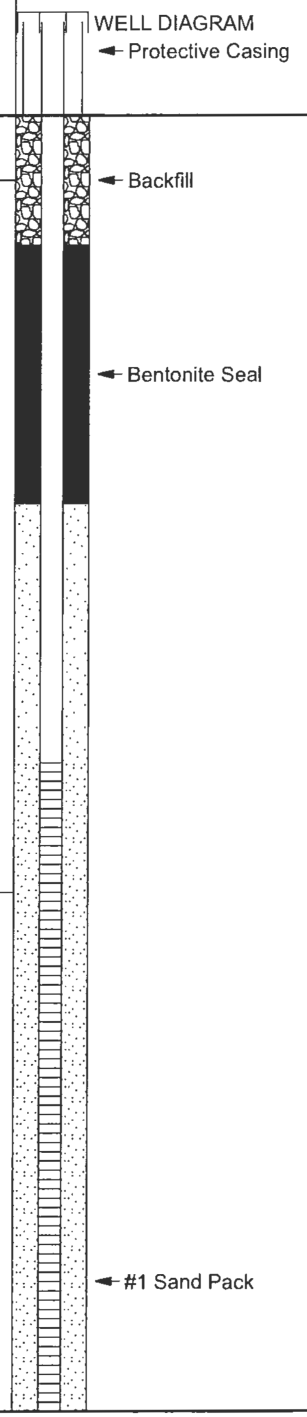
BORING NUMBER MW23-4R

CLIENT	U.S Army Corps of Engineers	**PROJECT NAME**	OD Grounds - Perchlorate Sampling
PROJECT NUMBER	748268.03200	**PROJECT LOCATION**	Romulus, New York
DATE STARTED	5/31/18 9:10 **COMPLETED** 5/31/18 10:30	**GROUND ELEVATION**	**HOLE SIZE** 6 inches
DRILLING CONTRACTOR	NYEG Drilling	**GROUND WATER LEVELS:**	
DRILLING METHOD	Truck Mounted Auger	∇ **AT TIME OF DRILLING**	2.00 ft
LOGGED BY	Cory Mahony **CHECKED BY** Todd Belanger	**AT END OF DRILLING**	---
NOTES		**AFTER DRILLING**	---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	45-FS-SS-MW23-4R-10017-0-0.5		Topsoil/vegetation
0.5			Dry, brown SILT, some gravel, no odor or stains
	45-FS-SB-MW23-4R-10018-1.5-2.0		∇
2.5			
5.0			
6.0			Dry, gray SILT, little gravel, no odor or stains
7.5			
10.0			



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BORING NUMBER MW23-4R

CLIENT U.S Army Corps of Engineers

PROJECT NAME OD Grounds - Perchlorate Sampling

PROJECT NUMBER 748268.03200

PROJECT LOCATION Romulus, New York

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG		MATERIAL DESCRIPTION	WELL DIAGRAM
10.0				Dry, gray SILT, little gravel, no odor or stains *(continued)*	0.01 inch slotted Schedule 40 PVC pipe
			11.0	Moist, dark gray CLAY and SILT (slightly plastic), no odor or stains	
12.5					
			14.0	Very wet, dark gray SILT, some fine sand, no odor or stains	
			14.5	Wet, dark gray CLAY (slightly plastic), some silt, no odor or stains	
15.0			15.0		

Bottom of borehole at 15.0 feet.

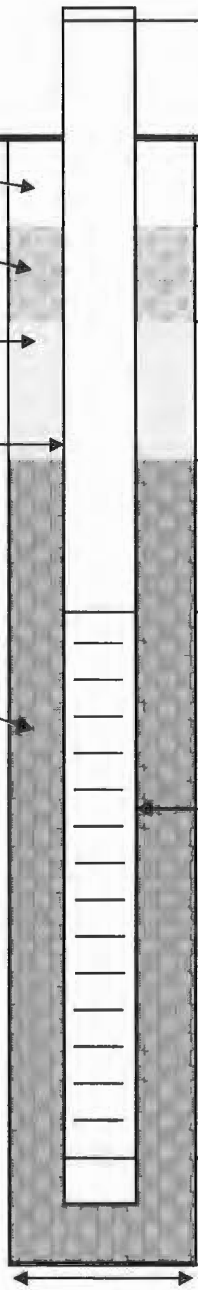
Well Construction Detail (Single Cased - Stickup)

Client: USACE

Well ID: MW23-4R

Date Well Installed: 5/31/2018

Location: OD Grounds



Top of Well Casing: +__3__ ft

	Depth Below Ground Surface (ft)
Ground Surface	0.0
Top of Backfill	0.0 ft
Top of Bentonite	1.0 ft
Top of Sand Pack	3.0 ft
Top of Screen	5.0 ft
Bottom of Screen	15.0 ft
Bottom of Borehole	15.0 ft

Cement

Backfill

Bentonite

Well Riser

Diameter: 2 inch

Material: Schedule 40 PVC

Sand Pack

Type: #1

Well Screen

Diameter: 2 inch

Slot Size: 0.01 inch

Material: Schedule 40 PVC

__6__ inches

Top of Confining Unit (if present): Approximately 11 ft

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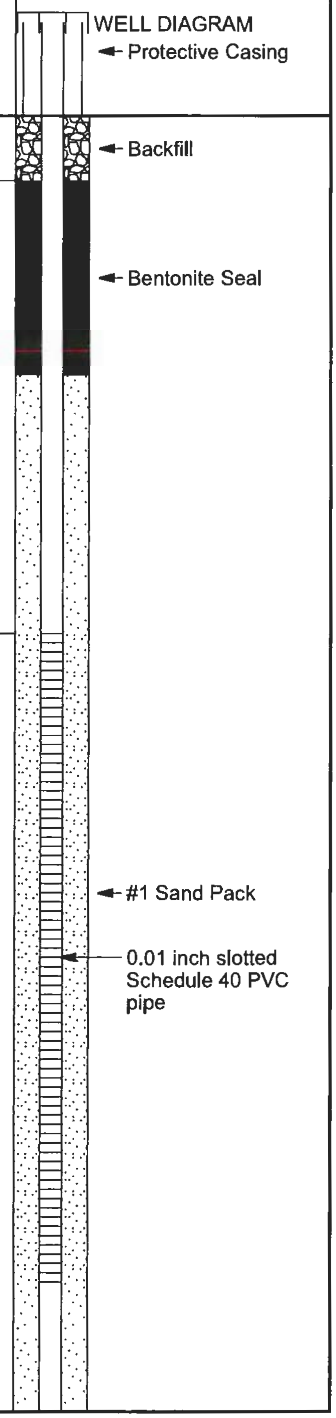
BORING NUMBER MW45-4R

CLIENT U.S Army Corps of Engineers
PROJECT NAME OD Grounds - Perchlorate Sampling
PROJECT NUMBER 748268.03200
PROJECT LOCATION Romulus, New York
DATE STARTED 5/31/18 12:30 **COMPLETED** 5/31/18 13:00
GROUND ELEVATION ____ **HOLE SIZE** 6 inches
DRILLING CONTRACTOR NYEG Drilling
GROUND WATER LEVELS:
DRILLING METHOD Truck Mounted Auger
∇ **AT TIME OF DRILLING** 4.00 ft
LOGGED BY Cory Mahony **CHECKED BY** Todd Belanger
AT END OF DRILLING ---
NOTES
AFTER DRILLING ---

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION
0.0	45-FS-SS-MW45-4R-10022-0-0.5		Dry, brown TOPSOIL and FINE GRAVEL
		0.5	Dry, brown SILT and GRAVEL, no odor or stains
2.5			
	45-FS-SB-MW45-4R-10023-3.5-4.0		
		4.0 ∇	Dry, gray SILT and ANGULAR GRAVEL, possibly weathered bedrock, no odor or stains
5.0			
7.5			
10.0		10.0	



Bottom of borehole at 10.0 feet.

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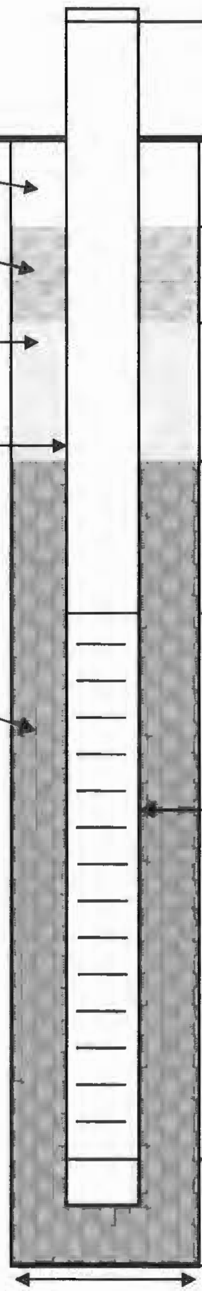
Well Construction Detail (Single Cased - Stickup)

Client: USACE

Well ID: MW45-4R

Date Well Installed: 5/31/2018

Location: OD Grounds



Cement

Backfill

Bentonite

Well Riser
Diameter: 2 inch
Material: Schedule 40 PVC

Sand Pack
Type: #1 Sand

Well Screen
Diameter: 2 inch
Slot Size: 0.01 inch
Material: Schedule 40 PVC

6 inches

	Depth Below Ground Surface (ft)
Top of Well Casing: + 3 ft	
Ground Surface	0.0
Top of Backfill	0.0 ft
Top of Bentonite	0.5 ft
Top of Sand Pack	2.0 ft
Top of Screen	4.0 ft
Bottom of Screen	9.0 ft
Bottom of Borehole	10.0 ft

Top of Confining Unit (if present): N/A

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APPENDIX G
RESPONSE TO COMMENTS

Army's Response to Comments from the United States Environmental Protection Agency

Subject: Final Feasibility Study Report

Munitions Response Action at Open Detonation Grounds

Seneca Army Depot

Romulus, New York

Comments Dated: November 25, 2015

Date of Comment Response: February 22, 2016

Comments Dated: March 22, 2016

Date of Comment Response: April 22, 2016

Date of Comment Response revision: November 30, 2018 (in track changes)

EPA GENERAL COMMENTS

Comment 1: It is our opinion that the Revised FS does not properly evaluate the alternatives presented within the subject document. The Revised FS does not reflect the CERCLA statutory preference for treatment of Principal Threat wastes (i.e. reactive and/or ignitable). The long term effects of underground munitions over an indefinite period of time for alternative 2 were not properly estimated. And the costs of implementing the remedy under alternative 3 appears to have been overestimated.

The Revised FS proposes to site a new landfill (identified in the Revised FS as the OD Hill) under alternative 2, but not all the elements of RCRA Subtitle D (solid waste landfill) ARARs were applied, including, without limitation, provision for requisite caps, liners, and groundwater monitoring. These requirements would be an action specific ARAR associated with moving solid wastes from one location and then placing them into a new landfill. As there is no such thing as a completely impermeable cap, RCRA requires liners and groundwater monitoring even for solid waste landfills. Provision in Alternative 2 of the Revised FS for further soil characterization prior to land disposal must be provided for. If the soils are classified as hazardous wastes, they would have to meet Land Disposal Restriction (LDR) treatment standards before the material could be land disposed. Additionally, alternative 2 should provide for a geophysical investigation of the surface and subsurface soils at the OD Hill before the new solid waste is consolidated at that location. These elements are more critical because the Army is planning to transfer this property to the public domain.

Army Response to General Comment 1: The Final FS (Revision ~~1~~3) includes six remedies which address 1) No Action, 2) LUCs only (with groundwater restriction), 3) consolidation and capping with surface/ subsurface clearance outside the OD Hill, 4) -Excavation of OD Hill and surface and subsurface clearance over the entire site, 5) Excavation of the entire site to 1ft bgs and perform surface/subsurface clearance, and 6) Excavation of the entire site and process for off-site disposal. A detailed review of all remedies is provided in the FS where the alternatives are weighed against criteria such as protectiveness, implementability, cost, and the effectiveness of each alternative to reduce the toxicity, mobility and volume of hazardous substances. The costs of the former alternative 3 (now alternative 4) are reviewed in the Army Response to Additional Comment 2, below. The remedy described in the former alternative 2 (now alternative 3) does not include a new landfill and, therefore, is not subject to RCRA Subtitle D requirements. Alternative 3 describes the design and installation of an engineered cap under which local impacted soils may be consolidated. Details of this remedy are in the FS and are described in Army Response to Additional Comment 1, below. The undesirable aspects of capping MEC in place are addressed in the evaluation of the alternative, and other alternatives are presented that are viable options.

NATURE AND EXTENT OF CONTAMINATION COMMENTS GENERAL COMMENTS

EPA Comment 1e: Section 1.3.2, Ditch Soil, discusses only three samples that were collected from drainage ditches at the site. However, Figure 1-4, Sediment, Surface Water, and Monitoring Well Locations at the OD Grounds, shows numerous Major Drainage Pathways, as designated by the green dashed lines on the figure, and only two of these drainages appear to have been sampled. These drainage pathways may represent areas with higher concentrations of contaminants due to lateral migration of potentially impacted soil and sediment during storm events. Therefore, it is unclear if drainage ditches at the site were adequately characterized or if additional sampling of ditch soil should be performed. Please revise the Final FS to discuss the adequacy of three samples to fully characterize the soils within the drainage ditches.

> **Army Response 1e:** The green lines on Figure 1-4 show major drainage pathways. These represent the dominant path that surface water runoff would follow. However, these drainage pathways are ephemeral and are not full of water year round. The FS also notes that the characteristics of the media in the drainage pathways are similar to soil; as such, the ditch soil samples are evaluated together with the soil samples. Therefore, a view of the combined soil and ditch soil datasets indicates that there is adequate coverage to characterize the surface soil across the site.

EPA evaluation of the Response to General Comment 1e: The response does not address the comment. The response states, "The green lines on Figure 1-4 show major drainage pathways. These represent the dominant path that surface water runoff would follow. However, these drainage pathways are ephemeral and are not full of water year round. The Revised FS also notes that the characteristics of the media in the drainage pathways are similar to soil; as such, the ditch soil samples are evaluated together with the soil samples. Therefore, a view of the combined soil and ditch soil datasets indicates that there is adequate coverage to characterize the surface soil across the site." This response does not take into consideration that the drainage pathway is an area that has received drainage from across the entire area and as such would likely receive concentrated amounts of the contaminants that could be historic and continuing sources of contaminant discharges into Reeder Creek. In addition, the figures in the Revised FS that present the soil sampling results (e.g., Figures 1-5B and 1-6A) do not show the drainage pathways (ditches), so it remains unclear if these pathways were characterized. Please modify the Revised FS to state that the drainage pathways symbolized by the green lines will be further characterized as part of the Remedial Design Work Plan (RDWP) to demonstrate that they are not historic and continuing sources of contaminant discharges into Reeder Creek. Alternatively, propose further characterization of Reeder Creek as part of the RDWP (e.g., quarterly sampling) to demonstrate that the drainage pathways were/are not historic and continuing sources of contaminant discharges into the creek.

> **Army Response 1e (2):** Due to the ephemeral nature of the drainage ditches, we believe that no further soil sampling of the drainage ditches is required and the drainage pathways will be removed from the figures. The drainage pathways are not permanent features at the OD Hill and should be removed so that the map is representative of site conditions at the OD Grounds. During the ESI, the drainage ditches were characterized as part of the surrounding soil area and four ditch soil samples were collected. Three of the samples were collected from the drainage ditches located downgradient of the OD Hill and the fourth sample was collected from a low-lying area northwest of the OD Hill. The ditch soil results are grouped with the soil results located in the OD Hill area.
>
> Additional soil samples may be collected as part of a confirmation sampling effort after the excavation at OD Grounds, and any drainage pathways leading to Reeder Creek will be inspected. The collection of sediment samples from Reeder Creek is not necessary because there is no active sediment deposition within Reeder Creek and no sediment to sample. Yearly inspections of Reeder Creek are performed as part of the OB Grounds LTM. These inspections have noted that only a thin layer of organic (i.e., decaying leaves) material is present within Reeder Creek. Erosional features along the Reeder Creek banks were not

observed. Currently, sand bags are located at the end of the ditches to trap any overland flow of soil towards Reeder Creek.

EPA evaluation of the Response to General Comment 1e (2): The response does not address the comment. The response indicates that the drainage pathways will be removed from figures and defines the drainage pathways as ephemeral. The response also states that there is no active sediment deposition within Reeder Creek and yearly inspections of the creek are performed as part of the Open Burning (OB) Grounds long-term monitoring (LTM). Since the historical drainage pathways will not be further characterized and contaminated soils will be disposed in a landfill within the Open Detonation (OD) Grounds, LTM of the surface water and sediment within Reeder Creek will be required as part of the OD Grounds remedy. Revise the Final Feasibility Study Report, Munitions Response Action at Open Detonation Grounds (the FS) to include the requirement for LTM of the surface water and sediment within Reeder Creek.

Army Response 1e (3): LTM of the sediment in and near Reeder Creek is currently a main element of the annual LTM conducted at the OB Grounds. Upon the time that a final remedy is selected in an updated FS, consideration will be given to the need for additional supplemental sediment and surface water sampling.

EPA Comment 1f: Section 1.3.3, Groundwater, indicates that the OD Grounds monitoring wells were last gauged and sampled in 1995, and two explosives, one SVOC, and numerous metals were detected at that time. Elevated metals results were attributed to turbid samples from the sampling methodology utilized. The text also indicates sampling of monitoring wells in the OB Grounds showed there was minimal contamination for metals and explosives during a 1996 assessment. Since these investigations were completed, only the OB Grounds monitoring wells have been sampled for lead and copper from 2007 to 2012. Section 1.3.3 states, "Although the OB Grounds are not immediately downgradient from the OD Grounds, the results from previous investigations at the OB Grounds site can be used as an analogue for the potential groundwater contamination expected in the adjacent OD Grounds." However, the text should provide additional information to support the use of the OB Grounds as an analogue for the OD Grounds. For example, numerous metals results were detected at the OD Grounds in 1995 and only minimal contamination was measured at the OB Grounds in 1996, so it is unclear why the current OB Grounds results would be considered similar to the current OD Grounds. It is also unclear why copper and lead are considered representative of all contaminants at the site, considering explosives and an SVOC were previously detected at the OD Grounds. Finally, the OB Grounds are located sidegradient from the OD Hill (see Figure 1-4), so the text should clarify why results for the OB Grounds would be considered analogous to the downgradient OD Grounds. Please revise the Final FS to provide justification for using recent lead and copper results from the OB Grounds as an analogue for the current conditions of the OD Grounds groundwater. Please also clarify why the assumption of turbidity at the OD Grounds leading to the elevated metals concentrations does not need to be confirmed to justify associated conclusions.

Response 1f: The detections in groundwater at the OD Grounds are limited to one VOC (TCE, detected once, no exceedances); one SVOC (bis(2-ethylhexyl)phthalate, detected four times, with four exceedances); two explosives (1,3-DNB and HMX, detected once each, no exceedances); and metals. A similar limited number of VOCs, SVOCs, and explosives were detected in the OB Ground groundwater. Numerous metals were detected in both the OD and OB Grounds sampling. OB Grounds and OD Grounds are adjacent to each other. Similar historic operations took place on the two sites, which would suggest similar distribution of contaminants. Based on the similar detections, the geography, and the historic use, it is appropriate to use the groundwater data from OB as an analog of the groundwater at OD Grounds. As mentioned in Section 1.3.3, the groundwater sampling methodology used during the 1995 ESI resulted in high turbidity in the samples. The elevated metals concentrations were likely due to the turbidity levels (e.g., values as high as 9860 nephelometric turbidity units [NTU]) and are associated with suspended particles rather than representative of actual conditions in the groundwater aquifer.

