FINAL

MMRP REMEDIAL ALTERNATIVES ANALYSIS

FOR

THE FORMER YORK NAVAL ORDNANCE PLANT

YORK, PENNSYLVANIA

Prepared for:

Harley-Davidson Motor Company Operations, Inc.
1425 Eden Road
York, PA 17402

Prepared by:

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January 2019

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LIST OF ACRONYMS AND ABBREVIATIONS

°F	Degrees Fahrenheit
µg/L	Microgram(s) per Liter
AMF	American Machine & Foundry Company
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirement
ASR	Archive Search Report
bgs	Below Ground Surface
BIP	Blow in Place
CAO	Corrective Action Objectives
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chemical of Concern
CSM	Conceptual Site Model
DERP	Defense Environmental Restoration Program
DGM	Digital Geophysical Mapping
DoD	Department of Defense
EA	EA Engineering, Science, and Technology, Inc., PBC
EM	Engineer Manual
EOD	Explosive Ordnance Disposal
ft	Foot (Feet)
fYNOP	Former York Naval Ordnance Plant
GPS	Global Positioning System
GSC	Groundwater Sciences Corporation
GW	Groundwater
Harley-Davidson	Harley-Davidson or Harley-Davidson Motor Company Operations, Inc.
HHRA	Human Health Risk Assessment
HTW	Hazardous Toxic Waste
in.	Inch(es)
LUC	Land Use Control
MC	Munitions Constituents
MD	Munitions Debris
MEC	Munitions and Explosives of Concern
MEC-HA	Munitions and Explosives of Concern – Hazard Assessment
mm	Millimeter(s)

MMRP	Military Munitions Response Program
MPPEH	Material Potentially Presenting an Explosive Hazard
MRA	Munitions Response Area
MRS	Munitions Response Site
MSC	Medium-Specific Concentration
NCP	National Oil and Hazardous Substances Contingency Plan
NMRD	Non-Munitions Related Debris
PADEP	Pennsylvania Department of Environmental Protection
PAH	Polycyclic Aromatic Hydrocarbons
PNDI	Pennsylvania Natural Diversity Inventory
PNHP	Pennsylvania Natural Heritage Program
PRG	Preliminary Remediation Goal
PRP	Potentially Responsible Party
RAA	Remedial Alternatives Analysis
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RSL	Regional Screening Level
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SI	Site Inspection
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TCRA	Time Critical Removal Action
TP	Target Practice
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UU/UE	Unlimited use and unrestricted exposure
UXO	Unexploded Ordnance
VSP	Visual Sampling Plan

EXECUTIVE SUMMARY

This Military Munitions Response Program (MMRP) Remedial Alternatives Analysis (RAA) was prepared by EA Engineering, Science, and Technology, Inc., PBC[2] (EA) to support the investigation of multiple munitions response sites (MRSs) and Areas of Concern (AOCs) collectively referred to as Munitions Response Areas (MRAs) at the former York Naval Ordnance Plant (fYNOP), also referred to as the Site, located at 1425 Eden Road, Springettsbury Township in York, Pennsylvania. The purpose of this RAA is to review and evaluate technology options for corrective actions at the MRAs (MRSs and AOCs) to achieve corrective action objectives (CAOs).

Two munitions response areas (MRAs) which include five MRSs and two AOCs were identified on the fYNOP. The MRS's and AOC were identified as follows: a former burial area in the west parking lot (MRS 1), a former misfire pit associated with Building 14 (MRS 2), a suspected 20-mm projectile dump (MRS 3), a suspect misfire pit associated with Building 16 (MRS 4), the Building 14 proof range (MRS 5), a suspect disposal area (AOC 1), and the Building 16 backstops and surrounding area (AOC 2) (USACE 1995, Alion 2008, EA 2018). Between 2015 and 2017, a Remedial Investigation (RI) was conducted to evaluate MRSs 1 thru 5 and AOCs 1 and 2 and a buffer area around MRSs 2-5 and AOCs 1 and 2, discussed hereafter as the Remainder RI Area. The area encompassing MRSs 2-5 and AOCs 1 and the Remainder RI Area is referred to as the MMRP RI Study Area or the RI Study Area throughout this report.

Based on the findings of the RI, MRS 1, MRS 2, MRS 3, MRS 4, and the Remainder RI Area have no known source of munitions and explosives of concern (MEC) or munitions constituents (MC) associated with historic activities within the fYNOP. MRS 1 was not intrusively investigated during the RI, however the probability of interaction with MEC and MC in MRS 1 is considered low. Under current and planned usages, the RI determined an incomplete pathway for MEC and MC exists for MRS 1 as land use controls restrict access to the subsurface in MRS 1.

MRS 2, MRS 3, MRS 4, and the Remainder RI Area were investigated, and the results were analyzed using statistics to determine the probability of finding MEC. There is a 95 percent confidence that at least 99.37 percent of the remaining anomalies in MRS 2, MRS 3, MRS 4, and the Remainder RI area are not MEC; conversely, there is the possibility that approximately six anomalies per thousand are MEC. Based on the general lack of a source area; limited MD findings during previous investigations, and the statistical validity presented in the RI, the likelihood that the remaining anomalies in MRSs 2-4 and the Remainder RI Area are not MEC is likely higher. The probability of interaction with MEC and MC in MRSs 2-4 and the Remainder RI Area is considered low. The pathway is considered incomplete under existing land uses with existing land use controls (LUCs). A surface clearance was conducted in these areas as part of the RI, however, potential interaction would be associated with intrusive operations. Also frost heave may eventually cause migration of items within the frost zone (up to 30 inches [in.] below ground

[2] Investigations and cleanup activities have been conducted at the Site initially under the oversight of PADEP and, later, the USEPA. In accordance with a 1995 settlement between Harley-Davidson Motor Company Operations, Inc. (Harley-Davidson), the United States Department of Defense (DoD) and the Department of Navy, environmental assessments and remedial activities at the fYNOP are being performed by Harley-Davidson with the U.S. Army Corps of Engineers (USACE) review and guidance (collectively the fYNOP Remediation Team). The DoD and Navy interests are represented by USACE. Project coordination is performed by AMO Environmental Decisions, Inc. (AMO). Official public information about the Site is located on the public web-link, http://yorksiteremedy.com.

surface [bgs]) toward the surface, causing such items to present a future surficial pathway over time if no clearance activities occur within areas with uninvestigated anomalies. MEC hazards and MC risk is currently mitigated with onsite controls including: a) an asphalt cap and LUCs preventing residential use and intrusive activities at MRS 1, and b) perimeter fencing with a manned access gate limiting access, education programs/awareness training, and dig permits for intrusive activities in MRSs 2-5, AOCs 1 and 2, and the Remainder RI Area.

The RI identified three primary areas with risks to human health to include MRS 5 (Building 14), AOC 1, and AOC 2. A summary of the hazards and risks to human health at each of those locations is listed below.

MRS 5 – This MRS includes components of the former Building 14 indoor firing range including the elevator shaft, target area/backstop, and the air handling system in the ventilation/fan room (including ductwork and the existing dust piles). Components of the air handling system and sand in the backstop are impacted with MC. MD and Material Potentially Presenting an Explosive Hazard (MPPEH) were observed in the backstop and no intrusive investigations occurred within the backstop material; therefore, the potential exists for MEC to be present. No evaluation of the sand conveyor system and elevator shaft in the north side of Building 14, a confined space, occurred during the prior investigations. A potentially-complete pathway for MEC and MC exists for MRS 5: however, the probability of interaction with MEC and MC is considered low. Although, it was determined that there was no sitewide impact from MC to groundwater at fYNOP, it was determined that a risk to human health remains from potential future groundwater use or direct contact with the process materials (i.e. backstop sand and dust) that are impacted by MC in MRS 5 (Building 14). MEC hazards and MC risk are currently mitigated with onsite controls including perimeter fencing with a manned access gate limiting access to the RI Study Area, education programs/awareness training, and restricted access to MRS 5 (Building 14 is locked/secured).