EPA Evaluation of the Response to General Comment 1f: The response does not address the comment. The response states, "The detections in groundwater at the OD Grounds are limited to one VOC (TCE, detected once, no exceedances); one SVOC, bis(2-ethylhexyl)phthalate, detected four times, with four exceedances); two explosives (1,3-DNB and HMX, detected once each, no exceedances); and metals. A similar limited number of VOCs, SVOCs, and explosives were detected in the OB Ground groundwater. Numerous metals were detected in both the OD and OB Grounds sampling." This response does not state that the OD and OB grounds results are the same. Instead the response uses words such as 'similar' and 'numerous' which do not provide sufficient justification to be the same. The text states that numerous metals results were detected at the OD Grounds in 1995 and only minimal contamination was measured at the OB Grounds in 1996. It is unclear why these two results would be considered similar if they are not the same. Please modify the Revised FS to provide justification and/or data statistical evaluation for using recent analytical results from the OB Grounds as an analogue for the current conditions of the OD Grounds.

Army Response 1f (2): The basis for using the OB Grounds data as an analogue of conditions at the OD Grounds is that the two sites share the same conceptual site model (CSM). The OB Grounds site is located within the OD Grounds and is adjacent to the OD Hill. Both the OD Grounds and the OB Grounds were operated as the same facility and the monitoring wells were placed to represent the entire facility. Due to the proximity, and inclusion, of the OB Grounds within the OD Grounds border, the groundwater within the OB Grounds will be representative of groundwater conditions at the OD Grounds. Both sites share contaminant sources, site locations, COCs, fate and transport, and potential receptors. The overlap of the CSMs leads to the conclusion that the data from one site would be representative of conditions at the other site.

EPA evaluation of the Response to General Comment 1f (2): The response does not address the comment. The response provides additional explanation for why the OB Grounds can be used as an analogue for the current groundwater conditions of the OD Grounds. Since the original response indicates that numerous metals were detected in both the OD and OB Grounds groundwater sampling and contaminated soils will be disposed in a landfill within the OD Grounds, LTM of the groundwater will be required as part of the remedy. Revise the FS to include the requirement for LTM of groundwater associated with the OD Grounds landfill.

Army Response 1f (3): The Army is planning to conduct two additional rounds of groundwater sampling for full suite of analysis, including perchlorates. This work is currently being contracted and is scheduled for Winter 2018 and Spring 2019. The FS will be updated with these results (including an update to the risk assessment) once the data are evaluated. Depending on the alternative selected in the future ROD, a long-term monitoring program for groundwater ~~will~~may be developed in the RD. ~~The Army performed remedial investigations focused upon the groundwater and the USEPA had previously agreed that the groundwater on site was not a concern. Consequently, it was agreed upon to remove the 6 wells installed near the OD Hill. Nonetheless, an the updated FS will be prepared withincludes groundwater restrictions and/or monitoring as a component of the alternative remedy. Alternative 2 includes a groundwater restriction. Alternative 3 includes a barrier wall to restrict movement of contaminated groundwater and subsequent LTM. Alternatives 4, 5, and 6 include a groundwater restriction and LTM. As stated in the FS, subsequent to the each remedial action, aa post RA groundwater sampling event will be conducted to confirm that the groundwater was not negatively impacted as a result of the remedial action.~~

EPA Comment 1h: Soil samples were not analyzed for dioxins/furans. Given the nature of activities at the site and the potential for the generation of dioxins/furans as a result of open burning/detonation activities, additional samples should be collected for these constituents to ensure an adequate dioxin/furan data set exists for site characterization and risk assessment, regardless of the sampling conducted at SEAD-23. Please revise the Final FS to describe how the data gap associated with the lack of dioxin/furan data will be addressed.

Response 1h: Dioxins and furans can be a concern related to open burning activities, but are not usually associated with OD activities and are not expected to have formed as part of any of the former activities at the OD Grounds. Multiple studies concluded that the extremely high temperatures and pressures that occur when explosives are detonated would not result in the formation of dioxins and furans at OD areas (EPA, 1998; Zellmer, 2004). Dioxin and furans formation is typically associated with low temperature, long residence time (e.g., not an explosive reaction), and the presence of chloride, organic material and a metal catalyst. Additionally, the human health risk assessment for the OB Grounds (Parsons ES, 1994) did not identify any risk associated with dioxins or furans. Therefore, the Army believes that there is no data gap related to dioxin and furan data.

EPA Evaluation of the Response to General Comment 1h: The response does not address the comment. The response states, "Dioxins and furans can be a concern related to open burning activities, but are not usually associated with OD activities and are not expected to have formed as part of any of the former activities at the OD Grounds. Multiple studies concluded that the extremely high temperatures and pressures that occur when explosives are detonated would not result in the formation of dioxins and furans at OD areas (EPA, 1998; Zellmer, 2004). Dioxin and furans formation is typically associated with low temperature, long residence time (e.g., not an explosive reaction), and the presence of chloride, organic material and a metal catalyst." However, there is a potential that dioxins/furans could be emitted/released during open detonation (OD) activities, and it is not clear that the operations at the OD unit were controlled such that dioxins and furans would not have been emitted/released as a result of OD operations. As discussed in EPA's Open Burning/Open Detonation Permitting Guidelines, dated February 2002 (Page 3-9), "It may be necessary for the facility to initially consider dioxins/furans if there is not available and sufficient generator or other knowledge which explicitly demonstrate that chlorinated wastes are not being treated by OB/OD." Please revise the response to propose further soil sampling which verifies that dioxins and furans are not present in soils at levels that pose unacceptable risk, or further revise the Revised FS to provide additional operation-specific information that demonstrates that chlorinated wastes were not treated to support the assertion that dioxins and furans would not have been released from this OD unit.

Army Response 1h (2): As stated previously, dioxins and furans are associated with incomplete combustion and not high-order detonation events. The kinetics of detonation reactions involve reaction of the explosives by a physical shock wave through the material, defined as greater than the speed of sound in the material. These kinetics do not generate dioxin and furan formation. Therefore, dioxins and furans are not expected to be associated with open detonation activities, these compounds were not included as part of the sampling program at the Open Burning Grounds RIFS or remediation, and should not be included as COCs for the Open Detonation Grounds.

Dioxin and furan sampling was not required for the OB/OD Grounds RCRA permit and no chlorinated wastes were treated at the OB/OD Grounds. Therefore, the precursors to dioxin and furan formation during burning were not present in the munitions treated by open burning and open detonation.

During the initial project discussion between the EPA, NYSDEC and Army, all Parties to the Federal Facility Agreement agreed that dioxins and furans were not COCs at any of the Seneca Army Depot sites.

ECOLOGICAL RISK ASSESSMENT COMMENTS SPECIFIC COMMENTS

EPA Comment 1: Section 1.3.2, Ditch Soil, Page 1-10: The text includes contradictory statements regarding the exceedances of the commercial SCOs. This section states, "The single exceedance of the commercial SCOs was limited to cadmium, which was detected at the low-lying ditch soil sample location at a concentration of 25.6 mg/kg compared to the commercial SCO of 9.3 mg/kg. Cadmium, copper, and mercury were detected above the commercial SCOs in the drainage swale samples located downgradient of the OD Hill...." Please revise the text to clearly state which metals exceeded the commercial SCOs.

Army Response to Comment 1: Section 1.3.2 was clarified and now reads as follows:

> A summary of the ditch soil analytical results from the ESI and a comparison to the Commercial SCOs is presented in Table 1-2. The results show that arsenic, cadmium, copper, and mercury were detected at concentrations above their respective Commercial SCOs. Arsenic exceeded its commercial SCO once with a concentration (16.1 mg/kg), similar to the SCO value (16 mg/kg). Cadmium, copper, and mercury each exceeded their Commercial SCOs twice at locations downgradient of the OD Hill. Compared to EPA Industrial RSLs, only arsenic (16.1 mg/kg) was found to exceed its EPA Industrial RSL (1.6 mg/kg) in four of four samples (EPA, 2012). The ditch soils are grouped with surface soil results because extensive RI data for the Open Burning Grounds showed that all drainage ditches and Reeder Creek sediment (at the time) were consistent with levels of metals in all the soil data, including background levels. Therefore there is no distinction between ditch soils and surface soils.

EPA Evaluation of the Response to Specific Comment 1: The Army's response to Specific Comment 1 is adequate. It specifies that a BERA for the OB Grounds was completed during the RI. The response also summarizes the reasons why ecological risk is not expected to be a concern at the OB Ground. However, a review of the Revised FS shows that the response to General Comment 1 provided in the Army's September 25, 2015 Army RTC memorandum is not included in the report. Amend the Revised FS by including a new section following Section 1.5 (Human Health Risk Assessment) to summarize the BERA results as provided in the Army RTC to General Comment 1.

Army Response Comment 1 (a): A BERA ~~focused on the~~for the OD Grounds was ~~completed during the RI at the OB Grounds. The OB Grounds is adjacent to, and surrounded by, the OD Grounds. There is no significant difference in the environmental setting and natural communities hosted by each site. As stated in Army Response to Comment 1f (2), both sites share a CSM. The COPCs at each site are similar and the concentrations of these COPCs are not notably different. Copper and lead were found to be drivers of ecological risks at the OB Grounds. Based on a comparison of EPCs and maximum values from each site, the ecological risks are expected to be similar at the OD Grounds. The following text was added to new section 1.6 Baseline Ecological Risk Assessment in the FS:~~

> ~~A BERA was completed during the RI at the OB Grounds. The OB Grounds is adjacent to, and surrounded by, the OD Grounds. There is no significant difference in the environmental setting and natural communities hosted by each site. The COPCs at each site are similar and the concentrations of these COPCs are not notably different. Copper and lead were found to be drivers of ecological risks at the OB Grounds. Based on a comparison of EPCs and maximum values from each site, the ecological risks are expected to be similar at the OD Grounds~~completed as part of the Final FS (Revision ~~1~~3). A detailed summary of the Baseline Ecological Risk Assessment is provided in Section 4.5 of Appendix E of the FS and the full BERA is provided in Appendix B2 of the FS.~~and is included as Appendix B2. A summary of the BERA is included in Section 1.6 of the FS text.~~

Additional General Comments generated during EPA review of the Revised FS.

Additional Comment 1. The Revised FS Army RTCs do not provide a clear discussion of what has been done/will be done to the central portion of "OD Hill," which is not included in the remedial options presented in the Revised FS. A discussion of this issue should be included in the Revised FS to allow for an analysis of the overall actions proposed for remediation of the entire site and the interface of the proposed alternatives with those proposed/

already accomplished in the central portion of "OD Hill." If the explained actions at the central portion of the "OD Hill" have not included a one-hundred percent geophysical mapping and investigation of all selected anomalies, the reasons for this should be stated, along with the fact that any degradation of a proposed cap without removal of any munitions and explosives of concern (MEC) under the cap may eventually expose that MEC to potential human contact. In addition, deterioration of the munitions over time may result in contamination of the groundwater. These two issues would necessitate very long term surface inspection and groundwater monitoring. It should be noted that some of the munitions disposed at the site (i.e., the bomb, fragmentation, 4-pound M83 [Butterfly Bombs]) are extremely dangerous if fuzed (fuzes are installed when these bombs are manufactured), as they may contain clockwork time fuzes and/or anti-disturbance fuzes. Both of these fuze types contain cocked strikers, and any disturbance of unexploded items may initiate the arming and firing cycle and detonate the munition. Modify the Revised FS Army RTCs to address the issues noted above.

Army Response to Additional Comment 1: The FS has been updated, and the latest revision (1) describes the work completed to-date in the OD Hill area, and (2) clearly details how each alternative would address the OD Hill area. In addition, the concern that munitions may be leaking and impacting groundwater is also addressed.

Alternative #	OD Hill Area	Groundwater
Alternative 2: LUCs only, including groundwater use restrictions	LUCs to prevent access. Note that this alternative is ruled out since it would not achieve ARARs).	monitoring the groundwater, and if impacts are observed in the groundwater, then the protectiveness of the remedy would be re-evaluated during a 5-year review.
Alternative 3: Consolidate and cap with surface and subsurface clearance outside the cap and LUCs	Caps the MEC in place to prevent access.	Potential groundwater concerns from leaching MEC are addressed by installing a low permeability barrier wall to prevent groundwater transport.
Alternatives 4, 5, and 6: Excavate OD Hill and varying levels of surface/subsurface clearance across the site	Removes the MEC from the OD Hill Area	Removal of source area of MEC impacts on groundwater

~~The geophysical mapping and investigation of targets will be performed up to the "OD Hill" in all areas that are not under the cap. A surface sweep, which is a visual inspection, will be performed on the OD Hill prior to and during earthwork for capping. Any observed MEC will be removed during the operations. DDESB allows MEC in engineered caps and has approved this in the ESS for this OD Grounds. The engineered cap functions to minimize the potential for human contact as well as the potential for leaching into groundwater. A barrier wall provides an additional method of protectiveness for the migration of groundwater.~~

Regarding the types of munitions and fuzes, the OD Grounds was not a range where munitions were fuzed, armed, and functioned as designed. Most ammunition is stored unfuzed and the fuze is treated separately through burning. The Depot performed extensive disassembly operations on the munitions that were to be treated. They had a large and well established contained burn pan which was used for the disposal of fuzes, small items, and WP warheads. The only portion of the M83 butterfly bomb that was found during munitions clearance work were bomb casings.

The applicable munitions hazards are addressed in the FS as part of the MEC ~~HA~~Risk Assessment. The MEC ~~HA~~ Risk Assessment is provided as Appendix C in the FS. ~~Although the munitions disposed of at the OD Grounds were not stored fuzed and were not previously used (i.e., fired or operated as intended), the MEC Classification category selected as part of the MEC HA was "Sensitive UXO" as the most conservative assumption.~~

Based on the data from the ~~Muntitions~~Munitions Response Action ~~Data~~ (2012-2014), ~~The~~ the percentage of all items found that were determined to be MEC (DMM or UXO) is ~~less than~~approximately ~~1~~14% of MPPEH items and ~~less than~~approximately ~~1 3 x 10^{-4-3}~~0.2% of ~~targets~~ all metal items found during the ~~investigated~~investigation. This is to be expected, as the activities were designed to safely destroy the munitions.

~~Regarding the potential for MEC to be present under the cap, and the potential to deteriorate and cause groundwater contamination, CERCLA allows wastes in place in engineered caps. These remedial actions monitor groundwater if necessary to ensure protection of groundwater.~~

Additional Comment 2. Table C-2C: Excavation and sifting for alternative 3 is quoted in the amount of 160,000 cubic yards. However, according to Parsons' estimates, "the topographic investigation concluded that bedrock underlying the area of the OD Hill mound is estimated to vary from 10 to 20 ft. bgs. Based on the topographic survey, the estimated volume of the earthen mound above ground surface is 38,000 cubic yards (cy). The estimated volume of soil in the OD Hill above bedrock surface is 75,000 cy (Parsons, 2010)." There are a handful of sites, nationwide, in excess of 100,000 cubic yards of contaminated soils, and they are mostly ammunition plants. The 160,000 cubic yards calculation used by the Army for alternative 3 cost estimates does not seem to be supported by the existing data. In addition to the overestimation of total soils volume, not all soils at the OD Hill would have to be treated and/or disposed if a commercial future use assumption is applied. Please provide an explanation for this apparent cost overestimation.

Army Response to Additional Comment 2: The volume of soil for excavation and mechanical separation~~sifting~~ is based on the need to remove MPPEH from the soil more than to evaluate and remove MC/COPC contaminated soil. While the footprint of the MC/COPC contaminated soil is anticipated to overlap with the MEC/MPPEH contaminated soil, it is anticipated that the volume requiring mechanical separation~~sifting~~ for MPPEH reasons will be larger than the volume of soil that may exceed commercial risk levels for MC/COPCs. The original 160,000 CY estimate was made assuming a 4-foot removal depth over the extent of the area within 500ft of the center of the OD Hill in addition to the full volume of the OD Hill above ground surface.

The latest revision to the FS has included new alternatives and a new evaluation of cost. Due to earthworks during the operation of the OD Grounds, ~~MPPEH~~DMM/UXO is anticipated to be potentially present within the entire volume of the OD Hill (estimated at between 31k and 38k cubic yards).

The following assumptions were made with regard to the volume of soil included under each alternative.

- Under Alternative 3, soil with dense metal will be put under the cap. Assume the cap will include the OD Hill and ~35,000 CY from other contaminated areas. This assumes 29k CY of soil from 500ft buffer area and additional 6k CY of contaminated soil from outside this area. Based on trenching within the vicinity of the OD Hill it is anticipated that not all areas within the 500ft buffer will contain dense metal debris; however, it is also anticipated that there would be many areas where deeper excavations to 2, 3 or 4 feet bgs may be needed to clear the dense metal debris. Therefore, an average removal depth of 1 foot bgs over the entire area within 500 feet of the OD hill is assumed.
- Under Alternative 4, it is assumed only the OD Hill itself is removed for mechanical separation~~sifting~~ and other dense metal areas will be dug during DGM operations.
- Under Alternative 5, it is assumed that the OD Hill and 1 foot of soil over the entirety of the MRS will be dug and processed via ~~a sifting~~mechanical separation operation.

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Army's Response to Comments from the United States Environmental Protection Agency

Subject: Draft Final Feasibility Study Report
Munitions Response Action at Open Detonation Grounds
Seneca Army Depot
Romulus, New York

Comments Dated: July 8, 2013

Date of Comment Response: February 27, 2015

Army's Response to Comments

GENERAL COMMENTS

Comment 1. Evaluation of the Response to General Comment 2: The response to General Comment 2 is inadequate. A baseline human health risk assessment (BHHRA) and baseline ecological risk assessment (BERA) have not been proposed to evaluate potential risks associated with munitions constituents (MC) detected at the site and the rationale provided for not assessing risks associated with MC is inadequate. While the risks posed by material potentially presenting an explosive hazard (MPPEH) is currently driving the need for a remedial action at the site, it is important to determine whether any chemical exposure risk needs to be addressed for current or future potential receptors (both human and ecological) exposed to MC in site media, particularly for those areas outside the proposed cap or excavation boundaries or posed by media that are not addressed by these proposed remedies. As stated in 40 CFR 300.430(d)(4), a site-specific baseline risk assessment shall be used "to characterize the current and potential threats to human health and the environment that may be posed by contaminants migrating to ground water or surface water, releasing to air, leaching through soil, remaining in the soil, and bioaccumulating in the food chain. The results of the baseline risk assessment will help establish acceptable exposure levels for use in developing remedial alternatives in the FS."

In addition, the response to this comment suggests that metals in soil are the only possible chemicals of concern in media at this site. Unless a more thorough risk evaluation is conducted, it is unclear if additional media or chemicals need to be considered during evaluation of remedial alternatives. Section 1.3.1, Soil, notes that 2,4-dinitrotoluene and Aroclor-1254 were detected above screening criteria in soil at the site in addition to the metals previously noted; Section 1.3.2, Groundwater, identifies metals, two explosives, and one semi-volatile organic compound (SVOC) in groundwater; Section 1.3.3, Surface Water, notes that metals and nitroaromatics were detected in surface water; and Section 1.3.4, indicates that metals were detected in sediment. A BHHRA and BERA are warranted to determine potential risks to human health or the environment posed by these contaminants.

Response 1: A human health risk assessment was developed and is included in the FS as (Appendix B. A summary of the HHRA is presented in Section 1.5.

As discussed in the Technical Memo dated August 27, 2013, 2,4-DNT and Aroclor-1254 were not determined to be pervasive contaminants within the OD Grounds soil. Metals in the soil, specifically within the 0-500 foot radius, were determined to be the COCs.

A total of ninety-seven soil samples (92 surface soil and five subsurface soil) were collected and analyzed for inorganic metals [2013 Draft Final FS Report, Figures 1-5A and 1-5B show the locations of the soil samples collected at the OD Grounds. A summary of surface and subsurface soil exceedances are presented in Table 1-1.]. 70 samples were collected within the 500 foot OD Hill radius. The remaining 27 samples were collected between 500 and 2000 feet (Kickout Area) from the OD Hill to delineate the extent of any impacts to the surface soil within the Kickout Area. Forty-seven samples (42 surface and 5 subsurface) were collected and analyzed for explosives and thirty-five samples (30 surface, 5 subsurface) were analyzed for SVOCs, herbicides, pesticides, and PCBs. Sixteen samples were analyzed for VOCs. None of the VOCs, herbicide, or explosive results exceeded their respective screening criteria (November 2012, EPA Regional Screening Levels (RSL) for industrial soil and the NYSDEC approved Remedial Program Soil Cleanup Objectives (EPA, 2012; NYSDEC, 2013a). 6 NYCRR Subpart 375-6, effective December 2006).

The SVOC concentrations were all below the Commercial SCOs; however, one result from the SVOC analysis was an explosive, 2,4-dinitrotoluene, which reported a concentration (14,000 μg/kg) that exceeded its respective industrial RSL (5,500 μg/kg) (a corresponding SCO value is not available) in one sample. This sample (TP45-2) was collected at a location on top of OD Hill. However, using the appropriate analytical method for explosive analysis, the same sample resulted in a concentration of 190 μg/kg. Also, this was the only exceedance of the RSL for 2,4-DNT in the SVOC results. The maximum concentration of 2,4-DNT detected using the explosive analytical method was 1,100 μg/kg (S45-ODH-18-01). This value is below both the industrial RSL and the residential RSL of 1,600 μg/kg. Other nearby detections of 2,4-DNT were well below applicable screening criteria; therefore, the Army does not believe that the site was impacted by 2,4-DNT and it is not considered a contaminant of concern. The OD Hill area will be addressed by one of the remedial alternatives proposed in the FS, and any elevated concentrations in the soil would be addressed at that time.

The concentration of one PCB, Aroclor-1254, exceeded both its commercial SCO and industrial RSL screening criteria in one sample. The elevated concentration of Aroclor-1254 appears to be an isolated occurrence. Aroclor-1254 was detected at two soil sample locations. The maximum concentration (2,000 μg/kg) of Aroclor-1254 was detected in the surface soil sample S45-ODH-4-01 located on the eastern side of the OD Hill. This concentration is above the NYS Commercial SCO value of 1,000 μg/kg. The second detection of Aroclor-1254 in the surface soil was observed in the sample duplicate collected at SS45-10 at an estimated concentration of 110 J μg/kg, below the commercial SCO; Aroclor-1254 was not detected in the duplicate's associated sample. Aroclor-1254 was not detected in the subsurface soil or in groundwater. Based on the fact that the PCB was not detected in any other samples on or surrounding the OD Hill, and groundwater sampling has confirmed that the PCB has not migrated to groundwater, Aroclor-1254 is not considered a constituent of concern.

Among the metals, cadmium, copper and mercury were the only metals to exceed their respective Commercial SCOs. Arsenic, cadmium, and lead exceeded their respective industrial RSLs. Analytical soil data demonstrate that concentrations of metals are higher closer to the OD Hill, and concentrations decrease as the distance increases from the OD Hill and into the Kickout area of the OD Grounds. This is illustrated in Draft Final FS, Figures 1-6A and 1-6B. There were no exceedances of NYSDEC Commercial SCOs in the Kickout area.

Comment 2. Evaluation of the Response to General Comment 3: The response to General Comment 3 is partially adequate; however, additional clarification is necessary. As noted in the response, the definition of a commercial land use category by the New York State Department of Environmental Conservation (NYSDEC) includes "passive recreational uses, which are public uses with limited potential for soil contact." Since the anticipated future land use of the OD Grounds is for conservation/recreation purposes, the types of recreation that are anticipated should be identified to ensure that they constitute "passive recreational uses" so that application of the commercial land use criteria are adequately protective. The response also states that activities such as "camping or digging" will not be allowed at the site, yet Section 4.2.1.1, Overall Protection of Human Health and the Environment, of the Draft Final FS notes that "campers" are anticipated future recreational users at this site. Please provide further clarification of the anticipated future activities at the site in support of the identification of the NYSDEC Soil Cleanup Objectives (SCOs) for a commercial use scenario as the most relevant and appropriate criteria for the site. In addition, please ensure that the future anticipated activities at the site are consistently documented throughout the Response to Comments and Draft Final FS.

Response 2: The text was updated in Section 1.2.2 to describe passive recreational uses. "*The planned future use for OD Grounds is for conservation and passive recreational purposes where there is a limited potential for soil contact.*" The report was checked for consistency. The mention of "campers" in Section 4.2.1.1 was removed.

Comment 3. Evaluation of the Response to General Comment 4: The response to General Comment 4 is inadequate. The nature and extent of MC in surface soil, subsurface soil, sediment, surface water, and groundwater at the OD Grounds has not been sufficiently characterized. Examples of outstanding data gaps in the characterization of MC are identified below:

Bullet 1: Aroclor 1254 was detected above the NYS SCO for commercial use in surface soil sample S45-ODH-4-01, but the vertical and lateral extent of this contamination has not been delineated. According to Table A-1, Analytical Data for Surface and Subsurface Soil Samples at OD Grounds, in Appendix A, the closest sample to this location (S45-R1-04), as shown on Figure 1-5B, Historic Soil Sample Locations at OD Grounds (OD Hill Area), was not analyzed for polychlorinated biphenyls (PCBs). In addition, no subsurface soil samples appear to have been collected at S45-ODH-4-01, which reported the initial exceedance in surface soil. Additional sampling to delineate the lateral and vertical extent of this contamination appears warranted. Please revise the FS to clarify how this data gap will be addressed.

Response Bullet 1: The concentration of one PCB, Aroclor-1254, exceeded both its commercial SCO and industrial RSL screening criteria in one sample. The elevated concentration of Aroclor-1254 appears to be an isolated occurrence. Aroclor-1254 was detected at two soil sample locations. The maximum concentration (2,000 µg/kg) of Aroclor-1254 was detected in the surface soil sample S45-ODH-4-01 located on the eastern side of the OD Hill. This concentration is above the NYS Commercial SCO value of 1,000 µg/kg. The second detection of Aroclor-1254 in the surface soil was observed in the sample duplicate collected at SS45-10 at an estimated concentration of 110 J µg/kg, below the commercial SCO; Aroclor-1254 was not detected in the duplicate's associated sample. Aroclor-1254 was not detected in the subsurface soil or in groundwater. Based on the fact that the PCB was not detected in any other samples on or surrounding the OD Hill and groundwater sampling has confirmed that the PCB has not migrated to groundwater, Aroclor-1254 is not considered a constituent of concern. Additionally, the sample location is expected to be covered by an impervious cap preventing any further potential migration.

Bullet 2. 2,4-dinitrotoluene was detected in subsurface soil sample TP45-2 at a concentration greater than the industrial Regional Screening Level (RSL) (no NYS SCO has been established), but the extent of this contamination has not been delineated. According to Table A-1, Analytical Data for Surface and Subsurface Soil Samples at OD Grounds, of Appendix A, the closest surface soil sample to this location (S45-R1-02), as shown on Figure 1-5B, Historic Soil Sample Locations at OD Grounds (OD Hill Area) was not analyzed for SVOCs or explosives so it is unknown if surface impacts exist. Please revise the FS to clarify how the extent of 2,4-dinitrotoluene contamination will be adequately delineated.

Response Bullet 2: The SVOC concentrations were all below the Commercial SCOs; however, one result from the SVOC analysis was an explosive, 2,4-dinitrotoluene, which reported a concentration (14,000 µg/kg) that exceeded its respective industrial RSL (5,500 µg/kg) (a corresponding SCO value is not available) in one sample. This sample (TP45-2) was collected at a location on top of OD Hill. However, using the appropriate analytical method for explosive analysis, the same sample resulted in a concentration of 190 µg/kg. Also, this was the only exceedance of the RSL for 2,4-DNT in the SVOC results. The maximum concentration of 2,4-DNT detected using the explosive analytical method was 1,100 µg/kg (S45-ODH-18-01). This value is below both the industrial RSL and the residential RSL of 1,600 µg/kg. Other nearby detections of 2,4-DNT were well below applicable screening criteria; therefore, the Army does not believe that the site was impacted by 2,4-DNT and it is not considered a contaminant of concern. The OD Hill area will be addressed by one of the remedial alternatives proposed in the FS, and any elevated concentrations in the soil would be addressed at that time.

Bullet 3. Figure 1-4, Sediment, Surface Water, and Monitoring Well Locations at the OD Grounds, shows numerous Major Drainage Pathways, as designated by the green dashed lines on the figure, but very few of these drainages appear to have been sampled. These drainage ways may represent areas with higher concentrations of contaminants due to lateral migration of potentially impacted soil and sediment during storm events. Additional sampling of these drainage ways appears warranted. Please revise the FS to address this data gap.

Response Bullet 3: The surface water samples were collected from drainage swales that were typically dry and the water sampled likely represented surface runoff from a recent precipitation event, rather than site surface water. The four surface water samples collected were from ephemeral drainage ditches and a low-lying swale. These on-site surface water pools are not classified by NYSDEC as surface water bodies and therefore NY Ambient Water Quality Concentrations (AWQC) do not apply. Surface water is not considered a media of concern.

Bullet 4. It is unclear if surface water and sediment have been evaluated adequately at the OD Grounds. Figure 1-4, Sediment, Surface Water, and Monitoring Well Locations at the OD Grounds, shows numerous surface water and sediment sampling locations, but data from only four surface water/sediment sampling locations have been provided in Appendix A, Table A-3, Analytical Results for Surface Water Samples, and Table A-4, Analytical Results for Sediment Samples at OD Grounds. In addition, the analytical results from the Reeder Creek samples do not appear to have been provided. Please revise the FS to present a more thorough discussion of the nature and extent of contamination in surface water and sediment, supplemented with data summary tables for all applicable samples.

Response Bullet 4: Surface water and sediment results from previous reports will be included in the FS. Reeder Creek is the only recognized surface water body within the OD Grounds. No significant impacts to the surface water or sediment in Reeder Creek were found by previous studies. Any contaminated sediment associated with Reeder Creek was removed during the Seneca OB Grounds remediation (Weston, 2005). Refer to the Technical Memo for further detail.

Bullet 5. Shallow subsurface soil at the site has not been adequately characterized. According to Table A-1, Analytical Data for Surface and Subsurface Soil Samples at OD Grounds, only six soil samples were collected at depths greater than 0.5 (ft) feet below ground surface (bgs) (TP45-1, TP45-11, TP45-2, TP45-3, TP45-4, and TP45-5.) All six of these subsurface soil samples were collected at 3 ft bgs. Section 1.2.6.3, 2003 Phase I Geophysical Investigation, indicates that the majority of excavated anomalies from the 2003 investigation were found at depths of up to 12 inches bgs, with none exceeding 20 inches bgs. Shallow subsurface soil samples should be collected at similar depths to evaluate potential impacts from MC. Please revise the FS to address this data gap.

Response Bullet 5: Other than metals, impacts by other COCs were not found in the subsurface soil samples collected. Locally, groundwater was determined to not be a media of concern. Subsurface soil will be either excavated and the excavated surface sampled prior to emplacement of a cap or confirmatory samples will be taken prior to emplacement of a cap.

Bullet 6. The extent of metals contamination has not been well delineated in the northeast and southeast quadrants within the 500-foot radius from the OD Hill center point, as minimal sampling appears to have been conducted in these areas (Figure 1-6A, Metals Exceedances in Soil at the OD Grounds). Please revise the FS to address this apparent data gap.

Response Bullet 6: Subsequent to the RA selected for the 0 to 500-foot radius, confirmatory samples will be collected and the northeast and southeast quadrants will be further delineated. Soil within this radius is expected to be included under the cap. Soil outside the cap will be tested for compliance.

Bullet 7. Groundwater at the OD Grounds monitoring wells has not been sampled or gauged since 1995. Two explosives, one SVOC, and numerous metals were detected in groundwater during the 1995 assessment. Section 1.3.2, Groundwater, indicates the elevated metals results were attributed to turbid samples from the sampling methodology utilized; however, this conclusion should be confirmed with a more recent round of groundwater data. Groundwater samples should be collected using low-flow methodology to minimize the potential impact of turbidity.

Response Bullet 7: Between 2007 and 2012, LTM of wells within the OB Grounds for copper and lead has shown no evidence of lead or copper in the groundwater above the cleanup goals subsequent to the completion of the remedial action for the Site. These findings are consistent with the groundwater analytical results obtained during the RI stage (1990s) of work at the Site, indicating that there is no evidence of groundwater quality deterioration over approximately 20 years.

Bullet 8. It does not appear that any soil samples were analyzed for dioxins/furans based on the analytical descriptions in Section 1.2.6, Previous Investigations and Activities, as well as the response to this comment. Given the nature of activities at the site and the potential for the generation of dioxins/furans as a result of open burning/detonation activities, additional samples should be collected for these constituents to ensure an adequate dioxin/furan data set for site characterization and risk assessment, regardless of the sampling conducted at SEAD-23.

Response Bullet 8: Dioxin and furan testing was not considered as part of the confirmation testing program for this site. The precedence set at SEAD-23 was used as the basis for testing requirements here since the entire SEAD-23 is wholly within this site. The Army did not expect to be required to reopen the previously agreed on conditions and considered them as an acceptable basis for the remedial action proposed.

Response 3: The FS was addressed as per above responses. Additional data tables regarding historical soil, sediment, and groundwater samples referenced in the text were provided in the Technical Memo.

Comment 4. Evaluation of the Response to General Comment 6: The response to General Comment 6 is inadequate. The Draft Final FS still uses inconsistent screening criteria to evaluate site sediment data. Table 1-4, Summary of Sediment Data, identifies the NYSDEC Commercial SCOs (6 NYCRR Subpart

375-6) as the applicable screening criteria for sediment whereas Table A-4, Analytical Results for Sediment Samples at OD Grounds, of Appendix A compares sediment data to the NYS SCO Unrestricted Use values. In addition, while the NYSDEC Commercial SCOs may be applicable to the site pending additional clarification of future activities at the site (i.e. types of recreation), the sediment data should also be compared to appropriate ecological screening criteria. Please revise the Draft Final FS to compare the sediment data to consistent screening criteria throughout the text, tables, and appendices. Further, please compare the sediment data to appropriate ecological screening values.

Response 4: There is no expected residential use of any type (even with restrictions) due to the past use of the site as an OB/OD range and the planned future use of the land for conservation/recreation. As a conservative measure, the Army did consider the application of the Restricted Residential SCO; however, this objective was not appropriate since no type of residential use will be permitted at the site. The screening criteria presented in Table A-4 will be corrected to be consistent with Table 1-4. Any contaminated sediment in Reeder Creek was removed during the Seneca OB Grounds remediation (Weston, 2005). The sample results presented in the previous version of Table 1-4/A-4 are more representative of soil, as the samples were collected from drainage ditches. This sample medium is referred to as the 'ditch soil' in the FS, tech memo, and HHRA. Table 1-4 was renamed Table 1-2 (Summary of Ditch Soil Data). Table A-4 was revised to reflect Ditch Soil. Both tables use NYSDEC Commercial SCOs as screening criteria.

Comment 5. Evaluation of the Response to General Comment 7: The response to General Comment 7 is partially adequate. Section 2.5, General Response Actions, of the Draft Final FS has been revised to identify general response actions (GRAs) potentially applicable to the site; however, narrative discussion of these GRAs is limited to the "No Action" GRA and the "Hazard Management – LUCs" GRA. A discussion of each general response action as part of the "Remedial Action" category has not been included in Section 2.5. Please revise Section 2.5 to include a narrative discussion of each GRA included in the "Remedial Action" category.

Table 2-2, OD Grounds Feasibility Study – Technology Screening, should not include land use controls (LUCs) as both a subcategory of the Hazard Management GRA and the Remedial Action GRA. Hazard Management/LUCs should be defined as its own GRA, and institutional controls and engineering controls should be identified as the "Primary Remedial Technologies" as categories of this GRA. Please revise Table 2-2 to make this change.

Response 5: Further information regarding the "Remedial Action" category was added to Section 2.5.

> A remedial action alternative employs engineered approaches to reduce the toxicity, mobility, or volume (TMV) of contaminants in the subsurface, thereby preventing or minimizing exposure of receptors to MEC or chemical contamination that could pose an unacceptable MEC hazard or MC risk. Physical extraction methods are typically used to remove surface and subsurface MEC for disposal. The feasibility and cost to implement MEC excavation options can vary widely based on site-specific conditions and circumstances.

Further detail of each GRA is provided in Section 2.6.

Land use controls were removed from the Remedial Action GRA category in Table 2.2. Institutional and engineering controls were identified as primary remedial technologies.

Comment 6. Evaluation of the Response to General Comment 9: The response to General Comment 9 is partially adequate. While estimates of the excavation volume and cap size have been provided, the basis for these estimates is largely undefined. Without sufficient data to support these estimates, the evaluation criteria for each alternative cannot be consistently applied and order-of-magnitude cost estimates, having an accuracy of +50 percent to -30 percent, cannot be provided with any reasonable certainty. It is noted that Munitions and Explosives of Concern (MEC) activities are currently being conducted at the site. In addition, significant data gaps in the investigation of MC at the site have been identified. The data obtained from the MEC activities and any future MC characterization activities to address data gaps may provide valuable information to inform the FS process. It is therefore suggested that the final FS be postponed until additional data from the MEC and suggested MC characterization activities are collected and evaluated to better define the scope of the FS.

Response 6: During the development of alternatives within the FS, the estimate for the excavation volume and cap size are presented. More detailed information will be presented in a Remedial Design Work Plan which would provide more exact dimensions. All additional information on MEC characterization at the site will be provided in the Closure Report and will be used to inform the actual design work plan. Refer to response to Comment 1 for information regarding MC data gaps.

Comment 7. Evaluation of the Response to General Comment 10: The response to General Comment 10 is inadequate. Very little additional detail has been added to Section 4.0, Detailed Analysis of Retained Alternatives. The evaluation of each of the alternatives does not adequately address all aspects of the nine evaluation criteria as presented in the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (October 1988, EPA/540/G-89/004) (RI/FS Guidance). For example, for an evaluation of short term protectiveness, the FS should discuss the protection of the community during remedial actions, protection of workers during remedial actions, environmental impacts during implementation of the remedial action, and the time until remedial action objectives are achieved. Please review Figure 6-2, Criteria for Detailed Analysis of Alternatives, of the RI/FS Guidance for information on what specific aspects of each of the criteria should be addressed.

Response 7: Additional detail was added to Sections 4.3.2.2 and 4.3.3.2 regarding the additional criteria provided in the RI/FS Guidance. Section 4.3.2.2 as follows:

> This is a long-term solution as long as the cap is maintained and appropriate LUCs are emplaced. During remedial actions, the community is shielded from construction activities by security measures already in place at the site. The protection of site workers will be ensured by using trained UXO personnel and by providing other personnel with UXO Technician escorts.

Section 4.3.3.2 was updated as follows:

> This is a long-term solution as both the MEC source and any soil identified outside of appropriate screening criteria would be removed. During remedial actions, the community is shielded from

> construction activities by security measures already in place at the site. The protection of site workers will be ensured by using trained UXO personnel and by providing other personnel with UXO Technician escorts. The environment would be protected during excavation activities by using the proper construction best management practices.