AOC 1 - This area has a high density of anomalies and appears to include a former small arms range and former disposal area. No MC sample results for metals, explosives, and/or polynuclear aromatic hydrocarbons exceeded criteria from surface or subsurface samples collected in AOC 1. Based on the findings of the RI, a potentially-complete pathway for MEC exists for AOC 1 based on the high concentrations of MD and classification of the area as a disposal area; however, the probability of interaction with MEC remains low. The potential for interaction with MEC was reduced by the surface MEC clearance conducted during the RI. Over time, frost heave may eventually cause migration of subsurface items within the frost zone (up to 30 in. bgs) toward the surface. These items may present a future surficial pathway if no clearance activities occur within potential source areas. No pathway exists for direct contact with MC by humans with surface soil as no source was identified in the surface soil samples in AOC 1; however, the direct contact pathway for subsurface soils is potentially-complete due to the observation of backstop sand within the area and the documented exceedances of metals in backstop sand associated with MRS 5. Risk is currently mitigated by onsite controls including perimeter fencing with a manned access gate limiting access to the RI Study Area, education programs/awareness training, and construction support (i.e. on-call oversite/support by qualified Unexploded Ordnance [UXO] personnel during excavation activities) for intrusive activities.

AOC 2 – This area contains a high density of anomalies and is located to the north of MRS 3, east of Building 14, and generally west of Building 16. This area includes the Building 16 (former indoor firing range) backstops, an area to the north of the backstops along a slope with a high density of anomalies, and an apparent 20-mm projectile disposal area with abundant sand. MEC comprised of 20-mm and 37-mm projectiles, and abundant MD were found in this area during the RI. Based on the findings of the RI, a potentially-complete pathway exists for MEC contact in AOC 2 and the probability of interaction with MEC is moderate due to access roads running through AOC 2. The probability of MEC increases to high if intrusive activities occur within this area. The potential for interaction with MEC was reduced by the surface MEC clearance conducted during the RI; however, frost heave may eventually cause migration of items within the frost zone (up to 30 in. bgs) toward the surface. These items may present a future surficial pathway if no clearance activities occur. One subsurface soil sample collected from a disposal area in AOC 2 containing sand assumed to be from the backstop and MD exceeded Pennsylvania Department of Environmental Protection (PADEP) Direct Contact criteria; however, this concentration was observed to be isolated based on samples collected surrounding the exceedance. No pathway exists for direct contact by humans with surface soil as no source was identified in the surface soil samples in AOC 2. The direct contact pathway for subsurface soils (including high density disposal areas) is potentially complete. MC hazards are currently mitigated by onsite controls including a fence, manned access gate, education programs, and limited site access. MEC risk is currently mitigated with onsite controls including perimeter fencing with a manned access gate limiting access to the RI Study Area, education programs/awareness training, and dig permits and construction support for intrusive activities.

Restructuring activities are ongoing or planned for the near future to include expansion of Building 3 and the associated access roads and parking areas as well as the existing infrastructure (to include underground utilities). The restructuring activities are expected to encroach on the western portion of the of the RI Study Area. Future development of the Site may include the western portion of the RI Study Area (inclusive of MRSs 2-4 and AOC 2) that is adjacent to the current plant expansion area. Development of the eastern portion of the RI Study Area is less likely as this area contains a natural gas pipeline, the topography is less suitable for development (sloping), further from site operations, and it is closer to the property boundary shared with adjacent residences.

Based on the findings of previous investigations and planned future use, the following corrective action objectives (CAOs) were developed for the Site:

- For MEC in soil and process materials, reduce the unacceptable hazard for current and future potential human receptors, including Harley-Davidson employees and subcontractors, property workers/contractors, and visitors, such that the likelihood of encounter is negligible. MEC could be present in areas where a MEC clearance has not been completed. Based on the findings of previous investigations, MEC may remain onsite within two media of concern, including the process materials or soil within approximately 36 in. of ground surface.

- For MC in soil exceeding the PADEP Direct-Contact or Industrial Soil criteria, prevent direct contact with the unacceptable hazard for current and potential future human receptors, including Harley-Davidson employees and subcontractors, property workers/contractors, and visitors. This CAO also applies to process materials.

The following potential remedial alternatives were developed for the fYNOP MRSs, AOCs, and the Remainder RI Area from the technologies that were retained from the development of alternatives discussed in Chapter 4. The five possible alternatives for further evaluation are:

- **Alternative 1 – No Action**

  No additional actions would be undertaken at MRS 1-5, AOCs 1 and 2, or the Remainder RI Area.

- **Alternative 2 – LUCs**

  The LUC components include continued maintenance of the site security force and fencing (maintain existing perimeter fence and add fencing for each applicable MRS/AOC), signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRSs/AOCs/Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, construction support for intrusive activities within MRSs 1-4, AOCs 1-2, and the Remainder RI Area, and maintenance of locks/prevention of entry into MRS 5 (Building 14). LUCs would require annual inspections to ensure compliance and assess the efficacy of the controls.

- **Alternative 3 – Focused Surface and Subsurface MEC Clearance, Removal of Process Materials, and LUCs**

  Perform a focused surface and subsurface MEC and process material clearance in MRSs 2-5, AOC 1, and AOC 2 and maintain LUCs in other areas. Depths to achieve focused surface and subsurface MEC and process material clearance would vary based on location. Focused surface and subsurface clearance in AOC 1 and AOC 2 would include removal of process materials, MD, and MPPEH to depth. Depth of removal for the anomalies and/or process materials would vary. Focused surface and subsurface clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

  To complete the focused MEC clearance, perform vegetation clearance activities, excavation-sifting-processing of known process materials/backstop sand-containing disposal areas in MRS 5 (to foundation depth), AOC 1 (to 36 in bgs) and AOC 2 (to 24 in. bgs), followed by 100% Mag-and-Dig of anomalies surrounding the sand-containing disposal areas in AOCs 1 and 2 using digital geophysical mapping (DGM) data (collected during the RI) and 100 % mag and dig of excavations to ensure removal to depth. Step out gridding using 100% Mag-and-Dig would be performed in any area where MD is found along the boundary of AOC 1 and 2. Remove and sift the existing soil/fill stockpiles within and to the east of AOC 2 (F1 and F2) and the existing soil stockpile to the south of MRS 4 (F3) as shown on Figure ES-1. Conduct 100% Mag-and-Dig of anomalies in the areas under these stockpiles.