Comment 8. Evaluation of the Response to General Comment 11: The response to General Comment 11 is partially adequate. Some revisions to the Comparative Analysis of Alternatives in Section 4.4 have been made; however, ambiguity remains when determining the overall ranking of the alternatives within each category as well as when identifying significant distinctions among the alternatives. For example, Section 4.4.4, Reduction of Toxicity, Mobility, or Volume Through Treatment, describes what Alternative 3 offers, what Alternatives 2 and 3 offer, and what Alternative 1 does not offer, but there is no clear indication of the alternative that performs best in this category.

In addition, Section 4.4.5, Short-Term Effectiveness, does not address the differences in the time needed to implement the remedies or the differences in worker or community protection afforded by the alternatives. Presenting additional details such as these may allow for further distinction among the alternatives. Please revise the comparative analysis to provide additional discriminating details for each of the alternatives within each category of evaluation. It is suggested that Table F-1, Individual Evaluation of Final Alternatives, Case Study, of the RI/FS Guidance be reviewed as an example of the level of detail necessary for a comparative analysis of alternatives.

Response 8: Additional text was added, where appropriate, within Sections 4.4.2 and 4.4.4 to address the best performing alternative in each category. Section 4.4.5 was updated to include further detail regarding the short-term effectiveness of each alternative as follows:

> No additional risk to the community, site workers, or the environment is provided by Alternative 1; however, Alternative 1 is determined to have the greatest risk and least short-term effectiveness due to no actions taken to remove the MPPEH and contaminated soil risk therefore a continued impact for existing conditions will persist.
>
> Locally, during implementation of Alternatives 2 and 3, a temporary increase in dust may be associated with cap installation and/or excavation; however, the local community is generally buffered from these activities due to the location of the site within SEDA. Both Alternative 2 and 3 would require UXO personnel who would be exposed to explosive hazards. Alternative 2 requires less excavation than Alternative 3 however both require the installation of a soil cap; therefore, protection would be required against dermal contact and dust inhalation during construction activities.
>
> Both Alternative 2 and 3 would provide similar short-term effectiveness in a similar amount of time (i.e., months). Alternatives 2 and 3 include demolition of recovered MPPEH thus reducing the explosive hazard at the site. Alternative 3, which includes off-site transportation and disposal, has a short-term negative impact of hauling materials on public roads outside of the Depot, which can impact the surrounding community.

Comment 9. Evaluation of the Response to General Comment 12: The response to General Comment 12 is partially adequate. It appears that the cost estimates have been revised to utilize a 2% discount rate; however, Section 4.2.2.5, Cost, of the Draft Final FS still indicates that a 7% discount rate was utilized. Please revise Section 4.2.2.5 to identify the 2% discount rate utilized for the evaluation.

Response 9: The text in Section 4.2.2.5 was corrected.

Comment 10. Evaluation of the Response to General Comment 13: The response to General Comment 13 is partially adequate. While some additional detail has been provided for the cost estimates, many of the lump sum costs included in the detailed cost estimates have not been substantiated. For example, as noted in the original General Comment 13, Table C-1C, Equipment and ODC Costs for Alternative 2, of Appendix C, Detailed Cost Estimate, included a $300,000 estimate for "Other travel" without describing the basis for the estimate.

The Draft Final FS still does not include a breakdown of costs associated with "Other travel." A lump sum cost for hydroseeding ($55,000) has also been added to Table C-1D, Subcontractor Costs for Alternative 2, but the assumptions inherent in this estimate have not been provided (cost per acre, number of acres requiring hydroseed, etc.). Revise the Draft Final FS to ensure all assumptions used in the cost estimates for all of the alternatives evaluated are noted and substantiated. In addition, as previously noted in original General Comment 13, but not addressed in the response or Draft Final FS, all acronyms and abbreviations used in the Appendix C tables should be defined within the tables.

Response 10: The costs presented in the FS are estimates based on the currently available data. Other travel includes activities such as field mobilization/demobilization, site visits, and meetings. As stated in the RI/FS Guidance:

> Typically, alternatives will have been defined well enough before screening that some estimates of cost are available for comparisons among alternatives. However, because uncertainties associated with the definition of alternatives often remain, it may not be practicable to define the costs of alternatives with the accuracy desired for the detailed analysis (i.e., +50 percent to -30 percent).
>
> Absolute accuracy of cost estimates during screening is not essential. The focus should be to make comparative estimates for alternatives with relative accuracy so that cost decisions among alternatives will be sustained as the accuracy of cost estimates improves beyond the screening process. The procedures used to develop cost estimates for alternative screening are similar to those used for the detailed analysis; the only differences would be in the degree of alternative refinement and in the degree to which cost components are developed.

Comment 11. Evaluation of the Response to General Comment 14: The response to General Comment 14 is partially adequate. The response notes that excavated soil will be staged on-site for potential re-use and/or incorporation under the site cap; however, this information has not been incorporated into all applicable sections of the Draft Final FS. The Executive Summary appears to have been revised appropriately, but Section 3.2.2, Alternative 2, Geophysical Mapping/Intrusive Investigation/Capping/ LUCs, of the Draft Final FS still states that overburden may be incorporated into the site cap, not placed under it. Please revise the Draft Final FS to consistently state, in all applicable sections, that excavated soil may be placed under the proposed cap and remove any reference to incorporating excavated soil into the cap.

Response 11: The document was scrubbed for consistency. Overburden may be placed under the cap. Sections 3.2.2 and 4.3.2.1 were updated to incorporate this change.

Army's Response to Comments from the United States Environmental Protection Agency

Subject: Draft Feasibility Report
Munitions Response Action at Open Detonation Grounds
Seneca Army Depot
Romulus, New York

Comments Dated: October 18, 2012

Date of Comment Response: April 17, 2013

Army's Response to Comments

GENERAL COMMENTS

Comment 1. The FS does not clearly identify the boundaries of the Open Detonation (OD) Grounds. Figure 1-3, OD Grounds Site Plan, shows the OD Hill Area in blue shading, but it is unclear if the OD Hill Area represents just a portion of the OD Grounds or if the OD Grounds extends beyond this boundary. Section 1.2.1, OD Grounds Description, indicates that the OD Grounds consists of 365 acres. A clearly defined boundary for the OD Grounds, which encompasses these 365 acres of land, needs to be included in the FS to better portray the area that is addressed by this FS. Revise the FS to include site figures that clearly portray the boundaries of the OD Grounds.

Response 1: Figure 1-3 has been renumbered as Figure 1-2, and has been updated to better distinguish the extent of the OD grounds. The text was updated to provide a more through explanation of the OD Grounds boundary. The acreage was revised to 403 acres.

> The OD Grounds consists of 403 acres and was used to perform open detonation and burning of munitions. The acreage includes the area enveloped by a 2500 foot radius around OD Hill. Note that the Open Burning Grounds (also known as SEAD-23) is a separate site that was previously addressed and is not included in the calculation of the OD Grounds acreage.

Comment 2. The FS includes a Munitions and Explosives of Concern (MEC) Hazard Assessment for the Open Detonation Grounds (Appendix B) to assess qualitatively the potential explosive hazards to human receptors; however, this assessment focuses on the explosive hazard and does not address potential human health risks associated with chemical exposure to munitions constituents (MC) in site media nor does it address potential ecological risks. The FS does not include nor reference a baseline human health risk assessment (BHHRA) and/or baseline ecological risk assessment (BERA) to determine whether constituents identified in site media result in potentially unacceptable risks to human or ecological receptors. In order to determine whether remedial action is necessary to protect human health or the environment from exposure to unacceptable levels of MC, a BHHRA and a BERA need to be conducted, and results summarized in the FS in support of the need for remedial action at the site. The results of these risk assessments will also determine which media (i.e., surface water, soil, etc.) and which chemical constituents need to be addressed by a remedial action. Revise the FS to present the results of a BHHRA and a BERA in support of the need for remedial action, and revise the proposed remedial alternatives, as appropriate, to address the results of these risk assessments.

Response 2: Results of a baseline risk assessment are used to determine the need for and the scope of a potential remedial action. Risk is the common driver for remedial actions.

At the OD Grounds, the primary COC is the potential exposure to MPPEH, and the presence of metals contamination is incidental to the MPPEH concern. A MEC Hazard analysis (MEC HA) was conducted for the OD Grounds site, and the results are presented in the subject document, which indicate that a remedial action is necessary. The results of the MEC HA indicate that there is a threat to human health corresponding to a level of "highest potential explosive hazard conditions" based on the current condition of the OD Grounds. The MEC HA evaluated the impact of implementing either of the remedial alternatives presented in the FS, and the results of the analysis suggested that implementation of either remedy would significantly reduce the hazard to a level of "low potential explosive hazard conditions".

The Army intends to proceed with implementing a remedial action driven by the need to address the risk posed by the potential presence of MPPEH at the site. As such, a baseline HHRA is not necessary to determine if a remedial action is required. The metals contamination at the site will be compared to the relevant criteria values as a means to confirm that residual levels of metals that remain at the site after the completion of the remedial action would not be of concern. It is also noted that Figure 1-6A and 6B (formally Figures 1-5) highlight that elevated concentrations of metals are concentrated close to the OD Hill. Consequently, this area of soil would be addressed as part of either of the proposed remedial alternatives designed to address the MPPEH hazard.

Comment 3. The FS indicates that the New York State Department of Environmental Conservation (NYSDEC) Soil Cleanup Objectives (SCOs) for a commercial use scenario are the most relevant and appropriate criteria for the site based on the site's anticipated future use for recreation/conservation; however, the FS has not presented sufficient justification that the exposure assumptions inherent in the commercial use SCOs are consistent with anticipated future recreational exposures at the site. Furthermore, the *New York State Brownfield Cleanup Program Development of Soil Cleanup Objectives Technical Support Document,* dated September 2006 (Technical Support Document), Section 3.0, Land Use Descriptions, suggests that a "Restricted-residential use" land category, for which separate SCOs have been developed, may be more applicable to the site. The Technical Support Document states that a restricted-residential use scenario "includes active recreational uses, which are public uses with a reasonable potential for soil contact." Revise the FS to clarify whether the NYSDEC SCOs for a restricted-residential use land category are more appropriate for the site, based on the anticipated future use of the site, or provide further justification for selecting the NYSDEC SCOs for a commercial use scenario as the most relevant and appropriate criteria for the site. If it is determined that the NYSDEC SCOs for a restricted-residential use land category are more appropriate for the site, data summary tables should compare detected concentrations in site media to these criteria, and the nature and extent of contamination summaries should be updated accordingly. To satisfy the substantive requirements under CERCLA, site data should also be compared to the USEPA Regional Screening Levels (RSLs) based on residential exposures.

Response 3: As defined in NYSDEC regulations Subpart 375-1: General Remedial Programs Requirements, Subparagraph 375-1.8(g)(2)(iii) defines commercial use as: "the land use category which shall only be considered for the primary purpose of buying, selling or trading of merchandise or services. Commercial use includes *passive recreational uses*, which are public uses with limited potential for soil contact." The anticipated future use of the OD Grounds area is for conservation / recreation purposes (See Figure 1-3). LUCs will be implemented to included restrictions on the type of recreational use offered to the public. Intrusive activities such as camping or digging will not be allowed.

There is no expected residential use of any type (even with restrictions) do to the past use of the site as a OB/OD range and the planned future use for conservation/recreation. The Army did consider the application of the Restricted Residential SCO; however, this objective was not appropriate since no type of residential use will be permitted at the site.

We have prepared comparisons of Commercial SCOs, Restricted Residential SCOs, and USEPA RSLs for residential exposure, and they are provided as Attachments 1 and 2 to this response to comments. The difference between the commercial and restricted residential SCO is mainly the identification of one exceedence of lead. The lead is located close to the OD Hill and would be addressed as part of the selected remedial alternative. The goal of the remediation is to restore the site to a condition suitable for transfer. During the confirmatory sampling process following the remedial action, the Army may revisit the determination of the cleanup goal in light of property transfer requirements.

Comment 4. The FS has not demonstrated that the nature and extent of MC in soil has been sufficiently characterized. Section 1.3, Nature and Extent of Impacts, describes soil analytical results, but does not differentiate between surface soil samples and subsurface soil samples so the lateral and vertical extent of soil contamination is unclear. Figure 1-5 A, Metals Exceedances in Soil at the OD Grounds, and Figure 1-5B, Metals Exceedances in Soil at the OD Grounds (OD Hill Area), also do not distinguish between surface or subsurface soil sample locations. However, based on the limited information provided in these two figures, the extent of metals contamination has not been well delineated in the northeast and southeast quadrants within the 500-foot radius from the OD Hill center point as minimal sampling appears to have been conducted in these areas.

In addition, Section 1.3.1, Soil, notes that a concentration of Aroclor-1254 in one sample exceeded the Commercial SCO, but the FS does not further address this exceedance or indicate whether further samples have been collected that adequately bound the contamination both laterally and vertically.

Furthermore, it does not appear that any soil samples were analyzed for dioxins/furans based on the analytical descriptions in Section 1.2.6, Previous Investigations and Activities. Given the nature of activities at the site and the potential for the generation of dioxins/furans as a result of open burning/detonation activities, additional samples should be collected for these constituents to ensure an adequate dioxin/furan data set for site characterization and risk assessment.

If a comprehensive Remedial Investigation (RI) Report consistent with the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (October 1988, EPA/540/G-89/004) (RI/FS Guidance), which summarizes all of the previously collected data and presents a complete evaluation of the nature and extent of contamination will not be prepared for the OD Grounds, the FS needs to demonstrate that the nature and extent of contamination has been adequately characterized prior to moving forward with remedy evaluation and selection. This will allow for a better approximation of the area and volume of site media that require remediation. In addition, please describe how the data gap associated with the lack of dioxin/furan data will be addressed, or provide adequate justification for not assessing these constituents.

Response 4: Figures 1-4 and 1-5 (now referred to as Figures 1-5 and 1-6) have been revised to denote whether the samples were surface or subsurface samples.

The previous soil sampling efforts have adequately described the nature and extent of contamination. Figures 1-5A and 1-5B provide a visual illustration that the impacts to soil are focused on the area surrounding the OD Hill, and the soil concentrations are below guidance levels at locations beyond the 500 foot radius depicted on the figures. All soil samples collected outside of the 500 ft radius ring, including samples located to the northeast and southeast quadrants, are below the Commercial SCOs for metals. This highlights that any potential impacts on soil are within the 500 foot radius. The exact boundary of impacted soil will be determined by soil sampling that will be conducted as part of the cap design.

The concentration of aroclor-1254 appears to be an isolated contaminant. Aroclor-1254 was detected at two soil sample locations. The maximum concentration of aroclor-1254, 2,000 μg/kg, was detected in the surface soil sample S45-ODH-4-01 located on the eastern side of the OD Hill, and this concentration is above the NYS Commercial SCO value of 1,000 μg/kg. The second detection of aroclor-1254 in the surface soil was observed in the sample duplicate collected at SS45-10 at an estimated concentration of 110 J μg/kg, below the commercial SCO; aroclor-1254 was not detected in the duplicate's associated sample. Aroclor-1254 was not detected in the subsurface soil or in groundwater. Based on the fact that the PCB was not detected in any other samples on or surrounding the OD Hill, and groundwater sampling has confirmed that the PCB has not migrated to groundwater, aroclor-1254 is not considered a constituent of concern.

Dioxin and furan testing was not considered as part of the confirmation testing program for this site. The precedence set at SEAD-23 was used as the basis for testing requirements here since the entire SEAD-23 is wholly within this site. The Army did not expect to be required to reopen the previously agreed on conditions and considered them as an acceptable basis for the remedial action proposed.

Comment 5. The FS has not identified numerous sampling locations on site figures, including groundwater sample locations, sediment sample locations, and surface water sample locations. This deficiency impedes an assessment of the data with respect to evaluating source areas and migration pathways. All sampling locations for the OD Grounds need to be adequately documented in this FS. Revise the FS to include site figures that identify all sample locations, including groundwater monitoring wells that may be located outside the boundary of the OD Grounds but were used to evaluate groundwater conditions at the OD Grounds.

Response 5: Figure 1-4 was added to the subject document, and it presents the historic sediment, surface water, and groundwater sample locations. It also shows groundwater contours at the OB Grounds from a recent OB Grounds LTM event. Note that figures previously labeled Figures 1-4 and 1-5 have been subsequently renumbered as 1-5 and 1-6, respectively.

Comment 6: Inconsistent screening criteria have been used to evaluate site sediment data. Table 1-4, Summary of Sediment Data, identifies the NYSDEC Commercial SCOs (6 NYCRR Subpart 375-6) as the applicable screening criteria for sediment whereas Table A-4, Analytical Results for Sediment Samples at OD Grounds, of Appendix A compares sediment data to the NYS SCO Unrestricted Use values. As previously noted, unless significant justification can be provided to show that the use of the Commercial SCOs are sufficiently protective of human health and the environment at this site, the unrestricted use criteria should be utilized during the initial assessment phase. Revise the FS to consistently compare sediment data to unrestricted use screening criteria, to include the USEPA RSLs for residential soil, or provide significant justification for use of the Commercial SCOs.

Response 6: Refer to response to general comment 3 above. Additionally, it should be noted that the remedy for the OB Grounds includes an annual sediment inspection of Reeder Creek. Should the condition of the sediment change it will be observed and documented as part of the OB Grounds annual survey.

Comment 7. The FS has not clearly defined general response actions for each medium of interest at the site. Table *2-2,* OD Grounds Feasibility Study ~ Technology Screening, only identifies a "No Action" general response action and a generic "Remedial Action" general response action under the General Response Action column. General response actions for soil, which is identified as a medium of interest in this FS, typically include no action; land use controls (LUCs); containment; excavation; treatment (in-situ or ex-situ); off-site disposal, or other action. The FS needs to expand its general response actions for soil to include, at a minimum, the actions listed above to ensure that all promising alternatives are considered. Table 2-2 should be updated to include these general response actions, and the text of the FS should present a narrative description of each general response included in the table. Technologies applicable to each of the general response actions (such as engineering controls [ECs] as a type of land use control [LUC]) could then be screened for effectiveness, implement ability, and relative cost in the preliminary identification and screening of technologies. Revise the FS to clearly define an expanded list of general response actions for each medium of interest at the site.

Response 7: A new section "Section 2.5 General Response Action" was added before the section previously numbered as 2.5, "Identification and Screening of Technologies".

The response actions presented are as follows:

- No Action
- Hazard Management – LUCs (etc)
- Remedial Action (Mapping, excavation, disposal, capping, restoration) – MEC removal through geophysical mapping and excavation, soil excavation, MEC disposal, soil capping, site restoration

With the exception of the No Action alternative, the general response actions identified above may be combined in developing remedial action alternatives for the project site. Some areas may exhibit a higher MEC density and a correspondingly greater potential for MEC hazards so it may be appropriate to apply a different response action or combination of response actions in different parts of the site.

The No Action alternative refers to a site remedy where no active remediation or enforceable LUCs are implemented. Under CERCLA, evaluation of a No-Action alternative is required, pursuant to the NCP (42 CFR 300.430 et seq.), to provide a baseline for comparison with other remedial technologies and alternatives.

Hazard management technologies include enforceable administrative institutional controls and/or physical measures (engineering controls) to prevent or limit exposure of receptors to MEC or MC. A deed notice/environmental easement is an example of an institutional control. Physical barriers and access restrictions (e.g., fencing, locked gates, and warning signs) or activity restrictions (prohibiting intrusive activities) are examples of engineering controls. LUCs can be cost-effective, reliable, and immediately effective, and can be implemented either alone or in conjunction with other remedial components. Inspections and monitoring typically are required to document long-term effectiveness of LUCs. The administrative feasibility of and cost to implement LUCs depend on site-specific circumstances (e.g., whether or not a site is under the direct operational control of the DoD, or has been transferred to non-federal ownership).