  The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and

working in the MRSs/AOCs/Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, and construction support for intrusive activities within MRSs 1-4, and AOCs 1-2 (for intrusive activities below clearance depths), and the Remainder RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

- **Alternative 4 – Surface and Subsurface MEC Clearance, Removal of Process Materials to Achieve UU/UE for the Western Portion of the RI Study Area and LUCs**

  Perform a complete (100%) surface and subsurface MEC clearance to achieve UU/UE for soil within AOC 1 and the western portion of the Remainder RI Area (including MRSs 2, 3, 4, and 5 and AOC 2), and maintain LUCs in other areas. Depths expected to achieve UU/UE would be up to 36 in. bgs for the entirety of AOC 2, 24 in. bgs for the entirety of AOC 1 and 12 in. bgs for the entirety of MRSs 2-4 and for the remaining area within western portion of the RI Study Area (as depicted on Figure ES-1). Clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

  To complete the clearance, perform vegetation removal activities in the western portion of the RI investigation area, fill areas (F1, F2 and, F3) and AOC 1 including the surrounding grids. Conduct excavation-sifting-processing of soils in AOC 1 and AOC 2. Conduct surface and subsurface clearance in the remainder RI Area including MRSs 2-4 that includes the use of DGM, followed by intrusive investigations and removal of all anomalies identified during DGM. Any disposal areas containing process materials in the remainder RI Area would be excavated to depth. Remove and sift the existing soil/fill stockpiles within and to the east of AOC 2 (F1 and F2) and the existing soil/fill stockpile to the south of MRS 4 (F3) as shown on Figure ES-1. Conduct 100% Mag-and-Dig of anomalies in the areas under these stockpiles to depth (expected to be 12 in. bgs). Any disposal areas containing process materials beneath the existing soil/fill stockpiles would be excavated to depth.

  The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRS 1 and the eastern portion of the Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, and construction support (i.e. on-call oversite/support by qualified UXO personnel during excavation activities) for intrusive activities within MRS 1 and the Eastern portion of the Remainder RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

- **Alternative 5 –Surface and Subsurface MEC Clearance and Removal of Process Materials to Achieve UU/UE[3] for the Complete RI Study Area and LUCs**

  Perform a complete (100%) surface and subsurface MEC clearance to achieve UU/UE for soil within the complete RI Study Area including MRSs 2-5 and AOCs 1-2 excluding the Eastern Landfill (as depicted in Figure ES-1) and maintain LUCs in MRS 1 and the Eastern Landfill. Depths expected to achieve UU/UE would be up to 36 in. bgs for the entirety of AOC 2, 24 in. bgs for the entirety of AOC 1 and 12 in. bgs for the entirety of the remaining area within the RI Study Area. Clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

  To complete the clearance, perform vegetation removal activities in the entirety of the investigation area, fill areas (F1, F2 and, F3) and AOC 1 including the surrounding grids. Conduct excavation-sifting-processing of soils in AOC 1 and AOC 2. Conduct surface and subsurface clearance in the remainder RI Area including MRSs 2-4 that includes the use of DGM, followed by intrusive investigations and removal of all anomalies identified during DGM. Any disposal areas containing process materials in the remainder RI Area would be excavated to depth. Remove and sift the existing soil/fill stockpiles within and to the east of AOC 2 (F1 and F2) and the existing soil/fill stockpile to the south of MRS 4 (F3) as shown on Figure ES-1. Conduct 100% Mag-and-Dig of anomalies in the areas under these stockpiles to depth (expected to be 12 in. bgs). Any disposal areas containing process materials beneath the existing soil/fill stockpiles would be excavated to depth.

  The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRS 1 and the Eastern Landfill in the Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, and construction support (i.e. on-call oversite/support by qualified UXO personnel during excavation activities) for intrusive activities within MRS 1 and the Eastern Landfill in the Remainder RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

These alternatives were evaluated based on the National Contingency Plan criteria and compared against each other for appropriateness to the Site (**Table ES-1**). Based on the comparative analysis and the anticipated current and future site usage, Alternative 4 is recommended. This alternative will remove the most likely potential sources of MEC, it allows UU/UE for the portions of the Site likely to be developed in the future, it provides for removal of both existing MC and MEC source materials, and UXO construction support in the remaining areas and it is protective of human health and the environment. This remedy is satisfactory for short-term and long-term effectiveness and can be implemented using commonly-applied processes and

[3] No groundwater issues are associated with the MMRP. Groundwater within this portion of the fYNOP was evaluated for HTW corrective actions under the Site-Wide CAO table from June 2017 (Groundwater Sciences Corporation [GSC] 2017).

technologies. This recommendation is contingent upon stakeholder review and acceptance. The preferred alternative will be identified in the Remedial Action Work Plan for the fYNOP

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Table ES–1. Summary of Comparative Analysis of Remedial Alternatives

National Contingency Plan and Pennsylvania Act 2 Evaluation Criteria	Alternative 1: No Action	Alternative 2: LUCs	Alternative 3: Alternative 3 – Focused Surface and Subsurface MEC Clearance, Removal of Process Materials, and LUCs	Alternative 4: Surface and Subsurface MEC Clearance, Removal of Process Materials to Achieve UU/UE for the Western Portion of the RI Study Area and LUCs	Alternative 5: 5 –Surface and Subsurface MEC Clearance and Removal of Process Materials to Achieve UU/UE for the Complete RI Study Area and LUCs
Threshold Criteria	***Result***	***Result***	***Result***	***Result***	***Result***
1. Overall Protectiveness of Human Health and the Environment	Not protective	Protective	Protective	Protective	Protective
2. Compliance with ARARs	Not compliant	Compliant	Compliant	Compliant	Compliant
Balancing Criteria	***Ranking***	***Ranking***	***Ranking***	***Ranking***	***Ranking***
3. Long-term Effectiveness and Permanence	Not applicable	1	2	3	3
4. Reduction of Toxicity, Mobility, or Volume through Treatment	Not applicable	1	2	3	3
5. Short-term Effectiveness	Not applicable	3	2	2	1
6. Implementability	Not applicable	3	2	2	1
7. Cost	$0	3 $ 789,439	2 $ 3,777,579	2 $ 4,813,740	1 $ 7,159,268
Balancing Criteria Score	Not applicable	11	10	12	9

Notes:

- Any alternative considered "not protective" for overall protectiveness of human health and the environment or "not compliant" for compliance with ARARs, it is not eligible for selection as the recommended alternative. Therefore, that alternative is not ranked as part of the balancing criteria evaluation.
- Scoring for the balancing criteria is as follows: Most favorable = 3, second most favorable = 2, least favorable = 1. The alternative with the highest total balancing criteria score is considered the most feasible.
- ARAR = Applicable and Relevant or Appropriate Requirement.
- UU/UE = Unlimited Use and Unrestricted Exposure

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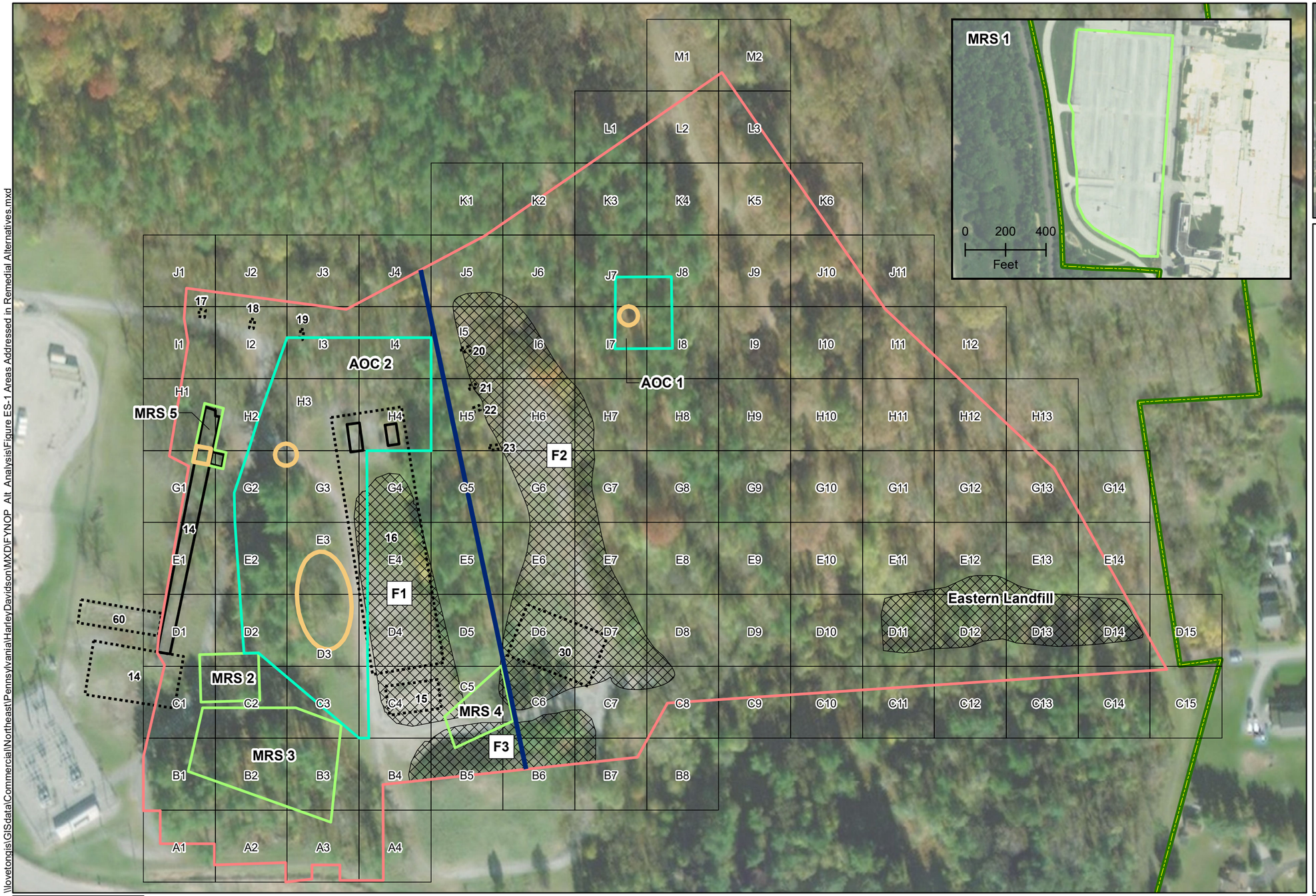

Legend

- Current AOC Boundary
- Current MRS Boundary
- Sand/Process Materials Found During RI
- Fill With High Anomaly Density
- Former Building Locations
- Current Building Locations
- 100x100 foot Survey Grid
- Division of Remedial Investigation Area for Remedial Alternatives (RI)
- Remedial Investigation Boundary
- Former York Naval Ordnance Plant Boundary

Notes:
No Investigation occurred within High Anomaly Density areas identified containing fill during the MMRP Remedial Investigation.

AOC = Area of Concern
MRS = Munitions Response Site
MMRP = Military Munitions Response Program

F3 = Fill Area

\\lovetongis\GISdata\Commercial\Northeast\Pennsylvania\HarleyDavidson\MXD\FYNOP_Alt_Analysis\Figure ES-1 Areas Addressed in Remedial Alternatives.mxd

Figure ES-1 Areas Addressed in Remedial Alternatives

Aerial: ESRI, 2015

Projection: NAD 1983 State Plane Pennsylvania South Feet

Date: August 2018

0 100 200
Feet

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1. INTRODUCTION

1.1 SITE OVERVIEW

The former York Naval Ordnance Plant (fYNOP), also referred to as the Site, is in Springettsbury Township in York, York County, Pennsylvania. The Site is bordered to the south by U.S. Route 30 (Arsenal Road); to the west by Eden Road, a railroad line, and Codorus Creek; and to the east and north by residential properties (**Figure 1-1, Appendix A**). Current owners of the fYNOP include Harley-Davidson (171 acres) and NorthPoint 58 Limited Liability Corporation (NorthPoint [58 acres]). The Harley-Davidson (171 acres) property has continued to be developed over the years. Operations were moved into a plant constructed in 2000 and is used to produce motorcycles while older site buildings have been demolished. Site development, includes installation of utilities, removal of existing structures, and placement of fill material. The NorthPoint property is part of a larger area that has been developed with a building and a parking lot.

As a result of the multiple investigations and removal actions at the Site, five munitions response sites (MRSs) and two areas of concern (AOCs) were designated by USACE as being present at the Site (Figure 1-2, Appendix A), collectively these areas were identified as two separate MRAs[4]. A description of the MRSs and AOCs is as follows: a burial area in the west parking lot (MRS 1), a misfire pit associated with Building 14 (MRS 2), a 20-mm dump (MRS 3), a misfire pit associated with Building 16 (MRS 4), Building 14 proof range (MRS 5), suspect disposal area (AOC 1), and the Building 16 backstops (AOC 2) (USACE 1995, Alion 2008) (**Figure 1-2, Appendix A**). The buffer area around MRSs 2-5, AOC 1 and AOC 2 is referred to as the Remainder RI Area, and the area encompassing MRSs 2-5 and AOCs 1 and the Remainder RI Area is referred to as the MMRP RI Study Area or the RI Study Area throughout this report.

1.2 REGULATORY FRAMEWORK

Harley-Davidson and the U.S. Environmental Protection Agency (USEPA) signed an agreement to participate in the Federal Facility Lead Program in 2002. The Facility Lead Program was superseded by the USEPA One Cleanup Program in 2003. Harley-Davidson submitted a Notice of Intent to Remediate to Pennsylvania Department of Environmental Protection (PADEP) in 2005 that initiated cleanup actions under Act 2. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Act 2 have no special provisions for dealing with explosive safety and, therefore, the provisions in the DoD Ammunition and Explosives Safety Standards (DoD 6055.9-M), USACE Engineer Manual (EM) 385-1-97 and the Final U.S. Army Military Munitions Response Program (MMRP) Munitions Response Remedial Investigation/Feasibility Study Guidance (US Army, 2009) were adhered to during the Remedial Investigation (RI) and during preparation of this report.

[4] The term munitions response area or "MRA" refers to separate areas on the fYNOP Site. MRA 1is inclusive of MRS 1, which is isolated in the western part of the Site. MRA 2 encompasses MRSs 2-5, AOCs 1 and 2, and the RI Study Area.

1.3 PURPOSE OF THE REMEDIAL ALTERNATIVES ANALYSIS

The purpose of this Remedial Alternatives Analysis (RAA) is to develop and evaluate potential remedial alternatives for addressing impacted media at fYNOP. Following this analysis, Harley-Davidson will select the preferred remedial alternative for the Site and prepare the Remedial Action Work Plan.

Remedial alternatives described in this report are developed and screened with respect to the following nine evaluation criteria: (1) overall protection of public health, welfare, and the environment; (2) compliance with laws and regulations; (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, and volume of contamination; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state acceptance; and (9) community acceptance.

1.4 REPORT ORGANIZATION

This report is divided into the following chapters:

- **Chapter 1, Introduction—**identifies the Site, regulatory framework, and the primary purpose and scope of the RAA.

- **Chapter 2, Background—**summarizes fYNOP background information, the physical characteristics of the Site, and the findings of previous investigations.

- **Chapter 3, Development of the Evaluation Process—**Provides an overview of the RAA evaluation process; identifies the chemical-, location-, and action-specific Applicable or Relevant and Appropriate Requirements (ARARs); develops preliminary remediation goals (PRGs); defines the corrective action objectives (CAOs); and identifies general response actions for MEC and MC.

- **Chapter 4, Identification and Screening of Technology Types and Process Options—** Identifies and screens various potential remedial technologies and options that may be used to address MEC and MC.