Table 2-2 was revised to include all three response actions.

Subsequent sections have been renumbered accordingly.

Comment 8. Section 3.2, Description of Alternatives, identifies LUCs as a component of Alternatives 2 and 3, yet LUCs were not included in the preliminary evaluation of alternatives, or even identified as a general response action for the site. LUCs need to be carried through the preliminary evaluation process just as any other technology prior to their inclusion as part of a remedial alternative. Revise the FS to identify LUCs as a general response action, identify the types of LUCs that may be used at the site (institutional controls [ICs] or ECs), and carry these technology types through the preliminary screening of technologies.

Response 8: Hazard management, with LUCs identified as the remedial technology, was added to the evaluation of technologies in Section 2.0. As noted in response to general comment 7, a new Section 2.5 "General Response Actions" has been added to the text and presents No Action, LUCs, and Remedial Action. LUCs were also added to Table 2-2.

Comment 9: The descriptions of the alternatives retained for detailed analysis in Section 4.0 are insufficiently detailed. The FS does not provide an estimate on the areal extent of the cap proposed as part of Alternative 2 nor does it provide an approximate volume of soil that may be excavated as part of Alternative 3. Uncertainties and assumptions associated with the alternatives are also not described. The RI/FS Guidance states, in Section 6.2.1, Alternative Definition, "Alternatives are defined during the development and screening phase. However, the alternatives selected as the most promising may need to be better defined during the detailed analysis. Each alternative should be reviewed to determine if an additional definition is required to apply the evaluation criteria consistently and to develop order-of-magnitude cost estimates (i.e., having a desired accuracy of +50 percent to -30 percent). The information developed to define alternatives at this stage in the RI/FS process may consist of preliminary design calculations, process flow diagrams, sizing of key process components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative." Revise the FS to present further definition of each of the alternatives retained for the detailed analysis consistent with the RI/FS Guidance to allow for a meaningful evaluation of these alternatives.

Response 9: At this time, the specific quantification information is not available for inclusion in the FS. A rough estimation of the excavation volume and the size (75,000 cy) of the cap has been added to Sections 3.2.2 and 3.2.3; however, the volume of soil excavated or and the aerial extent of the cap cannot be determined accurately until the extent of metallic saturation after the initial excavation is known. Following the excavation, the geophysical survey will be utilized to delineate the cap boundary, and GIS can be used to estimate the volume of excavated soil.

Comment 10. The detailed analysis of the nine evaluation criteria, presented in Section 4.0, Alternatives Retained for Detailed Analysis, are insufficiently detailed and do not adequately address all aspects of the evaluation criteria as presented in the RI/FS Guidance. For example, when evaluating long-term effectiveness of a remedy, the RI/FS Guidance states that the following components of the criterion should be addressed for each alternative: 1) magnitude or residual risk remaining from untreated water or waste residuals at the conclusion of remedial activities, and 2) adequacy and reliability of controls, if any, that are used to manage treatment residuals or untreated wastes that remain at the site. In Section 4.3.3.2, Assessment, for Alternative 3, neither of these components of the long-term effectiveness criterion is addressed. Substantial revision to the FS is necessary in order to present a thorough detailed evaluation of the alternatives that addresses all of the components of the nine evaluation criteria. Revise the FS to evaluate each of the alternatives with respect to all components of the nine evaluation criteria, as presented in the RI/FS Guidance, to allow for a meaningful evaluation of each alternative.

Response 10: The section has been revised to provide a more detailed evaluation against the nine criteria.

Comment 11. The comparative analyses of remedial alternatives, as presented in Table 4-1, Ranking of Alternatives, rank the proposed alternatives on a scoring system of 1 to 3. A score of 1 represents the least favorable score and 3 the most favorable. This approach does not constitute a sufficiently detailed rating system capable of providing a meaningful distinction among alternatives. Given the range of alternatives presented, three criteria do not allow for the assessment process to generate unique combinations thereby allowing for development of discriminating factors to aid in the selection of a preferred alternative. Page 55 FR 8719 of the Preamble, Section 300.430(e)(9), Detailed analysis of alternatives, states, "the purpose of the detailed analysis is to objectively assess the alternatives with respect to nine evaluation criteria that encompass statutory requirements and include other gauges of the overall feasibility and acceptability of remedial alternatives (53 FR 51428). This analysis is comprised of an individual assessment of the alternatives against each criterion and a comparative analysis designed to determine the relative performance of the alternatives and identify major trade-offs (i.e., relative advantages and disadvantages) among them. The decision-maker uses information assembled and evaluated during the detailed analysis in selecting a remedial action." The RI/FS Guidance states in Section 6.2.5, Comparative Analysis of Alternatives, page 6-14, "[a]n effective way of organizing this section is, under each individual criterion, to discuss the alternative(s) that performs the *best overall* in that category, with other alternatives discussed in the *relative order in which they perform* [emphasis added] .... the presentation of differences among alternatives can be measured either qualitatively or quantitatively, as appropriate, and should identify substantive differences." Further discrimination between factors is needed to make this process transparent to the public and Regulatory Agencies. Revise the FS to provide a system of rating using a ranking scale that allows for differentiation of all alternatives (i.e., use a range of terminology and identify the differentiating features) so that a straightforward determination of the relative performance of the alternatives and identification of major trade-offs can be made. Please also ensure that the assessment clearly indicates the alternative(s) that performs the best overall in each category.

Response 11: The discussion has been revised to better follow the format of the RI/FS Guidance Section 6.2.5.

Comment 12. The FS assumes a discount rate of 7% when preparing the net present value cost estimates, which is not an appropriate discount rate. The note at the bottom of Page 4-5 *of A Guide to Developing and Documenting Cost Estimates During the Feasibility Study,* July 2000, states: "Real discount rates from Appendix C of OMB Circular A-94 should generally be used for all Federal facility sites." The real discount rate from Appendix C of OMB Circular A-94, Revised Dec 2011, is 2.0%, not 7% as used in the remedial alternative cost estimate tables. Please revise the FS to prepare the cost estimates using the most current discount rate from Appendix C of OMB Circular A-94.

Response 12: The FS has been updated to use the 2% discount rate.

Comment 13. The assumptions included in the cost estimates for each of the evaluated remedial alternatives are not sufficiently detailed to allow for meaningful evaluation and comparison of remedial alternatives. For example, Appendix C, Detailed Cost Estimate, Table C-1C, Equipment and ODC Costs for Alternative 2, includes a S300,000 estimate for "Other travel" without describing the basis for the estimate. Additionally, Table C-2D, Subcontractor Costs for Alternative 3, includes only lump sum costs for "Earthwork" and "T&D"(assumed to be transport and disposal costs for soil), without a breakdown of costs associated with these activities. As such, it is unclear if the remedial alternatives were appropriately scoped and costed so as to reflect a - 30% to +50% margin as allowed for during the FS process. Revise the FS to ensure all assumptions used in the cost estimates for all of the alternatives evaluated are noted and substantiated. In addition, please revise the cost estimate tables in Appendix C to define all acronyms and abbreviations used in the table to facilitate review.

Response 13: The cost estimate has been revised. The backup in Appendix C shows the detailed unit cost associated with earthwork, T&D, and UXO subcontractor costs. The revised estimate also reflects to the change to the 2% discount rate. The updated TPV costs are $8.9M and $28.0M for Alternatives 2 and 3, respectively.

Comment 14. The Draft OD MRA FS Report appears to be inconsistent with respect to the disposition of soil that is removed in Alternative 2. The Executive Summary states that, "In the metallic saturation (likely near the OD Hill), excavation of the top 6 inches of soil. Soil will be screened to remove potential MPPEH, followed by additional DGM, and intrusive investigation, (and additional excavation, if needed). The excavated overburden will be staged on-site for potential reuse and/or incorporation into the site cap." According to this statement, the soil may be used as a portion of the site cap.

However, a subsequent statement in the next portion of the Executive Summary indicates that the alternative will include "Design and construction of an engineered cap to cover contaminated soils and be at least 18 inches thick over the OD Hill area. Excavated soil that passed through the screen will be placed on the OD Hill under the cap." This seems to place all of the soil under the cap and eliminates its use in the cap itself.

Review all sections of the document that refer to Alternative 2 use of the excavated and screened soil and revise them as necessary to ensure a consistent placement of that soil on the site.

Response 14: The text in the FS has been revised to read "The excavated overburden will be staged on-site for potential reuse and/or incorporation under the site cap."

SPECIFIC COMMENTS

Comment 1. Section 1.2.1, OD Grounds Description, Page 1-2: The third paragraph of this section describes the OD Grounds, but it does not indicate how the OD Hill Area and Kick Out Area, shown on Figure 1-3, OD Grounds Site Plan, relate to the site. For clarity, a brief description of these site areas should be incorporated into the discussion of the site proper. Revise Section 1.2.1 to discuss the OD Hill Area and Kick Out Area of the OD Grounds.

Response 1: The figure (renumbered Figure 1-2) was revised to clearly show the boundary of the site. The following statement was added to the paragraph:

> For ease of discussion in this FS, two different portions of the OD Grounds Site were identified. They are referred to as the "Kickout Area" and the "OD Hill Area". The OD Hill Area is the location of demolition activities. The Kickout Area is the area in which blast fragments emanating from the OD Hill activity are expected to land. The boundaries of these areas are defined on Figure 1-3.

Comment 2. Section 1.2.1, OD Grounds Description, Page 1-2: The third paragraph describes an access road that branches off North-South Baseline Road near Building 2104, located in the southeastern corner of the OD Grounds, but the location of Building 2104 has not been identified on site figures (i.e., Figure 1-3, OD Grounds Site Plan). In addition, the FS has not identified current and historic use of Building 2104. This information needs to be provided in order to determine whether all potential sources of contamination have been identified and considered in the investigation of the OD Grounds. Revise the FS to identify Building 2104 on site figures. In addition, revise Section 1.2.1 to describe historic and current use of Building 2104.

Response 2: The text was updated to include a description of Building 2104.

> Building 2104 was built in 1951 and is described as "Change House (OB/OD Grounds)". The building is not included in lists of structures with potential UXO hazards or in which potentially hazardous materials were stored (Woodward-Clyde, 1997). A change house is a location for military personnel to change clothes and uniforms.

Figure 1-2 (formerly Figure 1-3) has been revised to designate the number of the building.

Comment 3. Section 1.2.2, Future Land Uses, Page 1-3: Section 1.2.2 refers to an incorrect site in the description of future land use. This section states, "The area that encompasses SEAD-12 was determined to be "Conservation/Recreation Area." The OD Grounds, also known as SEAD-006-R01 (formerly SEAD-45 and SEAD-115) is the subject of the FS, not SEAD-12. For accuracy, revise Section 1.2.2 to document future site use for the OD Grounds, and remove reference to SEAD-12.

Response 3: SEAD-12 was mentioned in error. The sentence was revised to remove the reference.

Comment 4. Section 1.2.4, Hydrogeology, Page 1-4: The last paragraph of Section 1.2.4 references ground water elevation data from April 1994. It is unclear if more recent data are available upon which to determine groundwater flow direction at the OD Grounds. Recent data are preferred so that current conditions at the site can be characterized with a high level of confidence. Revise the FS to clarify whether the April 1994 groundwater elevation data are the most recent data for the site.

Response 4: Samples have not been collected from the OD Grounds wells since 1994. Recent data has been collected at the adjacent Open Burning (OB) Grounds between 2007 and 2012 that suggests that groundwater flows to the northeast. The text has been revised as follows:

> Groundwater elevations collected within the Open Burning Grounds between 2007 and 2012 show a general groundwater flow to the northeast. Comparison between the 1994 data and the recent groundwater elevations suggests an approximately NNW-SSE trending groundwater divide through the western portion of the Open Burning Grounds (approximately at the large C-shaped berm visible in Figure 1-4) (Parsons, 2013). Groundwater east of the divide flows to the northeast while groundwater west of the divide flows to the southwest."

Comment 5. Section 1.2.5, SWMU History, Page 1-4: Section 1.2.5 states that the OD Grounds was used for "open burning and open detonation of explosives, propellants and pyrotechnics and other unserviceable ammunition" but specific types of explosives, propellants, pyrotechnics, and ammunition are not identified. A complete history of the site should be presented to ensure that appropriate analyses for potential chemicals of interest in site media have been selected. Revise the FS to clarify the types of explosives, propellants, pyrotechnics, and ammunition that may have been burned or detonated at the OD Grounds. Specific chemicals associated with these materials should be identified to the extent known or reasonably expected.

Response 5: There is no basis to list all items reasonably expected to have been on the site. The sampling requirements listed in the FS identify the contaminants of concern which are the most common and most abundant MC expected to be found in various types of military munitions. Any list as proposed could be misleading or subject to challenge for any munitions that may have been in the DOD inventory. No list will be provided in the FS.

Comment 6. Section 1.2.6.2, 2000 Ordnance and Explosives Engineering Evaluation and Cost Analysis, Page 1-6: This section indicates that anomalies were identified during various geophysical surveys at the site, but only a fraction of the anomalies were intrusively investigated. For example, the first paragraph on Page 1-6 notes, "Of the 1,337 anomalies identified in the EM61 surveyed grids, 86% were intrusively investigated." No discussion is presented concerning the status of the anomalies left unresolved. For clarity and completeness, expand Section 1.2.6.2 to provide a brief discussion of the unresolved anomalies, and clarify why they were not intrusively investigated. This comment also applies to the unresolved anomalies identified in Section 1.2.6.3, 2003 Phase I Geophysical Investigation, and Section 1.2.6.4, 2006 Phase II Ordnance and Explosives Removal Activities.

Response 6: The following text has been added to the FS:

> Occasionally, anomalies identified on the Anomaly Dig Sheet could not be reacquired with the instrument that performed the survey. In such instances, the anomaly was flagged at the coordinate location and the inability to reacquire the anomaly was documented on the reacquisition team dig sheet. The intrusive teams would again geophysically search the immediate area around the flag using both Schonstedt® and Foerster® metal-detectors. If again no anomaly was identified, the location was assumed to be a "false positive"; however, 10% of the "false positives" were excavated to 18 inches and re-checked using the Schonstedt® and Foerster for QC purposes. No OE was ever found in locations where "false-positive" digs were performed.

Comment 7. Section 1.2.6.3, 2003 Phase I Geophysical Investigation, Page 1-6: The second paragraph of this section states that "Of the 512 target anomalies excavated from the non-wooded / open areas, approximately 97% of the items were found at a maximum depth of 12 inches bgs. No items were excavated from a depth exceeding 20 inches bgs." The last sentence is unclear as to its exact intent. It is unclear if it indicates that all excavations stopped at 20 inches below ground surface (bgs) regardless of whether the anomaly was resolved, or if it means that all anomalies were resolved at 20 inches bgs or less. Revise the cited sentence to better explain its intent.

Response 7: The last sentence has been replaced with the following text: "No items were identified at depths exceeding 20 inches bgs."

Comment 8. Section 1.2.6.4, 2006 Phase II Ordnance and Explosives Removal Activities, Pages 1-6 and 1-7: This section uses the redundant term "MEC/UXO" in two instances. MEC (munitions and explosives of concern) is defined as follows:

"MEC: A term distinguishing specific categories of military munitions that may pose unique explosives safety risks. It is: UXO (unexploded ordnance); DMM (discarded military munitions); or MC (munition constituent) (e.g., TNT, cyclotrimethylenetrinitramine [RDX]), present in high enough concentrations to pose an explosive hazard." Based upon this definition, the term "MEC/UXO" is redundant and should be replaced with the term "MEC." Please make this correction.

Response 8: Footnote added to clarify. "*The Phase II report, and other older reports, use the term UXO to describe unexploded ordnance. UXO items were reclassified and included in the broader category of MEC. In this paragraph, both terms were used for clarity.*"

Comment 9. Section 1.2.6.3, 2003 Phase I Geophysical Investigation, Page 1-6: The last paragraph of Section 1.2.6.3 states, "This investigation identified approximately 14,700 anomalies that are to be investigated in the open areas between 1,000 ft. and 1,500 ft. from the OD Hill under an area munitions response action." The status of the area munitions response action for the area between 1,000 ft. and 1,500 ft. has not been described. For clarity, revise Section 1.2.6.3 to provide the current status of the munitions response action in this area.

Response 9: The text was revised. "*The anomalies identified within the 1,000 to 1,500 ft radius will be addressed as part of Alternatives 2 or 3 proposed in this FS.*"

Comment 10. Section 1.2.6.4, 2006 **Phase II Ordnance and Explosives Removal Activities, Page 1-7:** The last paragraph of Section 1.2.6.4 uses the term "CD" in relation to the items recovered during a removal action; however, this acronym has not been defined in the FS. For clarity, revise the FS to define CD in the List of Acronyms at the beginning of the document, and at its first use.

Response 10: The term CD was defined as cultural debris and was added to the acronym list. Cultural debris is non-munitions related debris such as barbed wire, horseshoes, and consumer hardware.

Comment 11. Section 1.2.6.5, 2010 Supplemental Work, Page 1-7: This section indicates that an objective of the 2010 supplemental investigation was to determine the volume of soil in the OD Hill, but the FS does not indicate if this objective was met. If the volume of soil in the OD Hill was determined, this information should be presented in the FS. Revise Section 1.2.6.5 to clarify if the volume of soil in the OD Hill was determined as this may impact the selection of remedial alternatives for the site.

Response 11: An estimated volume of the OD Hill was provided in the text. "*The estimated volume of the earthen mound above ground surface is 38,000 cubic yards (cy). The estimated volume of soil in the OD Hill above bedrock surface is 75,000 cy (Parsons, 2010).*"

Comment 12. Section 1.3.1, Soil, Page 1-8: This section states that soil data were compared to the May 2012 USEPA RSLs; however, a note at the bottom of Table 1-1, Summary of Surface and Subsurface Soil Samples, indicates that the June 2011 RSLs were used in the evaluation. For consistency, revise the FS to compare soil data to the most recent version of the USEPA RSL Table, currently the May 2012 update. In addition, as previously mentioned, site data should be compared to residential screening criteria, not industrial.

Response 12: The FS was revised to include the most up to date USEPA RSLs from November 2012. Please reference the response to general comment 3. Soil and sediment will remain compared to industrial screening criteria. When comparing the industrial and residential screening criteria, there are a minimal number of additional exceedances found for soil and sediment concentrations. See Attachments 1 and 2.

Comment 13. Section 1.3.1, Soil, Page 1-8: This section indicates that soil results were compared to USEPA RSLs as well as the NYSDEC SCOs for commercial use; however, the discussion of the results only addresses exceedances of the SCOs. The second paragraph of Section 1.3.1 states, "None of the VOC and SVOCs results exceed the Commercial SCOs." However, the FS fails to acknowledge that 2,4-dinitrotoluene exceeded the industrial RSL (Table 1-1, Summary of Surface and Subsurface Soil Samples). The discussion of analytical results should describe exceedances of both the SCOs and the RSLs. Revise the FS to present a discussion of soil analytical results in comparison to both the SCOs and the RSLs.

Response 13: The FS text was updated to include further discussion of soil results versus both NYSDEC SCOs (Commercial) and USEPA industrial RSLs.