- **Chapter 5, Development and Detailed Analysis of Remedial Alternatives—**Develops remedial alternatives for addressing MEC and MC based upon the individual technologies that were retained from the screening process in Chapter 4. Subsequently, a detailed evaluation and comparative analysis is presented for each of the remedial alternatives with respect to the nine evaluation criteria.

2. BACKGROUND

2.1 SITE USE AND HISTORY

In 1941, York Safe and Lock Company constructed a plant on the Site for production of armaments for the DoD use during World War II. Operations conducted onsite included manufacturing and assembly of 40-millimeter (mm) twin/quadruple guns and mounts, 37-mm guns and carriages, 3 inch (in.) and 90-mm twin/quadruple guns and mounts, and Navy shields and gun slides. The York Safe and Lock Company constructed two proof testing ranges for the testing of the 40-mm, 3-in., and 37-mm manufactured guns. Facilities constructed in the proof testing area (referred to as the Magazine Area in 1959) included proof testing range buildings (Buildings 14 and 16), along with ammunition storage buildings/magazines (Buildings 17 through 23). By Executive Order, dated 21 January 1944, the Secretary of the Navy permitted the Government to possess and operate the facility. The facility was named the U.S. Naval Ordnance Plant, York, Pennsylvania. During the Korean War in the early 1950s, the Site was used to manufacture 3-in., 0.50-caliber guns, and 20-mm aircraft machine guns. Towards the end of 1955, the plant began to manufacture power drive units for the 5-in. and 0.54-caliber guns along with the 20-mm aircraft machine guns.

General production operations at fYNOP continued until 1964 when the plant was sold to American Machine & Foundry Company (AMF). AMF continued manufacturing operations to include rocket launchers, gun components, and other materials formerly manufactured at the facility for several years before switching over to non-ordnance manufacturing such as snowmobiles and golf carts. In 1969, AMF merged with Harley-Davidson. In 1973, Harley-Davidson moved its motorcycle assembly operations to the fYNOP.

2.2 MUNITIONS RESPONSE SITE AND AREA OF CONCERN SITE DESCRIPTIONS

Harley-Davidson has been conducting investigations and cleanup activities under the supervision of the PADEP since 1984. Following a 1995 settlement agreement between Harley-Davidson, the Department of Defense (DoD), and the Department of Navy, environmental assessments and remedial activities at the fYNOP are to be performed by Harley-Davidson with the U.S. Army Corps of Engineers (USACE) review and guidance consistent with the National Oil and Hazardous Substances Contingency Plan (NCP) and other applicable federal, state, and local regulations. The DoD and Navy interests are represented by the USACE with AMO Environmental Decisions facilitating the operation of the settlement agreement and providing review and guidance. Harley-Davidson is actively participating with the DoD under a November 2013 agreement to address the cleanup of residual ordnance and explosive waste for site remedial actions.[5]

Between 1984 and 2013, USACE and Harley-Davidson conducted multiple investigations and cleanup/removal actions to address Munitions and Explosives of Concern (MEC), munitions debris (MD), and Munitions Constituents (MC) related to former proof testing operations. Actions conducted include a removal action by Explosive Ordnance Disposal (EOD) Detachment personnel in 1993, a time critical removal action (TCRA) in 2004, and a site inspection (SI) in

[5] The term ordnance and explosive waste has been replaced with Munitions and Explosives of Concern (MEC), munitions debris (MD), and Munitions Constituents (MC) in USACE terminology

2007/2008, as well as the removal of most of Building 16 to include the material present in the two backstop areas (i.e., MD and dust/soils with elevated concentrations of MC).

As a result of the multiple investigations and removal actions at the Site, five munitions response sites (MRSs) and two areas of concern (AOCs) were designated by USACE as being present at the Site (**Figure 1-2**, **Appendix A**), collectively these areas are referred to as MRAs. One MRA consists of MRS 1 that is isolated in the western part of the Site and the second MRA encompasses MRSs 2-5, AOC 1 and 2 and the RI Study Area. The five MRSs and two AOCs include: a burial area in the west parking lot (MRS 1), a misfire pit associated with the southern end/firing point of Building 14 (MRS 2), a 20-mm dump (MRS 3), a misfire pit associated with southern end/firing point of Building 16 (MRS 4), the Building 14 proof range (MRS 5), a suspect disposal area (AOC 1), and the Building 16 backstops (AOC 2). Since 2007, Harley-Davidson had additional munitions-related findings outside the designated MRS and AOC boundaries. These findings appear to be related to historic operations associated with the proof ranges (Buildings 14 and 16). Between 2015 and 2017, an RI was conducted to evaluate MRSs 1 thru 5, AOCs 1 and 2, and the Remainder RI Area comprised of buffer area around MRSs 2-5 and AOCs 1 and 2 and within the RI boundary area. A description of the MRSs, AOCs, and the Remainder RI Area, along with a summary of the findings as they relate to remaining MEC hazards and MC risk, is presented in Sections 2.4 and 2.5.

2.3 PHYSICAL CHARACTERISTICS

2.3.1 Climate

Pennsylvania is generally considered to have a humid continental type of climate, but the varied physiographic features have a marked effect on the weather and climate of various sections within the state. The average yearly temperature at the fYNOP is 58.3 degrees Fahrenheit (°F), with the maximum being 95 °F and the minimum being 45 °F. This climate corresponds with a frost-line depth of 30 in. below ground surface (bgs). The average precipitation is 40 in. (USACE 1995, Alion 2008).

2.3.2 Topography

Ground surface topography at the Site and surrounding area ranges from an elevation of 565 feet (ft) above mean sea level in the northeastern corner of the Site, to an elevation of 340 ft above mean sea level at Codorus Creek (Groundwater Sciences Corporation [GSC] 2011).

2.3.3 Soils

Unconsolidated overburden material of residual soils and saprolite has developed from the underlying bedrock throughout the fYNOP. The overburden material ranges in thickness from 15 ft to greater than 60 ft. Portions of the fYNOP also have alluvial deposits, including more coarsely-grained sediments interspersed among the predominantly fine-grained residual soils (Science Applications International Corporation [SAIC] 2009).

2.3.4 Vegetation

The vegetation in the fYNOP MRA containing MRSs 1-5, AOC 1, and AOC 2 consists of white pine, red pine, Norway spruce, white spruce, jack pine, European larch, ash, walnut, lespedeza bicolor, bush honeysuckle, and shrub roses (USACE 1995, Alion 2008). A portion of the fYNOP surrounding MRS 1 (no longer owned by Harley-Davidson) is developed with limited or no vegetation (parking lot).

2.3.5 Geology

Two geologic formations underlie the fYNOP: a solution-prone gray carbonate-rich limestone located in the flat lowland, and a quartzitic sandstone underlying the more steeply sloping hills or upland are in the eastern part of the fYNOP. The bedrock is from the Kinzers Formation. The Kinzers Formation in York County is a medium to dark gray microcrystalline to very fine crystalline limestone with some quartz veins (USACE 1995).

Weathering has taken place within the limestone bedrock in the form of dissolution of carbonate minerals. Several sinkholes have occurred on the fYNOP, that are typical within areas of karst topography (USACE 1995, Alion 2008).

2.3.6 Hydrogeology

Groundwater generally migrates from the upland area (east) towards Codorus Creek (west). The eastern upland area (containing MRSs 1-5, AOC 1, and AOC 2) is underlain by quartzitic sandstone while a carbonate (karst) aquifer underlies the western half of the Site (MRS 1). Aquifer transmissivity is very different between these geologic materials with the quartzitic sandstone being lower due to groundwater migrating through minor bedding planes, joints, and fractures that have a high resistance to flow compared to the solution-enhanced carbonate aquifer. The materials of the carbonate aquifer are prone to dissolution by migrating groundwater that increases the formation's transmissivity and permits groundwater to more readily flow through the aquifer (GSC 2016).