> The analytical data are compared to the NYSDEC Commercial SCOs and EPA RSLs Industrial Soil. None of the VOC, herbicide, or explosive results exceed the Commercial SCOs or EPA RSLs for industrial soil. None of the SVOC results exceeded the Commercial SCOs; however, one SVOC (2,4 dinitrotoluene) exceeded its respective EPA RSL for industrial soil (Note: there is no corresponding SCO value). The concentration of one PCB, Aroclor-1254, exceed both its Commercial SCO and EPA RSL screening criteria in one sample. Among the metals, cadmium, copper and mercury were the only metals to exceed their respective Commercial SCOs. In comparison, arsenic, cadmium, and lead exceeded their respective EPA RSLs for industrial soil.

Comment 14. Section 1.3.2, Groundwater, Page 1-8: The first paragraph of this section indicates that groundwater data collected for the Open Burning (OB) Grounds site, located south of the OD Grounds, was used to evaluate groundwater conditions at the OD Grounds. The FS has not presented any figures that identify the locations of the monitoring wells used for this assessment; therefore, the applicability of using the OB Grounds wells to evaluate site groundwater at the OD Grounds cannot be established, hi addition, no potentiometric surface maps have been provided to show the anticipated groundwater flow direction at the site. A potentiometric surface map can be used to determine the relevance of using the OB Grounds data to evaluate the OD Grounds. Revise the FS to identify the monitoring wells used for the OD Grounds groundwater assessment on a site figure and justify why these wells are appropriately located and screened at appropriate depths to assess groundwater conditions at the OD Grounds. To further support the use of these wells for an assessment of groundwater conditions at the OD Grounds, revise the FS to include a recent potentiometric surface map which illustrates the groundwater flow direction in the vicinity of the site.

Response 14: The FS was updated to include a figure showing the applicable wells, potentiometric surface, and groundwater flow directions (Figure 1-4) based on available data. Additionally, see response to specific comment 4.

Comment 15. Section 1.3.2, Groundwater, Page 1-9: The last sentence of this section states, "It is not believed that the groundwater at the OD Grounds is impacted by historic site activities" but the FS has not presented sufficient evidence to justify this conclusion. First, the wells from which the data were obtained have not been identified on a figure in relation to the OD Grounds. Second, bis(2-ethylhexyl)phthalate and some metals were detected above screening criteria in groundwater samples used for the evaluation. The FS has not demonstrated that none of these constituents should be considered site-related. This section also notes that two explosives were detected in groundwater, but "below their groundwater criteria." This statement is misleading as Table 1-2 indicates that NYS Class GA criteria have not been established for one of the two explosives (i.e., HMX). Revise the discussion of the assessment of groundwater at the OD Grounds to clearly demonstrate that the wells used for the assessment are appropriate for the site, and none of the detected constituents in groundwater are site-related. In addition, revise Section 1.3.2 to more accurately present the explosives results in comparison to screening criteria by acknowledging that a NYS Class GA value has not been established for HMX. In this case, it may be appropriate to screen against the May 2012 USEPA tap water RSL for HMX (780 micrograms per liter [ug/L]).

Response 15: The groundwater well locations were added to Figure 1-4.

Adjacent to OD Hill, the groundwater within the OB Grounds site was sampled and six wells from this site currently are undergoing long-term monitoring. Groundwater monitoring for explosives, metals, total organic carbon, total organic halides, pH, pesticides, and nitrates between 1981 through 1987 indicated no exceedances of then current NYS AWQS except for iron and manganese. In 1989, sampling was conducted on ten additional installed wells and six of the seven previous wells. This round of sampling examined EP Toxicity metals and explosives. No metals or explosives exceeded applicable screening criteria.

Results from Phase I and II groundwater sampling at the OB Grounds were compiled in the OB Grounds RI Report. Analytes examined during these sampling events included VOA, semivolatiles (SVOCs), pesticides, and PCBs, TAL metals, and explosives. Groundwater was found to be minimally impacted by metals and explosives. Based on these results, the 1996 OB Grounds FS Report determined that groundwater was not a medium of concern.

Based on the 1999 Record of Decision (ROD) for the OB Grounds, lead and copper were the contaminants of concern proposed for remedy in the site soils and sediments adjacent to Reeder Creek. Between 2007 and 2012, long-term monitoring of wells within the Open Burning Grounds for copper and lead has shown no evidence of lead or copper in the groundwater above the cleanup goals subsequent to the completion of the remedial action for the Site. These findings are consistent with the groundwater analytical results obtained during the remedial investigation stage (1990s) of work at the Site, indicating that there is no evidence of groundwater quality deterioration over approximately 20 years (Parsons, 2012).

Although the OB Grounds are not immediately downgradient from the OD Grounds, the results from previous investigations at the OB Grounds site can be used as an analogue for the potential groundwater contamination expected in the adjacent OD Grounds. Potential contaminants, fate and transport, and exposure scenarios are expected to be the same as was discussed in previous studies. As such, groundwater is not expected to be a medium of concern within the OD Grounds; however, potential examination of the groundwater may be appropriate subsequent to the remedial alternative selected in this FS.

The text was revised as follows:

> Two explosives were detected in the groundwater one time. One of the explosives (1,3-Dinitrobenzene) was detected below its respective groundwater criteria. NYS AWQS and EPA MCL screening criteria for the other explosive (HMX) do not exist; however, the detected value (0.5 ug/L), for comparison, is far less than the EPA tap water screening criteria of 780 ug/L.

Comment 16. Section 1.3.3, Surface Water, Page 1-9: The FS has not demonstrated that surface water has been adequately characterized at the site. Surface water sample locations have not been identified on a site figure so their applicability to the site is unclear. In addition, it is noted that metals and nitroaromatics were detected in surface water samples above screening criteria, but further evaluation of these exceedances does not appear to have been conducted. In addition, Section 1.2.1, OD Grounds Description, states "Reeder Creek runs through the OD Grounds" but it is unknown if surface water from Reeder Creek itself has been sampled. Significant additional information needs to be provided to ensure that the extent of surface water impacts has been characterized. Revise the FS to identify surface water sample locations on a site figure, and clarify how the remaining data gaps associated with surface water characterization will be addressed.

Response 16: Surface water sample locations and drainage patterns are provided on Figure 1-4.

The four surface water samples collected as part of the 1995 OD Grounds ESI were from ephemeral drainage ditches and a low-lying swale. These on-site surface water pools are not classified by NYSDEC as surface water bodies and therefore NYS Ambient Water Quality Concentrations (AWQC) do not apply. Because the AWQC do not apply, on-site surface water in not considered a medium of concern. This approach was applied in the 1996 OB Grounds FS to on-site ephemeral pools sampled in the 1994 OB Grounds RI and, for consistency, will be applied in this FS.

During the 1994 OB Grounds RI, surface water sampling was conducted within Reeder Creek (Figure 1-6). Reeder Creek is a recognized surface water body and therefore AWQCs would apply to human and ecological receptors. Numerous surface water samples were collected from Reeder Creek up- and down-gradient of the OB Grounds. Reeder Creek serves as drainage for much of the OD Grounds; therefore, these samples would also be downgradient of various portions of the OD Grounds.

Results from Reeder Creek were compared to recent NYS AWQC values. No significant impacts to the surface water were found therefore it is not considered a medium of concern (Parsons, 1996).

Comment 17. Section 1.3.4, Sediment, Page 1-9: Section 1.3.4 does not present an accurate summary of all of the sediment data collected, and focuses instead, on only three metals: cadmium, copper, and mercury. The second paragraph of Section 1.3.4 states, "Several SVOCs, nitroaromatics, pesticides, and PCBs were detected [in sediment], primarily at low concentrations..."However, these detections are not addressed further or described in comparison to applicable screening criteria. Table A-4, Analytical Results for Sediment Samples at OD Grounds, of Appendix A shows that 4,4-DDE, Aroclor-1254, dieldrin, arsenic, chromium, lead, nickel, silver, and zinc also exceeded action levels, but these exceedances are not highlighted in Section 1.3.4. In addition, Table A-4 shows that numerous explosives and semi-volatile organic compounds (SVOCs) were detected in the sediment samples, but the results for many of these constituents are not compared to any screening values or action levels.

The FS needs to be revised to include an expanded discussion of the sediment data, which highlights exceedances of screening values and acknowledges the lack of screening values for other detected constituents. Revise the FS to address this concern. In addition, for a preliminary screening, sediment data should be compared to the USEPA RSLs for residential soil since the RSL table includes screening criteria for many of the detected constituents. Ecological screening criteria may also be appropriate for this site.

Response 17: The sediment samples collected as part of the 1995 OD Grounds ESI were coupled with the previously mentioned surface water samples. The collection areas were ephemeral and not representative of sediment within the site boundary. An ecological assessment of these areas suggests that they are more terrestrial in nature rather than aquatic (Parsons, 1996). Previous studies have included sediment samples collected from temporary water bodies in their soil assessments. Attachment 2 provides comparison of sediment results to EPA RSLs for residential soil and NYS SCOs for Commercial use.

In conjunction with surface water samples, collocated sediment samples were collected from within Reeder Creek (Figure 1-6). Arsenic, copper, lead, manganese, mercury, nickel and zinc exceeded NY Sediment Criteria values. These exceedances were for a TBC, therefore sediment was retained as a media of interest in the 1996 OB Grounds FS. The inspection of Reeder Creek has found sediment in various sections. The sediment is from decomposition of fallen leaves and tree material stockpiles by beavers in previous seasons and not the result of erosion of the site soil and soil transport (Parsons, 2013). Evidence for excessive erosion into the creek was not found. Current monitoring of the surface water indicates that Reeder Creek is not impacted by the surrounding OD Grounds. The FS was revised to include the above information.

Comment 18. Section 1.3.4, Sediment, Page 1-9: It is unknown if the nature and extent of sediment contamination has been sufficiently characterized. First, it is unclear if all potential drainage swales were sampled since the locations of the sediment samples have not been identified on a site figure. In addition, the locations of the site drainage swales have not been identified on a site figure. Of the four sediment samples that were collected, 4,4-DDE, Aroclor-1254, dieldrin, arsenic, cadmium, copper, chromium, lead, mercury, nickel, silver, and zinc were detected above screening criteria, but it is unclear if the extent of this contamination has been evaluated further. Revise the FS to identify all drainage swales at the site in relation to the existing sediment sample locations so that an evaluation of the extent of contamination can be conducted. If it is determined that four samples does not adequately address potential impacts to sediment at the site, revise the FS to clarify how this data gap will be addressed.

Response 18: Sediment samples from the 1995 OD Grounds ESI and the 1996 OB Ground RI are shown on Figure 1-4. Drainage pathways are noted.

See response to specific comment 17 for information on sediment. Additionally, 4,4-DDE, Aroclor-1254, dieldrin, chromium, lead, nickel, silver and zinc did not exceed NYSDEC commercial use SCOs (Attachment 2). There was one detection of arsenic which was 0.1 mg/kg above the Commercial use screening criteria. Gross contamination of the other analytes is not present and concentration of cadmium, copper, and mercury in the sediment did not exceed EPA RSLs for soil in a residential scenario.

Drainage features were added to Figure 1-4. See response to specific comment 17. Additional information related to Reeder Creek is available from previous studies.

Comment 19. Section 1.4, Fate and Transport, Page 1-10: This section presents conflicting information regarding contaminants at the site. The first paragraph states that the contaminants detected at the OD Grounds are metals, and potential Material Potentially Presenting an Explosive Hazard (MPPEH)/ Munitions Debris (MD). However, the third paragraph indicates that investigations at the site indicate the presence of MEC/MD, metals, nitrates and explosives at the OD Grounds. The process by which it is determined whether or not a chemical is considered a contaminant at the site has not been clearly presented. Furthermore, there is no explanation as to why constituents detected above screening criteria, such as SVOCs and Aroclor 1254, were excluded from further consideration in the fate and transport analysis and subsequent development of remedial alternatives. The FS needs to clearly state how chemicals considered for further evaluation in the fate and transport analysis and the subsequent development of remedial alternatives were identified. Revise the FS to include this information, and to ensure that the contaminants at the site are consistently identified in Section 1.4 and throughout the FS.

Response 19: Site contaminants are identified as constituents that have a significant impact on the matrix. The text was revised as follows:

> This section presents an overview of the fate and transport characteristics for the site contaminants identified as constituents that have an impact on the applicable matrix at the OD Grounds. Contaminants of concern may be selected because of their intrinsic toxicological properties, because they are present in large quantities, or because they are presently in or potentially may move into critical exposure pathways (e.g., drinking water supply) (EPA, 1988). Sediment and surface water collected on-site and downgradient of the site do not show gross contamination of site media indicative of an observed release. There was no evidence of a release to groundwater from either on-site samples or samples collected from an adjacent site. Constituents of concern for this site are MC (metals) in soil and potential items of MPPEH/MD.

As discussed in response to general comment 4, the detection of Aroclor-1254 is not considered a COC since it is not pervasive in the soil and has not migrated to other media. Explosives are not COCs since they were detected in soil below USEPA residential RSLs, with the exception of one detection of RDX.

Comment 20. Section 1.4, Fate and Transport, Page 1-10: The third paragraph uses the acronym COPC without defining it in the text or the List of Acronyms. For clarity, revise the FS to define COPC as chemical of potential concern in the List of Acronyms at the beginning of the document, and at its first use.

Response 20: COPC has been defined as Chemicals of Potential Concern in the text and the List of Acronyms.

Comment 21. Section 1.4.1, Metals, Page 1-11: This section describes the results of the soil samples that were selected for leachability determinations using the synthetic precipitation leaching procedure (SPLP), and indicates that results of these analyses are presented in Appendix A-5. This section also indicates that total metal analysis results were compared to EPA's RSLs for residential soils and NYSDEC Commercial SCO values, while the SPLP results are compared to NYSDEC GA Groundwater Effluent values. However, none of these screening criteria are presented in Appendix A-5 in comparison to data. To substantiate the discussion of the results, revise Appendix A-5 to compare the SPLP and total metals data to the appropriate screening criteria.

Response 21: Appendix A-5 was updated to include the appropriate screening criteria.

Comment 22. Section 2.0, Remedial Action Objectives, Page 2-1: The first paragraph indicates that the process for identifying and screening technologies/processes consists of six steps, but this statement is followed by only five steps in the bullet points. All six steps should be clearly presented. Revise the FS to document all steps in the identification and screening process, and ensure that the text consistently states the number of steps in the process.

Response 22: The FS was updated to include an additional step as follows: "Identify estimates of volumes or areas, to the extent practical, of media to which general response actions might be applied (**Section 2.0**);"

Comment 23. Section 2.0, Remedial Action Objectives, Page 2-1: The first bulleted item, which addresses development of Remedial Action Objectives (RAOs), does not describe all of the RAO development criteria specified in the RI/FS Guidance. Section 4.1.2.1, Development and Screening of Alternatives, of the RI/FS Guidance states that RAOs should specify "the contaminants and media of interest, exposure pathways, and preliminary remediation goals that permit a range of treatment and containment alternatives to be developed." To be consistent with the RI/FS Guidance, revise the first bullet point of Section 2.0 to address the criteria for RAOs as outlined in the RI/FS Guidance.

Response 23: The first bulleted item was revised to include all of the development criteria specified in Section 4.1.2.1 of the EPA RI/FS Guidance.

> Develop RAOs that specify media of interest, chemical constituents of concern, exposure pathways, and preliminary remediation goals that permit a range of treatment and containment alternatives to be developed. The preliminary remediation goals will be based on chemical-specific ARARs and the results of the Hazard Assessment (**Section 2.0**);

Comment 24. Section 2.0, Remedial Action Objectives, Page 2-1: The FS has not identified the volumes or areas of media to which general response actions might be applied. The RI/FS Guidance indicates that this information should be described prior to the identification and screening of technologies. The volumes or areas of media to which general response actions might be applied should take into account the requirements for protectiveness as identified in the RAOs and the chemical and physical characterization of the site. To be consistent with the RI/FS Guidance, revise the FS to identify the volumes or areas of media to which general response actions might be applied.

Response 24: Section 2 was updated to include information regarding the areas of media impacted by general response actions.

Comment 25. Section 2.1, General Remedial Action Objectives, Page 2-1: This section states, "Based on the previous investigations and the proposed future site use, soil was identified as a media of interest" but the RI/FS does not state how soil was identified as the only media of interest at this site (i.e., through risk assessment). Section 1.3, Nature and Extent of Impacts, indicates that concentrations of detected constituents in groundwater, surface water, and sediment also exceeded screening criteria, so it is unclear why these media are not considered media of interest for this FS. Please revise the FS to present farther justification for excluding groundwater, surface water, and sediment as media of interest to be addressed by this FS.

Response 25: Please refer to response to specific comments 15, 16, 17, and 18.

Comment 26. Section 2.1, General Remedial Action Objectives, Page 2-1: Section 2.1 states that the "future use for the OD Grounds is recreation/conservation for walking and hiking activities and no intrusive soil activities such as digging, camping, camp fires, tent staking, trail construction, etc." It is unclear how it is known that these intrusive recreational activities will not be conducted at the site. The FS has not identified the means by which these restrictions will be implemented. For clarity, revise the FS to clarify how it is known that intrusive activities will not be conducted at the site, or it should generally be assumed that these activities could occur during recreational use of the site.

Response 26: Future land uses have been established for the Seneca Army Depot by the Seneca County Industrial Development Authority (SCIDA). The area is designated for Conservation/Recreation Use, shown in Figure 1-3 (formerly labeled 1-2). As such, the property will have a LUC restricting the land uses to those consistent with non-intrusive Conservation/Recreation activities, such as hiking and bird watching. Residential use and intrusive activities including camping would be restricted. The restrictions would be implemented through the deed restriction/environmental easement.

Comment 27. Section 2.1, General Remedial Action Objectives, Page 2-2: The RAOs do not address potential exposures to ecological receptors. The FS has not presented any information or results from an ecological risk assessment to conclude that potential ecological exposures need not be addressed. To ensure that the RAOs address all exposure pathways, revise the FS to develop RAOs specific to ecological exposures, or provide significant justification (i.e., the results of an ecological risk assessment) to show that these exposure pathways need not be addressed.

Response 27: Please refer to the response to general comment 2. The remedial action is being driven by addressing the hazards presented by the potential presence of MPPEH. The details of an Ecological Risk Assessment would not impact the path forward with proceeding with a remedial action.

Comment 28. Section 2.1, General Remedial Action Objectives, Page 2-2: The first RAO presented on Page 22 addresses contaminants, media of interest, and exposure pathways but it does not identify an acceptable contaminant level or range of levels for each exposure route, as specified in the RI/FS Guidance. A RAO developed to protect human health and the environment should specify an acceptable contaminant level or range of levels (such as a PRG for soil) which will allow for a range of alternatives to be developed. Revise the first RAO presented on Page 2-2 to include an acceptable contaminant level or range of levels for each exposure route.

Response 28: The first bullet addressing RAOs on page 2-2 was revised to indicate that the goal is to comply with NYSDEC Commercial SCOs. "*NYSDEC Commercial SCOs were determined to be an appropriate and acceptable contaminant level for protection of human health and the environment.*"

Comment 29. Section 2.1, General Remedial Action Objectives, Page 2-2: None of the RAOs address the protection of groundwater. Section 1.4.1, Metals, which presented the results of the SPLP analysis, indicated that a review of the data found that all of the metals detected show some potential to leach to groundwater. A RAO should be developed to limit potential impacts to groundwater. Revise the FS to include a RAO that addresses the protection of groundwater at the site.

Response 29: An additional RAO for protection of groundwater is not necessary. There is no indication that any analytes in the groundwater are leaching into the soil or other media. As part of LUC, digging will not be permitting on site therefore the groundwater will not be accessible.

Comment 30. Section 2.2.1, Soil, Page 2-3: This section identifies potential chemical-specific applicable or relevant and appropriate requirements (ARAR) for soil at the site but To Be Considered (TBC) criteria do not appear to have been addressed. USEPA RSLs should be identified as chemical-specific TBC for the site. Revise the FS to identify TBCs for the site, including the USEPA RSLs.