Water table gradients are relatively steep (6 to 10 percent) in the upland, quartzitic sandstone regions and are reduced to a relatively flat gradient (less than 1 percent) once groundwater flows into the carbonate rock aquifer. The upland area flow patterns are mainly driven by the interconnected network of fractures, joints, and bedding planes. Once the groundwater enters the carbonate rocks, groundwater flow is directed along fractures, dissolution cavities, interconnected conduits, and weathered zones in the rock. Locally, the groundwater flow through the karst bedrock is widely variable following the pathways of the karstic conduits (GSC 2016).

The extent of the karst aquifer is limited to the north and east by phyllite, quartzite, and quartzitic sandstone. These non-carbonate formations underlie the carbonate formation, dipping at an angle of approximately 15 to 20 degrees toward the carbonate, and form the lower limit of the karst aquifer in the northern and eastern portions of the Site. To the south, the carbonate aquifer is laterally extensive, and the depth of the karst aquifer is unknown. Under the southern portion of the fYNOP (including the West Parking Lot/MRS 1), the depth to the bottom of the carbonate aquifer ranges from 200 to 800 feet thick (GSC 2016).

The supplemental groundwater remedial investigation described seeps and springs near Buildings 14 (MRS 5), 15, and 30 as specifically discharging from the sandstone/quartzite bedrock interface along the base of the hill. These springs feed a southern tributary to Johnsons Run that originates near the small pond near the Gate 5 area (GSC 2016).

2.3.7 Additional Site Information

Using as a guide the procedures of Act 2 PA Law Section 50.311, 'Evaluation of ecological receptors' Section a, EA conducted an evaluation of the Site to determine if the RI is required to assess impacts to ecological receptors from exposure to MC. EA completed the Pennsylvania Natural Diversity Inventory (PNDI) Coordination using the PADEP website (http://www.gis.dcnr.state.pa.us/hgis-er/PNDI_Introduction.aspx) to determine if any of the following are present in the MMRP response area:

(1) Individuals of threatened or endangered species as designated by the United States Fish and Wildlife Service under the Endangered Species Act (16 U.S.C.A. § § 1531—1544),
(2) Exceptional value wetlands as defined in § 105.17 (relating to wetlands),
(3) Habitats of concern,
(4) Species of concern.

The PNDI Coordination response indicates that no threatened or endangered species, exceptional value wetlands, habitats of concern, or species of concern are located on the Site within the MMRP RI Study Area.

Additionally, there are no identified wetlands within the designated RI study area at the fYNOP, and the Site is in south-central Pennsylvania, thus there are no coastal zones present on the Site or in the study area (USACE 1995, Pennsylvania Natural Heritage Program [PNHP] 2017). The fYNOP is not currently in a 100-year flood plain.

No cultural and archaeological resources are present within the site boundaries of fYNOP (USACE 1995) and no active waste disposal sites currently exist.

Drinking water populations within 4 miles of the fYNOP include residents of York County, Pennsylvania, that has an estimated population of over 443,744 (United States Census Bureau 2016).

A water study was completed as part of the RI, including an Updated Water Use Survey Report (GSC 2018a). Several groundwater monitoring wells are currently present on the fYNOP property; however, there are no potable water wells located within the fYNOP. Potable water for fYNOP is obtained from the York Water Company or from bottled water suppliers.

2.3.8 Surface Water

No naturally-formed channelized surface water systems are present within the RI Study Area. Two lined conveyances are present in the southern portion of the fYNOP RI Study Area and convey runoff in the southern portion of the study area to the south and west. Johnsons Run is the nearest downgradient surface water body to the Site and is located to the west of the Gate 5 area and

receives flow from a small pond and nearby adjacent drainages. Water entering this pond follows Johnsons Run, a losing stream, to the west and terminates at Codorus Creek.

2.3.9 Underground Utilities

The most prominent underground utility is a natural gas pipeline, that runs from west to east starting near Gate 5 until turning south-southeast near the former magazine areas and exiting the RI Study Area between MRS 4 and the former Eastern Landfill. The other prominent feature is an underground stormwater conveyance that runs from east-to-west prior to becoming a visible concrete-lined surface feature to the south of the demolished portion of Building 14 and running to the west beneath the access road entering the substation. Other mapped utilities are present within the Site and are mostly inactive. Known electrical poles are presented on **Figure 2-1** (**Appendix A**).

2.4 PREVIOUS INVESTIGATIONS AND REMEDIATION

Since 1984, numerous environmental investigations and remedial efforts have been conducted at the fYNOP and the Harley-Davidson facility as part of the ongoing potentially responsible party (PRP) hazardous, toxic, waste (HTW) project. Media samples, including groundwater, soil, and process materials (i.e. backstop sand and dust associated with firing range operations), have been collected for analysis from areas throughout the fYNOP.[6]

Between 1984 and 2013, USACE and Harley-Davidson conducted multiple investigations and cleanup/removal actions to address MEC, munitions debris (MD), and MC related to operations associated with the former proof ranges. These investigations included a time-critical removal action by an EOD Detachment in 1993, a time-critical removal action in 2004, a MMRP site inspection (SI) in 2007/2008, demolition/removal of much of Building 16 in 2009, and removal of MD and MC impacted dust from Building 16 operations completed concurrently with demolition. As a result of these investigations and findings an MMRP RI was conducted as discussed below.

2.4.1 Military Munitions Response Program Remedial Investigation

As documented in the RI Report, a two-phased investigation approach was completed to identify the nature and extent of both MEC and MC for the fYNOP. Phase I activities included vegetation clearance, survey and staking of 100 ft by 100 ft grids, and a magnetometer-assisted surface clearance for MEC within each of the grids. Surface clearance activities also included anomaly counts to determine high density and low-density grids. No MC sampling was performed during Phase I because no breached MEC were identified. Surface clearance for MEC was not performed in MRS 1 (due to the presence of a paved parking lot) or portions of the Remainder RI Area (i.e. Eastern Landfill).

Based on the results of the Phase I activities, a Work Plan Addendum was prepared, and Phase II activities were completed that included digital geophysical mapping (DGM) of 13 select grids classified as high density, intrusive investigation of anomalies, and MC sampling based on the

[6] During previous investigations this area is referred to "The Bunkers and Shell Ranges Area". The area is listed as being comprised of Buildings 14, 15, 16, and 30 and the surrounding areas where former buildings associated with the proof ranges have been removed. Data from previous investigations in this area was used to support the RI.

findings of the intrusive investigations. In addition, an investigation of Building 14 was conducted including the backstop area and ventilation dust bag room. This included an inspection of surface items in the backstop (to determine if MEC was present) and MC sampling.

The results of the DGM investigation were evaluated using statistical software to determine the number of anomalies for intrusive investigation to gain statistical validity that remaining anomalies were not MEC. The results of the statistical analysis concluded that at least 300 anomalies should be investigated in each of the areas (high density and low density) to validate a 95 percent confidence level that 99 percent of the remaining anomalies are not MEC. Specific anomalies targeted from high-density areas were reacquired and investigated, and a variety of specific and random anomalies were targeted from low-density areas to achieve the required statistical validity. No intrusive investigations were performed in MRS 1 or portions of the Remainder RI Area including the Eastern Landfill and several high-density areas that were covered with fill material (noted on Figures 2-2 and 2-3).

The Phase II intrusive investigation identified 578 instances of Non-Munitions Related Debris (NMRD), 95 instances of MD, and 3 instances of MEC (4 items were identified as MEC and two items were collocated with each other).

The RI concluded the potential for encountering MEC in MRSs 2-4 and the Remainder RI Area is considered low (i.e., low probability). For statistical purposes, the areas comprising the Remainder RI Area, MRS 2, MRS 3, and MRS 4 were combined and re-evaluated using Visual Sampling Plan (VSP) to calculate the probability of non-MEC-item anomalies. The analysis concluded a 95 percent confidence that at least 99.37 percent of remaining anomalies are not MEC within these areas. The pathway is also viewed as incomplete for these MRSs and the Remainder RI Area assuming existing security fencing is maintained, and no intrusive activities occur.

A protective covenant exists for MRS 1, associated with environmental impacts to soil and groundwater that restricts access to the Site and the potential for encountering MEC in this area is considered low. The pathway is also viewed as incomplete assuming the existing land use controls remain, and no intrusive activities occur.

The RI determined that Munitions constituents (MC) samples collected from the process materials (sand and dust associated with former firing range operations) in Building 14 (MRS 5) predominantly exceeded soil-to-groundwater criteria and/or direct contact screening levels; however, the process materials are underlain by impervious surfaces and are not exposed to precipitation. The lone exceedance in subsurface soil exceeds the PADEP buffer distance for lead into groundwater through a soil-to-groundwater pathway. Lead in the subsurface is strongly retained in soil with little transport via leaching except in highly acidic environments and concentrations from samples collected below and surrounding, the concentration was less than screening criteria. Site conditions and results from prior investigations indicate that groundwater leaving the Site is not impacted by lead at concentrations exceeding screening levels.

The results of the Human Health Risk Assessment (HHRA) reveal potential impacts to the springs from source material remaining within Building 14 (MRS 5). The calculated risk empirically proves the need for the current protective measures to remain in place for onsite groundwater under the model for potential future use; however, removal of the source material in Building 14 will

likely mitigate such risk as upgradient groundwater does not show impact. A residential re-use of the Site and the use of the springs as a tap water source is an unlikely scenario in the future; therefore, actual exposures to receptors, especially to water from the springs, are overestimated.

Several of the MRS and AOC boundaries were revised as part of the RI because of the historical and MMRP RI findings. No revision of the location or boundaries of MRS 2, MRS 3, and MRS 4 occurred. The boundary of MRS 1 was expanded and it includes the extent of the fill area of the west parking lot.[7] The initial boundary of MRS 5 was moved to encompass the remaining MMRP sources areas within Building 14 (the backstop area and ventilation dust bag room). The boundary of AOC 1 as depicted in the MMRP SI was moved to the southwest to encompass the terraced area investigated during the MMRP RI. Finally, the boundary of AOC 2 was expanded to include an area between Buildings 14 and 16, to the north of former MRS 2 and MRS 3, and to the south of the finds within grids I3 and I4. The remaining area within the MMRP RI Study Area excluding MRS 2, MRS, 3, MRS 4, MRS 5, AOC 1, and AOC 2 is discussed hereafter as the Remainder RI Area. Findings are arranged by MRS and AOC as discussed below.

2.4.2 Munitions Response Site 1 – Burial Area (Parking Lot)

MRS 1 is located on the western side of the Site, previously termed the West Parking Lot. This land is no longer owned by Harley-Davidson. MRS 1 was originally listed as having an area of 1 acre and it derived its shape, acreage, and location from the USACE Archive Search Report (ASR) that created a "square" shaped range area encompassing a location where a former employee had drawn an "X" on a site map. The "X" was drawn to indicate the location of a former "dump" area used by the fYNOP. The ASR noted that, historically, an inert projectile had been found during sinkhole repair activities in the west parking lot near monitoring well CW-9. During the 2007 MMRP SI, it was noted that MRS 1 was part of the west parking lot landfill area that was the subject of an ongoing investigation. No additional evidence of MEC/MC was found during the 2007 MMRP SI.

The area is currently paved and a protective covenant (land use control) is in place for this area. Future use as a parking area is not expected to change. No additional investigation was completed for MRS 1 during the MMRP RI (EA 2018). Based on lack of evidence that a source is present (i.e. only MD reportedly found during historical activities), the existence of a protective covenant, and the low likelihood that MEC is present, the pathway is considered incomplete. The RI recommended amending the protective covenant in this area to require UXO construction support during intrusive activities, pending anticipated future site use. Because of discussions with the project delivery team[8], the boundaries of MRS 1 were expanded to encompass the entire extent of the fill area in the west parking lot totaling 10.7 acres as shown on **Figure 1-2** (**Appendix A**).

2.4.3 Munitions Response Site 2 – Burial Area (Building 14 Misfire Pit)

MRS 2 is located east of Building 14 (MRS 5) in the eastern portion of fYNOP (**Figure 1-2, Appendix A**). MRS 2 was listed as having an area of 1-acre and it is inclusive of a small (4 ft square and 6 ft deep) concrete-covered pit termed the misfire pit. The misfire pit and an area

[7] As a result of discussions with the project delivery team, the boundaries of MRS 1 were expanded to encompass the entire extent of the fill area in the west parking lot. This change was agreed to after publication of the RI Report.
[8] On-site discussion with stakeholders on 8 June 2018.

comprising approximately 400 ft^2 was investigated several times between 1993 and 2018 (1993 unexploded ordnance [UXO] removal action through the 2018 RI). In 1993, MEC to include 20-mm target practice [TP] cartridges, 3-in. antiaircraft gun TP cartridges, 37-mm TP cartridges, a 37-mm M74 shot cartridge, and 105 assorted small arms cartridges was removed from a concrete pit. The 2004 TCRA resulted in the removal of the entire concrete pit to depth. The area where the pit was removed was also investigated and sampled during the 2007 SI to determine if any evidence of MEC or MC hazards remain. There were no MEC/MD findings and samples were below screening criteria; however, investigations were limited to the source area (the former pit location) and a limited area immediately surrounding the pit.

This area was subsequently evaluated during completion of the MMRP RI. Surface MEC clearance was conducted during the RI and no MEC or MD was observed within this MRS.[9] No intrusive investigations were conducted, and no soil or groundwater samples were collected during the RI. The RI concluded that this MRS falls within an area characterized during the RI that was determined to have a 95% confidence that at least 99.37% of remaining anomalies were not MEC. Conversely, there is the possibility that approximately six anomalies per thousand are MEC. The likelihood that MEC is present is low and the pathway is considered incomplete.

Due to historical findings in and around the MRS, the RI recommended this area for evaluation in the RAA with consideration of UXO construction support during intrusive activities, as required, pending anticipated future site use.

2.4.4 Munitions Response Site 3 – Burial Area (20-mm Dump)

MRS 3 is located southeast of Building 14 (MRS 5), between Building 14 and the former location of the Building 16 firing point (**Figure 1-2, Appendix A**). This area was the reported location of a "dump" where 20-mm MD, and potentially MEC, was disposed of from the proof ranges. The MRS was listed as having an area of 1 acre; however, the acreage listed does not correspond to the area investigated during the SI. Historically, MD (to include one 37-mm projectile) was found and removed during the TCRA; however, no MEC was found in the MRS. The area was investigated during the MMRP SI and no MEC or MD was found. Risks to ecological receptors (select metals in surface soils) were also identified during the SI.