Response 30: The USEPA RSLs have been added as TBCs.

Comment 31. Section 2.3.1, Action-Specific ARARs, Page 2-5: Multiple federal and state action-specific ARARs are identified in this section, but the last sentence states, "Based on the OD Grounds conditions, further consideration of these action-specific ARARs does not appear warranted at this time." The FS does not provide sufficient justification for excluding these action-specific ARARs from further consideration. To substantiate the above referenced statement, revise the FS to clarify the OD Grounds conditions that warrant exclusion of the action-specific ARARs from further consideration during remedy evaluation.

Response 31: The text has been revised to provide a rationale for why each regulation wasn't an ARAR. Generally, it is noted that regulations that are not related to environmental law or do not govern activities that take place at the CERCLA site are not considered ARARs.

Comment 32. Section 2.4, Site-Specific Cleanup Goals, Page 2-5: Table 2-1, OD Grounds Remedial Action Objectives, presents RAOs that are not completely consistent with the RAOs described on Page 2-2. Table 2-1 summarizes two RAOs: one that addresses MC and one that addresses MEC. The RAOs described on Page 2-2 include both MC and MEC as contaminants of concern in one RAO, and a second RAO is developed that addresses restoration of the area to a condition that would comply with the SEDA LRA determination that the future use of the OD Grounds would be for recreation/conservation. Restoration of the site is not addressed in Table 2-1. Additionally the first RAO on Page 2-2 does not address the inhalation exposure pathway that Table 2-1 addresses. Revise Page 2-2 of the FS and Table 2-1 to consistently state the RAOs developed for the site.

Response 32: Page 2-2 and Table 2-1 were revised for consistency. A third row was added to Table 2-1 to address the restoration of the site. The inhalation exposure pathway was added to the first RAO on page 2-2.

Comment 33. Section 2.4, Site-Specific Cleanup Goals, Page 2-5: Table 2-1, OD Grounds Remedial Action Objectives, includes a notation in the Applicable ARAR/TBCs column, but this notation has not been defined. For clarity, all notations should be properly defined in notes at the end of the table. Revise Table 2-1 to define the notation used in the Applicable ARAR/TBCs column.

Response 33: Note 1 was included at the bottom of Table 2-1. "*1) ARARs and TBCs are described in Subchapter 2.1 of this report.*"

Comment 34. Section 2.5.1.3, Disposal Technologies for MEC, Page 2-8: The second and third paragraphs of this section state that "Engineering controls, such as sandbag mounds and sandbag walls over and around the MEC item, are often used to minimize the blast effects when an MEC item is destroyed in this manner." As these engineering controls are also used to minimize the effects of fragmentation as well as blast (See Department of Defense Technical Paper 15, Approved Protective

Construction), insert the words "and fragmentation" between the words "blast" and "effects" in the cited sentences.

Response 34: The text was revised as requested: "*...to minimize the blast and fragmentation effects when an MEC item is destroyed in this manner.*"

Comment 35. Section 2.5.2, Technologies for Soil Remediation, Page 2-8: The preliminary identification and screening of technologies applicable to each general response action that addresses MC is too limited, and does not evaluate a variety of technologies for the site. Only excavation and capping/containment technologies are described. To ensure that no potential remedial technology is overlooked, the FS should expand the preliminary identification and screening of technologies section to evaluate other potential technologies, such as in-situ and ex-situ treatment technologies and land use controls. Revise the FS to expand the preliminary identification and screening of technologies section to include additional potential remedial technologies.

Response 35: The evaluated technologies presented in the FS are considered adequate options. Further alternatives are not deemed appropriate. Because of the MEC hazard, other alternatives were not considered acceptable. The text in Section 2.6.3 was added to better clarify that LUCs are a technology that will be included in the alternatives.

Comment 36. Section 2.5.2, **Technologies for Soil Remediation, Page 2-8:** Table 2-2, OD Grounds Feasibility Study — Technology Screening, presents a preliminary evaluation of costs associated with each process option, but this evaluation should be separated by relative capital costs and relative operation and maintenance (O&M) costs. An example of this approach is shown on Figure 4-5, Evaluation of Process Options — Example, of the RI/FS Guidance. Revise Table 2-2 to separate costs by relative capital costs and relative O&M costs for each process option.

Response 36: Table 2-2 was revised to include relative capital and O&M costs.

Comment 37. Section 2.5.2, Technologies for Soil Remediation, Page 2-8: Table 2-2, OD Grounds Feasibility Study — Technology Screening, does not address all criteria used to evaluate the effectiveness of the remedial technology. With the exception of the No Action technology, all of the technologies are described as "potentially effective in meeting RAOs." However, Section 2.5.3, Evaluation of Technologies., indicates that the effectiveness category is divided into four evaluation criteria: Overall Protection of Public Safety and the Human Environment; Compliance with ARARs; Long-Term Effectiveness; and Short-Term Effectiveness. None of these evaluation criteria is specifically addressed in Table 2-2. In addition, Table 2-2 does not address all the criteria summarized in Section 2.5.3 to evaluate implementability. Revise Table 2-2 to provide a preliminary evaluation of the four criteria used to evaluate a technology's effectiveness, and the six criteria used to evaluate a technology's implementability.

Response 37: Table 2-2 was updated to include a screening column that addresses the technical implementability of each remedial technology. Further detail regarding the four evaluation criteria of effectiveness is provided in the text in Section 4.3.

Comment 38. Section 3.2, Description of Alternatives, Page 3-1: The first sentence of this section begins, "The following general response actions were retained for the OD Grounds..." However, the statement is followed by the remedial action alternatives, not general response actions. To ensure that accurate nomenclature is used, the above referenced statement should be revised to state, "The following remedial action alternatives were developed for the site..." Revise the FS to make this correction.

Response 38: The first line of Section 3.2 was revised as requested. "*The following remedial action alternatives were developed for the OD Grounds:*"

Comment 39. Section 3.2.2, Alternative 2, Geophysical Mapping/Intrusive Investigation/ Capping/LUCs, Page 3-2: This section states, "LUCs will be placed on the site to prohibit the use of groundwater, prohibit digging, and prevent the use of the site for use as a daycare or a residential facility..." but it does not clarify what types of LUCs will be used (ECs or ICs). If ICs are being considered, the FS needs to clarify what mechanism (deed restriction, master plan, etc.) will be used to enact these restrictions. Revise the FS to identify the types of LUCs anticipated under this alternative, and provide a brief description of the mechanisms that will be used to implement the restrictions, if ICs are anticipated. This comment also applies to Section 3.2.3, Alternative 3, in which LUCs were also identified as a component of the alternative.

Response 39: The LUC in the form of Institutional Controls will prohibit digging or any intrusive activities. The mechanism will be described in the Proposed Plan and the Record of Decision (ROD). Similar to other sites at Seneca, a LUC Remedial Design will be prepared which will provide for the recording of an environmental LUC which is consistent with Paragraphs (a) and (c) of the New York State Environmental Conservation Law (ECL) Article 27, Section 1318: Institutional and Engineering Controls. In addition, the Army will prepare an environmental LUC for the site, consistent with Section 27 1318(b) and Article 71, Title 36 of ECL, which will be recorded at the time of the property's transfer from Federal ownership and which will require the owner and/or any person responsible for implementing the LUCs set forth in the ROD to periodically certify that such institutional controls are in place.

Comment 40. Section 3.2.2, Alternative 2, Geophysical Mapping/Intrusive Investigation/ Capping/LUCs, Page 3-2: It is unclear why LUCs are necessary to prohibit the use of groundwater at the site if groundwater was not identified as a media of interest for this FS. Further clarifying information needs to be presented to explain why the use of groundwater should be prohibited. Revise the FS to address this concern.

Response 40: As per response to specific comment 15, Section 1.3.2 was revised to suggest that "...potential evaluation of site groundwater conditions may be appropriate subsequent to the remedial alternative selected in this FS." As part of LUC, digging will not be permitted on-site; therefore, the groundwater will not be accessible to potential receptors.

Comment 41. Section 3.2.3, Alternative 3, Geophysical Mapping/Intrusive Investigation/ Excavation/Off-Site Disposal/LUCs, Page 3-2: The first paragraph of this section refers to excavated soil potentially being incorporated into a site cap; however, capping is not a component of Alternative 3. The FS should consistently describe the components of each alternative. Revise Section. 3.2.3 to remove reference to a site cap since capping is not a component of Alternative 3.

Response 41: Reference to the site cap was removed from sections discussing Alternative 3.

Comment 42. Section 3.2.3, Alternative 3, Geophysical Mapping/Intrusive Investigation/ Excavation/Off-Site Disposal/LUCs, Page 3-3: The second paragraph on Page 3-3 states that excavated soils will be sampled, but it does not identify the proposed analyses or the number of samples anticipated. It also does not appear that costs associated with this sampling were incorporated into the cost estimate for Alternative 3 (Appendix C, Detailed Cost Estimate). Revise the FS to present additional details on the proposed soil sampling and ensure that costs associated with this sampling are included in the cost estimate.

Response 42: The second paragraph of Section 3.2.3 was revised to include the proposed analyses for excavated soil.

> Excavated soils will be sampled for RCRA hazardous waste characteristics to include a full TCLP analysis (TCLP VOCs, TCLP SVOCs, TCLP pesticides and herbicides, TCLP metals plus ignitability,

> corrosivity, and reactivity). Soils deemed free from MPPEH and meeting site or unrestricted cleanup standards will be left for potential re-use at the Depot.

The cost estimate in Appendix C previously included the expected analytical sampling costs.

Comment 43. Section 3.2.3, Alternative 3, Geophysical Mapping/Intrusive Investigation/ Excavation/Off-Site Disposal/LUCs, Page 3-3: The third paragraph on Page 3-3 states, "The LTM of groundwater described as part of Alternative 2 would be a part of Alternative 3 as well." However, no long term monitoring of groundwater was included as part of Alternative 2. In addition, it is unclear why long-term monitoring will be included as part of Alternative 3 when groundwater was not identified as a media of interest for this FS. The FS needs to clearly and consistently state whether or not groundwater needs to be addressed as part of this FS. This information should be supported by the results of a BHHRA and BERA. Remedies that address groundwater, such as natural attenuation with long term monitoring, need to be identified and evaluated in the preliminary screening of technologies. If it is determined that long-term monitoring of groundwater should be a component of the remedy, the FS needs to clearly state the purpose of this long-term monitoring. Revise the FS to address these concerns.

Response 43: Refer to response to specific comment 15. Based on the existing data from the OD Grounds and the adjacent OB Grounds sites, it does not appear that groundwater is a media of concern. However, as a conservative measure, the groundwater conditions may be re-evaluated to confirm whether LUCs to prohibit groundwater are necessary. As part of the LUC, digging will not be permitted therefore the groundwater will not be accessible.

Comment 44. Section 3.2.3, Alternative 3, Geophysical Mapping/Intrusive Investigation/ Excavation/Off-Site Disposal/LUCs, Page 3-3: Alternative 3 includes excavation and off-site disposal of contaminated soil, but the FS does not indicate whether confirmatory soil samples will be collected after the excavation to determine the effectiveness of this remedy at removing contamination. Post-excavation confirmatory soil sampling needs to be incorporated into this alternative to ensure that all soil exceeding clean-up criteria have been removed. Costs associated with this activity also need to be incorporated into the cost estimate. Revise the FS to include post-excavation confirmatory soil sampling as part of this alternative, or provide significant justification for excluding this sampling and clarify how the effectiveness of the remedy will be determined. If confirmatory sampling becomes part of this alternative, ensure the associated costs are added to the cost estimate.

Response 44: The second paragraph of Section 3.2.3 was revised to include the proposed analyses for in-situ soil.

> Post-excavation, in-situ soil will be sampled for metals by EPA method SW846 6010C as part of the confirmatory sampling. A more detailed sampling strategy for the soil surface within the 0 to 1,000-foot radius, including sample locations, sampling frequency, and the complete analytical list, will be addressed in a follow-on document subsequent to MEC clearance activities.

The cost estimate in Appendix C previously included the expected analytical sampling costs.

Comment 45. Section 3.2.3, Alternative 3, Geophysical Mapping/Intrusive Investigation/ Excavation/Off-Site Disposal/LUCs, Page 3-3: The last paragraph of Section 3.2.3 incorrectly states that Alternative 3 which includes excavation and off-site disposal, "would be highly effective in reducing the toxicity, mobility, and volume of MPPEH and MC." Removing contaminated soil from the site and disposing of it off-site does not reduce the toxicity, mobility, and volume of MC; it simply moves it from one place to another. In addition, EPA's preference is for remedies that reduce the toxicity, mobility, and volume of contaminants through treatment, which is not a component of Alternative 3. Revise the FS to remove statements that indicate Alternative 3 would be highly effective in reducing the toxicity, mobility, and volume of MC at the site.

Response 45: The last paragraph of Section 3.2.3 was revised as follows:

> Implementation of this alternative using excavation and off-site disposal would be effective in reducing the on-site toxicity, mobility, and volume of MPPEH and MC at the OD Grounds, and transfer the impact of the overall toxicity and volume to a controlled environment. The associated costs for excavation and off-site disposal are extremely high.

The FS has been revised to remove statements that indicate Alternative 3 would be highly effective in reducing the toxicity, mobility, and volume of MC at the site.

Comment 46. Section 4.3.2.2, Assessment, Page 4-5: This section appears to present conflicting information when addressing threshold factors for Alternative 2. First, the discussion notes that Alternative 2 cannot completely control behavior or restrict access to residual soil contamination, and then continues on to state that Alternative 2 complies with the ARARs identified for the site. ARARs for this site were identified as the NYS SCOs. If residual soil contamination above the NYS SCO remains at the site, compliance with ARARs may not be achieved for this alternative. Revise the FS to clarify if Alternative 2 will allow residual contamination above NYS SCOs to remain at the site.

Response 46: The FS was clarified to state that Alternative 2 will not allow exposure to contamination above NYS SCOs that remain at the site. The text in Section 4.3.2.2 was revised as follows:

> Additionally, although access to potentially contaminated soils will be prevented by the cap, Alternative 2 will allow residual contamination above NYS Commercial SCOs to remain at the site therefore the Site is not suitable for residential activities. Alternative 2 prevents exposure to soil with concentrations above the SCO specified in the ARARs by preventing access to soils above the SCO through the use of a cap and LUCs.

Comment 47. Section 4.3.2.2, Assessment, Page 4-5: Under Balancing Factors, it appears that the FS does not address the reduction of toxicity, mobility, or volume through treatment criterion as intended by the RI/FS Guidance. The FS states, "This alternative provides a degree of reduction in toxicity, mobility, and volume of potential MPPEH by removing it through intrusive investigations and surface excavations in areas of metallic saturation." However, this proposed remedy does not employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances. Revise Section 4.3.2.2 to indicate that Alternative 2 does not reduce the toxicity, mobility, and volume of potential MPPEH through treatment.

Response 47: The text in Section 4.3.2.2, Balancing Factors, 2nd paragraph was revised as requested. "*This alternative does not employ treatment technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous substances.*"

Comment 48. Section 4.3.3.2, **Assessment, Page 4-7:** Under Threshold Factors, the FS states, "Alternative 3 complies with the action-specific ARAR identified for the site..." It is unclear to which action-specific ARAR this statement is referring, particularly since Section 2.3.1, Action-Specific ARARs, indicated that none of the action-specific ARARs described needed further consideration for remedy evaluation/selection. In addition, Section 4.3.3.2 does not indicate if the chemical-specific ARARs will be met under this alternative. For clarity, revise Section 4.3.3.2 to identify the action-specific ARAR that is being addressed, and state if the chemical-specific ARARs will be met under this alternative.

Response 48: The text should have referenced "chemical specific". Chemical-specific ARARs will be addressed through the sampling strategy as per response to specific comment 42. Additional text was added to Section 4.3.3.2. "*Chemical-specific ARARs will be addressed by addressed by achieving the Commercial SCOs for soil remaining on-site.*"

Comment 49. Section 4.4.1, Overall Protection of Human Health and the Environment, Page 4-8: This section does not address the overall protection of the environment. This criterion was only evaluated in terms of possible human interaction. The RI/FS Guidance states, "Evaluation of the overall protectiveness of an alternative should focus on whether a specific alternative achieves adequate protection and should describe how site risks posed through each pathway being addressed by the FS are eliminated, reduced, or controlled through treatment., engineering, or institutional controls." Revise Section 4.4.1 to address the overall protection of human health and the environment consistent with the intent of the RI/FS Guidance.

Response 49: Section 4.4.1 was revised to include an evaluation with regards to overall protection of the environment. A portion of Section 4.4.1 was revised as follows:

> Alternative 1 provides the least overall protection of human health and the environment because it does not remove or restrict access to potential MPPEH or reduce the in-situ toxicity, mobility, and volume of soil contamination. Alternatives 2 and 3 both provide good protection of both human health and the environment by limiting exposure to MPPEH or soil contamination. The limitation of Alternative 2 with regards to environmental protection, is the potential for soil contamination remaining under the soil cap above screening criteria; however, the implementation of LUC would make Alternative 2 equally protective of human health. Alternative 3 has a higher level of permanence since soil and MPPEH would be removed off-site and analytical sampling would confirm that remaining in-situ soils were below the selected screening criteria.

Comment 50. Appendix B, MEC Hazard Assessment, Page B-25: Section B.12, Glossary of Terms, contains some obsolete term definitions. The definitions with issues include those of the following terms:

- Munitions and Explosives of Concern (MEC'): The citation for the source of the UXO definition contained in the MEC definition should read "10 U.S.C. 101 (e)(5)."
- Munitions Potentially Presenting an Explosive Hazard (MPPEH): The incorrect definition on page B-25 should be replaced with the current official definition, which reads: "Material that, prior to determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris); or potentially contains a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations). Excluded from MPPEH are munitions within the DoD established munitions management system and other hazardous items that may present explosion hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions."
- Unexploded Ordnance (UXO): The citation for the source of the UXO definition contained in the definition should read "10 U.S.C. 101 (e)(5)."

Correct these definitions as noted (See Department of Defense Ammunition and Explosives Safety Standards, Volume 8, Glossary [DoDM 6055.09-M-V8]).

Response 50: The Appendix B glossary was revised as requested.

MINOR COMMENTS

Comment 51. Section 1.3.3, Surface Water, Page 1-9: The first sentence of Section 1.3.3 repeats the term "surface water." Revise the sentence to state surface water only once.

Response 51: The sentence was revised.

Comment 52. Appendix A, Table A-5, Summary of SPLP Extract and Total Metals Analysis: Analysis is misspelled in the title of Table A-5. Please correct this error.

Response 52: The spelling of 'analysis' was corrected in the title of Table A-5.

Attachment 1
Comparison of Soil Data to Criteria Levels
OD Grounds
Seneca Army Depot Activity

						NYSDEC SCOs UNRESTRICTED USE		NYSDEC SCOs RESTRICTED RESIDENTIAL USE		NYSDEC SCOs COMMERCIAL USE		EPA RSL RESIDENTIAL SOIL	
Parameter	Unit	Max Value	Frequency of Detection	No. of Detects	No. of Analyses	Criteria Level	No. Above Criteria	Criteria Level	No. Above Criteria	Criteria Level	No. Above Criteria	Criteria Level	No. Above Criteria
VOCs													
Tetrachloroethene	UG/KG	19	38%	6	16	1,300	0	19,000	0	150,000	0	22,000	0
Herbicides													
MCPA	UG/KG	9,400	6%	2	35							31,000	0
Explosives													
1,3,5-Trinitrobenzene	UG/KG	190	60%	28	47							2,200,000	0
2,4,6-Trinitrotoluene	UG/KG	1,400	81%	38	47							19,000	0
2,4-Dinitrotoluene	UG/KG	1,100	77%	36	47							1,600	0
2-amino-4,6-Dinitrotoluene	UG/KG	680	77%	38	47							150,000	0
4-amino-2,6-Dinitrotoluene	UG/KG	500	57%	27	47							150,000	0
HMX	UG/KG	470	68%	32	47							3,800,000	0
Nitroglycerine	UG/KG	1,500	3%	1	31							6,100	0
RDX	UG/KG	5,800	83%	39	47							5,600	1
Tetryl	UG/KG	330	9%	4	47							240,000	0
Semivolatile Organic Compounds													
2,4-Dinitrotoluene	UG/KG	14,000	37%	13	35							1,600	2
2,6-Dinitrotoluene	UG/KG	700	6%	2	35							61,000	0
Acenaphthylene	UG/KG	30	9%	3	35	100,000	0	100,000	0	500,000	0		
Anthracene	UG/KG	18	6%	2	35	100,000	0	100,000	0	500,000	0	17,000,000	0
Benzo(a)anthracene	UG/KG	50	23%	8	35	1,000	0	1,000	0	5,600	0	150	0
Benzo(a)pyrene	UG/KG	82	23%	8	35	1,000	0	1,000	0	1,000	0	15	8
Benzo(b)fluoranthene	UG/KG	55	26%	9	35	1,000	0	1,000	0	5,600	0	150	0
Benzo(ghi)perylene	UG/KG	66	20%	7	35	100,000	0	100,000	0	500,000	0		
Benzo(k)fluoranthene	UG/KG	56	20%	7	35	800	0	3,900	0	56,000	0	1,500	0
Bis(2-Ethylhexyl)phthalate	UG/KG	740	26%	9	35							4,600	0
Chrysene	UG/KG	130	34%	12	35	1,000	0	3,900	0	56,000	0	15,000	0
Diethyl phthalate	UG/KG	35	3%	1	35							49,000,000	0
Di-n-butylphthalate	UG/KG	6,800	34%	12	35							6,100,000	0
Fluoranthene	UG/KG	68	31%	11	35	100,000	0	100,000	0	500,000	0	2,300,000	0
Hexachlorobenzene	UG/KG	110	31%	11	35	330	0	1,200	0	6,000	0	300	0
Hexachloroethane	UG/KG	1,100	17%	6	35							12,000	0
Indeno(1,2,3-cd)pyrene	UG/KG	52	11%	4	35	500	0	500	0	5,600	0	150	0
Naphthalene	UG/KG	30	14%	5	35	12,000	0	100,000	0	500,000	0	3,600	0
N-Nitrosodiphenylamine	UG/KG	320	6%	2	35								
N-Nitrosodipropylamine	UG/KG	1,600	14%	5	35							99,000	0
Phenanthrene	UG/KG	48	26%	9	35	100,000	0	100,000	0	500,000	0		
Pyrene	UG/KG	110	34%	12	35	100,000	0	100,000	0	500,000	0	1,700,000	0
Pesticides & PCBs													
Aroclor-1254	UG/KG	2,000	6%	2	34	100	2	1,000	1	1,000	1	220	1
4,4'-DDD	UG/KG	2.4	6%	2	34	3.3	0	13,000	0	92,000	0	2,000	0
4,4'-DDE	UG/KG	4.2	63%	22	35	3.3	2	8,900	0	62,000	0	1,400	0
4,4'-DDT	UG/KG	3.4	50%	17	34	3.3	1	7,900	0	47,000	0	1,700	0
Alpha-Chlordane	UG/KG	2	12%	4	34	94	0	4,200	0	24,000	0		
Dieldrin	UG/KG	3.2	41%	14	34	5	0	200	0	1,400	0	30	0
Endosulfan I	UG/KG	55	60%	21	35	2,400	0	24,000	0	200,000	0		
Endosulfan II	UG/KG	0.88	3%	1	34	2,400	0	24,000	0	200,000	0		
Endrin	UG/KG	3.6	3%	1	34	14	0	11,000	0	89,000	0	18,000	0
Endrin ketone	UG/KG	0.56	3%	1	34								
Gamma-Chlordane	UG/KG	1.1	9%	3	34								
Methoxychlor	UG/KG	45	3%	1	34							310,000	0
Inorganics													
Aluminum	MG/KG	27,900	100%	97	97							77,000	0
Antimony	MG/KG	5.1	33%	32	97							31	0
Arsenic	MG/KG	12.6	100%	97	97	13	0	16	0	16	0	0.39	97
Barium	MG/KG	365	100%	97	97	350	1	400	0	400	0	15,000	0
Beryllium	MG/KG	1.2	98%	95	97	7.2	0	72	0	590	0	160	0
Cadmium	MG/KG	1,100	81%	77	95	2.5	67	4.3	60	9.3	11	70	1
Calcium	MG/KG	193,000	99%	96	97								
Chromium	MG/KG	446	100%	97	97	30	23	180	1	1,500	0		
Cobalt	MG/KG	26.8	100%	97	97							23	2
Copper	MG/KG	7,310	100%	97	97	50	79	270	52	270	52	3,100	2
Cyanide	MG/KG	0.7	13%	2	16	27	0	27	0	27	0	22	0
Iron	MG/KG	118,000	100%	97	97							55,000	3
Lead	MG/KG	998	100%	97	97	63	31	400	1	1,000	0	400	1
Magnesium	MG/KG	15,000	100%	97	97								
Manganese	MG/KG	5,040	100%	97	97	1,600	1	2,000	1	10,000	0	1,800	1
Nickel	MG/KG	59.3	100%	92	92	30	78	310	0	310	0	1,500	0
Potassium	MG/KG	4,880	100%	76	76								
Selenium	MG/KG	0.92	4%	4	97	3.9	0	180	0	1,500	0	390	0
Silver	MG/KG	205	68%	66	97	2	48	180	1	1,500	0	390	0
Sodium	MG/KG	213	84%	81	97								
Thallium	MG/KG	0.27	6%	6	97							0.78	0
Vanadium	MG/KG	41.9	100%	97	97								
Zinc	MG/KG	1,470	100%	92	92	109	78	10,000	0	10,000	0	23,000	0
Mercury	MG/KG	9.1	99%	96	97	0.18	84	0.81	71	2.8	49	23	0

Footnotes:

1) No.of Analyses is the number of detected and non-detected results excluding rejected results. Sample duplicate pairs have not been averaged.

2) Criteria level source document and web address.

- The NYS SCO Unrestricted Use values were obtained from the NYSDEC Soil Cleanup Objectives.
http://www.dec.ny.gov/regs/15507.html
- The NYS SCO Restricted Residential Use values were obtained from the NYSDEC Soil Cleanup Objectives.
http://www.dec.ny.gov/regs/15507.html
- The NYS SCO Commercial Use values were obtained from the NYSDEC Soil Cleanup Objectives.
http://www.dec.ny.gov/regs/15507.html
- The USEPA RSLs for soil, residential scenario are from November, 2012.
http://www.epa.gov/region9/superfund/prg/

Attachment 2
Comparison of Sediment Data to Criteria Levels
OD Grounds
Seneca Army Depot Activity

						NYSDEC SCOs UNRESTRICTED USE		NYSDEC SCOs RESTRICTED RESIDENTIAL USE		NYSDEC SCOs COMMERCIAL USE		EPA RSL RESIDENTIAL SOIL	
Parameter	Unit	Max Value	Frequency of Detection	No. of Detects	No. of Analyses	Criteria Level	No. Above Criteria	Criteria Level	No. Above Criteria	Criteria Level	No. Above Criteria	Criteria Level	No. Above Criteria
Explosives													
2,4,6-Trinitrotoluene	UG/KG	120	25%	1	4							19,000	0
2,4-Dinitrotoluene	UG/KG	83	25%	1	4							1,600	0
2-amino-4,6-Dinitrotoluene	UG/KG	260	25%	1	4							150,000	0
RDX	UG/KG	210	25%	1	4							5,600	0
Tetryl	UG/KG	140	25%	1	4							240,000	0
Semivolatile Organic Compounds													
Benzo(a)anthracene	UG/KG	32	50%	2	4	1,000	0	1,000	0	5,600	0	150	0
Benzo(a)pyrene	UG/KG	37	50%	2	4	1,000	0	1,000	0	1,000	0	15	2
Benzo(b)fluoranthene	UG/KG	37	50%	2	4	1,000	0	1,000	0	5,600	0	150	0
Benzo(ghi)perylene	UG/KG	48	25%	1	4	100,000	0	100,000	0	500,000	0		
Benzo(k)fluoranthene	UG/KG	28	50%	2	4	800	0	3,900	0	56,000	0	1,500	0
Chrysene	UG/KG	50	75%	3	4	1,000	0	3,900	0	56,000	0	15,000	0
Di-n-butylphthalate	UG/KG	25	25%	1	4							6,100,000	0
Fluoranthene	UG/KG	60	75%	3	4	100,000	0	100,000	0	500,000	0	2,300,000	0
Hexachlorobenzene	UG/KG	40	50%	2	4	330	0	1,200	0	6,000	0	300	0
Indeno(1,2,3-cd)pyrene	UG/KG	32	25%	1	4	500	0	500	0	5,600	0	150	0
Naphthalene	UG/KG	24	25%	1	4	12,000	0	100,000	0	500,000	0	3,600	0
Phenanthrene	UG/KG	34	75%	3	4	100,000	0	100,000	0	500,000	0		
Pyrene	UG/KG	110	75%	3	4	100,000	0	100,000	0	500,000	0	1,700,000	0
Pesticides & PCBs													
4,4'-DDE	UG/KG	12	50%	2	4	3.3	2	8900	0	62,000	0	1,400	0
Aldrin	UG/KG	2.2	25%	1	4	5	0	97	0	680	0	29	0
Alpha-Chlordane	UG/KG	5.7	25%	1	4	94	0	4200	0	24,000	0		
Aroclor-1254	UG/KG	580	50%	2	4	100	1	1000	0	1,000	0	220	1
Dieldrin	UG/KG	7.4	25%	1	4	5	1	200	0	1,400	0	30	0
Endosulfan I	UG/KG	2.7	50%	2	4	2,400	0	24,000	0	200,000	0		
Endrin aldehyde	UG/KG	3.2	25%	1	4								
Inorganics													
Aluminum	MG/KG	35,000	100%	4	4							77,000	0
Arsenic	MG/KG	16.1	100%	4	4	13	1	16	1	16	1	0.39	4
Barium	MG/KG	308	100%	4	4	350	0	400	0	400	0	15,000	0
Beryllium	MG/KG	1.4	100%	4	4	7.2	0	72	0	590	0	160	0
Cadmium	MG/KG	25.6	100%	4	4	2.5	3	4.3	3	9.3	2	70	0
Calcium	MG/KG	84,400	100%	4	4								
Chromium	MG/KG	48.4	100%	4	4	30	3	180	0	1,500	0		
Cobalt	MG/KG	19.7	100%	4	4							23	0
Copper	MG/KG	814	100%	4	4	50	4	270	2	270	2	3,100	0
Iron	MG/KG	50,500	100%	4	4							55,000	0
Lead	MG/KG	101	100%	4	4	63	2	400	0	1,000	0	400	0
Magnesium	MG/KG	10,200	100%	4	4								
Manganese	MG/KG	935	100%	4	4	1,600	0	2,000	0	10,000	0	1,800	0
Mercury	MG/KG	5.3	100%	4	4	0.18	4	0.81	3	2.8	2	23	0
Nickel	MG/KG	67.7	100%	4	4	30	4	310	0	310	0	1,500	0
Potassium	MG/KG	4,880	100%	4	4								
Silver	MG/KG	5.8	75%	3	4	2	3	180	0	1,500	0	390	0
Sodium	MG/KG	377	100%	4	4								
Vanadium	MG/KG	53.7	100%	4	4								
Zinc	MG/KG	755	100%	4	4	109	3	10,000	0	10,000	0	23,000	0

Footnotes:

1) No. of analyses is the number of detected and non-detected results excluding rejected results. Sample duplicate pairs have not been averaged.

2) Criteria level source document and web address.

- The NYS SCO Unrestricted Use values were obtained from the NYSDEC Soil Cleanup Objectives.

http://www.dec.ny.gov/regs/15507.html

- The NYS SCO Restricted Residential Use values were obtained from The NYSDEC Soil Cleanup Objectives.

http://www.dec.ny.gov/regs/15507.html

- The NYS SCO Commercial Use values were obtained from the NYSDEC Soil Cleanup Objectives.

http://www.dec.ny.gov/regs/15507.html

- The USEPA RSLs for soil, residential scenario are from November, 2012.

http://www.epa.gov/region9/superfund/prg/

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Army's Response to Comments from the New York State Department of Environmental Conservation

Subject: Draft Final Feasibility Study Report
Munitions Response Action at Open Detonation Grounds
Seneca Army Depot
Romulus, New York

Comments Dated: August 6, 2013

Date of Comment Response: February 27, 2015

Army's Response to Comments

GENERAL COMMENTS

Comment 1. Page E-2: Executive Summary – Please specify the appropriate Part 375 Soil Cleanup Objectives (SCOs) Category that the engineered cap will be adhering to.

Response 1. The engineered cap will adhere to Part 375.6-7 (d)(1)(ii)(b) for commercial use sites which use the lower of the protection of groundwater or the protection of public health soil cleanup objectives, for the identified use of the site as set forth in Table 375-6.8(b). As per Section 1.3.1 of the FS, commercial use SCOs were determined to be appropriate therefore the commercial value set forth in Table 375-6.8(b) will be used. The referenced paragraph was updated as follows: "*The cap will comply with applicable requirements of New York State (NYS) Part 360 requirements for leaving waste in-place and the applicable screening criteria outlined in Part 375.6-7 (d)(1)(ii)(b).*"

Comment 2. Page 1-8, Section 1.3.1 (Soil) – It is mentioned that the OD grounds is located in the future Conservation/Recreation area and that the NYSDEC SCOs for the Commercial Use scenario are considered to be appropriate criteria for the OD grounds. Because of the definition of commercial use, the site should not be used in cases where contact with the soil is likely. This would include, but is not limited to, playgrounds and ball parks. Hiking trails and scenic walk paths are considered acceptable. This language should be clarified throughout the document.

Response 2. The language in Section 1.3.1 was revised as requested. "*The OD Grounds is located in the future Conservation/Recreation area (Figure 1-3); however, the site should not be used for uses where contact with the soil is likely (e.g., playgrounds and ball parks). Hiking trails and scenic walk paths are considered acceptable.*"

Section 2.1 (1st paragraph) was clarified. "*The future use for the OD Grounds is passive recreation/conservation for walking and hiking activities. There will be no intrusive soil activities such as digging, camping, camp fires, tent staking, trail construction, playgrounds, etc.*"

Section 2.1 (5th paragraph, 2nd bullet) was revised. "*...would be for passive recreation/conservation where contact with the soil is not likely (i.e., would not include playgrounds, ballparks, camping).*"

Section 1.2.2 was clarified as follows: "*Passive recreation indicating a use of the land where there is a limited potential for soil contact (e.g, does not include playgrounds or ballparks, but would include hiking or nature trails).*"

Comment 3. Page 1-10, Section 1.3.2 (Groundwater) – On page 1-10, the metals in groundwater is likely due to high turbidity levels. In the future, filtered groundwater samples should be taken and be compared to unfiltered groundwater samples if the turbidity levels are high. This is to ensure that no metals were leached into the groundwater from the soil.

Response 3. Comment noted. Recent groundwater samples collected during LTM of the OB Grounds have had low turbidity values and have not needed field filtering; however, in the future, if turbidity levels become a concern, filtering of the samples will be discussed with the BCT as USEPA does not accept filtered samples unless there is agreement as to how the data will be used.

Comment 4. Page 1-11, Section 1.3.4 (Sediment) – The report stated that sediment samples are collected from drainage ditches (ditch soil) and low-lying areas. It is confusing to label these samples as sediment and then compare the results with the Part 375 Commercial SCOs since the State's Division of Fish and Wildlife has its own sediment screening criteria. A suggestion would be to change the title of the section to "Ditch Soil" or simply reorganize them under the Section 1.3.1 for Soils. A new Section for Sediments can be started in Page 1-12 for actual sediments collected from the Reeder Creek.

Response 4. The paragraph concerning "Ditch Soil" was moved to follow Section 1.3.1 – Soil and was named Section 1.3.2 – Ditch Soil. The groundwater, surface water and sediment sections were renumbered as appropriate. Section 1.3.5 – Sediment only included the historical results from the sediment collected in Reeder Creek.

Comment 5. Page 1-12, Section 1.3.4 (Sediment), Second Paragraph: It is stated that the sediment found in Reeder Creek was from 'decomposition of fallen leaves and tree material stockpiles...' Please explain why or how the levels of heavy metals were found in the sediment exceeding NY Sediment Criteria values. For instance, could these heavy metals be taken up by the roots of trees and released back to the environment upon decomposition? Or are these heavy metals part of the native makeup of the soils?

Response 5. The sampling results with heavy metals exceeding screening criteria in sediment from Reeder Creek were from samples collected in 1991/1992 (Parsons, 1994) at a time when sediment (i.e., sand and silt), in sufficient quantities to sample, was observed in the creek. Since the 1991/1992 sampling event, the sediment in the creek was removed as part of the OB Grounds remediation (Weston, 2005).

Recent (2014) observations of the bottom of Reeder Creek have noted that the stream bottom is composed mostly of bedrock or bedrock fragments with a thin veil of organic sediment and/or tree and leaf litter. These observations are consistent with previous annual inspections conducted in the past five years. Section 1.3.5 was clarified as follows:

> The streambed was observed to contain exposed bedrock and fractured shale pieces and thin organic/sediment layers which appear to be from decomposition of fallen leaves and the migration of tree material stockpiles by beavers in previous seasons and not the result of active erosion of the site soil and soil transport (Parsons, 2014).

Comment 6. Page 3-1, Section 3.0 (Alternatives), First Paragraph: The entire Section sometimes makes references to remediating munitions constituents (MC) but eliminates MC from the discussion in other write-ups. Please make it clear at the beginning of Section 3 if MC are being considered as part of the remedial goals. If MC's are part of the remedial goals, they need to be discussed in all the alternatives and/or screening criteria.

Response 6. The remedial actions evaluated in the FS are driven by the reduction of the hazard presented by the presence of MPPEH; however, both Alternatives 2 and 3 will address MC (e.g., heavy metals) at the site. MC levels will be remediated to comply with the proposed cleanup criteria.

Comment 7. Page 4-5, Section 4.3.2.1 (Description Alternative 2), Second Paragraph: "The soil will be screened to remove MPPEH, and the overburden will be staged on-site for potential reuse and/or incorporation into the site cap..." The concern over reusing the overburden as a site cap is that the MPPEH screening does not remove all the heavy metals in the soil. Per Section 1.3.1, the soil is found to exceed Commercial SCOs for cadmium, copper and mercury. This site cannot meet the Commercial SCOs for soil if the cap is taken from the same soil that contains heavy metals above the Commercial SCOs. Because of this, it is advised that the soil will have to be retested to ensure the compliance to Commercial SCOs after it has been screened for MPPEH, or an outside source meeting the soil Commercial SCOs should be used for the site.

Response 7. Overburden will be retested prior to reuse in the soil cap. A sufficient layer of cover soil which complies with NYSDEC SCOs will be emplaced over the reused overburden. Overburden will be used to shape the area to promote drainage and will be under the impervious layer. Any soil used as part of the actual cap will demonstrate compliance with the SCOs.

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