This area was subsequently evaluated during completion of the MMRP RI. Surface MEC clearance and limited intrusive investigations were conducted during the RI. No MEC or MD was observed within MRS 3.[10] No soil or groundwater samples were collected during the RI. This MRS falls within an area characterized during the RI that was determined to have a 95% confidence that at least 99.37% of remaining anomalies were not MEC. Conversely, there is the possibility that approximately six anomalies per thousand are MEC. The likelihood that MEC is present is low and the pathway is considered incomplete.

[9] MRS 2 was mainly in the area deemed "low density" for purposes of the RI. Statistical sampling following VSP did not require an investigation of specific anomalies in MRS 2; however, one anomaly was selected in MRS 2 that was determined to be non-munitions related debris (NMRD).
[10] MRS 3 was in the area deemed as "low density" for purposes of the RI. Statistical sampling following VSP did not require an investigation of all anomalies in MRS 3. Three anomalies were selected in MRS 3 that were investigated and determined to be NMRD.

Due to historical findings in and around the MRS, the RI recommended this area for evaluation in the RAA with consideration of UXO construction support during intrusive activities, as required, pending anticipated future site use.

2.4.5 Munitions Response Site 4 – Burial Area (Building 16 Potential Misfire Pit)

MRS 4 is located east of Building 16, in the eastern portion of fYNOP (**Figure 1-2, Appendix A**). The MRS was listed as having an area of 1 acre (matching MRS 2 Misfire Pit Acreage). Historically, there have been no finds of MEC or MD in the location of MRS 4 and no MEC/MD findings were observed during the SI. The MMRP SI recommended no further action for the MRS; however, investigations were limited to the suspect source area (former pit location) and the immediate surrounding area.

This area was subsequently evaluated during completion of the MMRP RI. Surface MEC clearance was conducted during the RI and no MEC or MD was observed within this MRS.[11] No intrusive investigations were conducted, and no soil or groundwater samples were collected during the RI. This MRS falls within an area characterized during the RI that was determined to have a 95% confidence that at least 99.37% of remaining anomalies were not MEC. Conversely, there is the possibility that approximately six anomalies per thousand are MEC. The likelihood that MEC is present is low and the pathway is considered incomplete.

Due to historical findings around the MRS and the fact that portions of this MRS are covered with fill, the RI recommended MRS 4 for evaluation in the RAA with consideration of UXO construction support during intrusive activities, as required, pending anticipated future site use.

2.4.6 Munitions Response Site 5 – Building 14 Proof Range

MRS 5 is in the western portion of the MMRP Study Area (**Figure 1-2, Appendix A**). The MRS is approximately 1 acre, and the designated MRS boundary encompasses a portion of Building 14 (to include the ventilation/fan room and target backstop area). No MEC was identified during the MMRP SI; however, historical finds of MD were present prior to MMRP SI activities (Alion 2008). No intrusive work occurred within the backstop sand during the MMRP SI or MMRP RI and the sand handling system and elevator area are unable to be accessed due to their nature as a confined space.

The boundary of MRS 5 presented in the ASR included an area encompassing the northern portion of Building 14. Building 14 was investigated during the RI and found to contain MD and MC associated with process materials in the backstop sand, process dust from active operations, and MC associated with rainwater and/or groundwater contacting process material prior to exiting the building during high groundwater flow conditions. Based on the lack of findings outside of Building 14 in the original boundary of MRS 5, the boundary of MRS 5 was redrawn to include the portion of Building 14 containing sources of MD and MC.

[11] MRS 4 was located in the area deemed "low density" for purposes of the RI; however, portions of MRS 4 are also covered with fill material and those areas were not investigated. Statistical sampling following VSP did not require an investigation of any anomalies in MRS 4 and no anomalies were specifically selected in MRS 4.

MD and Material Potentially Presenting an Explosive Hazard (MPPEH) were observed in the firing range backstop. Based on findings of 20-mm HE rounds identified to the east of MRS 5 and the presence of 20-mm MD and MPPEH within the backstop area within MRS 5, the potential for MEC exists. Currently, the Harley-Davidson security team controls the fenced area surrounding Building 14 and maintains locks on the entrances to Building 14. Personnel entering the area must participate in awareness training also. These controls restrict, but cannot eliminate, personnel access to MD and potential MEC. Assuming no changes to land usage and land use controls, a potentially-complete pathway exists for MEC in MRS 5.

2.4.7 Area of Concern 1 – Solid Waste Management Unit (SWMU) 20/21 (37-mm Suspect MD and Sand Disposal Area)

AOC 1 is in a wooded area in the northeastern portion of fYNOP (**Figure 1-2, Appendix A**) east of the proof testing area (Building 14, Building 16, and the magazines). The area is mostly covered by mature trees; however, a portion of the area contains grass cover and features associated with past use (i.e., appearance of an access road leading to a clearing that is carved into a hillside indicative of a backstop). There are no structures in this location and the only evidence of past use consists of a topographical map from the 1940s that shows evidence of a clearing as well as historical field findings, RI findings, and aerial photographs that support the MMRP RI field observations that an activity was occurring in this area. No MEC or MD was found at AOC 1 during the MMRP SI reconnaissance or sampling activities. Subsurface anomalies were noted as being present in the area based on the results of a prior geophysical survey. Investigations by Science Applications International Corporation (SAIC) and USACE in 2007 noted the presence of MD in this area. A supplemental soils RI indicated that an interim remedial action was planned to secure AOC 1 by installing a fence. Installation of an orange snow fence around AOC 1 was completed in 2010 by SAIC (EA 2018).

This area was subsequently evaluated during Phase I and II of the MMRP RI. Surface MEC clearance and intrusive investigations were conducted during the RI and no MEC was found. Abundant MD was identified in the subsurface in an area characterized as a potential disposal area and a small arms range. MD identified within this area is similar to MD identified between Buildings 14 and 16, some classified as MEC. Additionally, sand matching the characteristics of the Building 14 backstop sand was identified in the western portion of AOC 1. Though no MEC was identified during historical or current investigations, the presence of backstop sand and abundant MD indicates the potential presence of MEC in the subsurface. The area is within the overall fenced area controlled by security forces, a dig permit is required by Harley-Davidson, and this area is demarcated by orange snow fence, all limiting the likelihood of interaction with MD or potential MEC. Under current land use controls, an excavation permit is required to conduct intrusive activities in this area that reduces, but does not eliminate, the potential for exposure. Therefore, a potentially-complete pathway exists for MEC in AOC 1.

2.4.8 Area of Concern 2 (Centralized Area between Buildings 14 and 16 and Building 16 Backstops)

AOC 2 surrounds the area that contains the two backstops for Building 16 and based on the results of the RI, now contains the presumed 20-mm disposal area (**Figure 1-2, Appendix A**). This area is located directly east of MRS 5 (Building 14) and north of MRS 3 (presumed 20-mm Disposal

Area). Current structures at this location include the east and west backstops of Building 16 that historically consisted of side-by side structures separated by an open courtyard. The area is partially covered with concrete and contains very little vegetation. The areas to the north of the backstops contain tall trees and thick vegetation, and a pile of material removed from the area south of the backstops. Historically, MEC (37-mm projectiles) and MD to include sand filled or empty projectiles certified-as-inert along with slag material was found and removed from the Building 16 backstop areas (2002 response and 2004 TCRA). During the MMRP SI, MD and MC (dust piles associated with the former proof range ventilation system) were observed to be scattered throughout the area south of, and inside, the backstops. The MMRP SI recommended further action for MEC due to the presence of MD and MC due to risks to human and ecological receptors (select metals in surface soils). A supplemental soils RI indicated that an interim remedial action was planned to remove the dust and ventilation equipment in the remaining portions of Building 16 and secure all openings to the remaining portions of Buildings 14 and 16. These activities, that included the characterization and disposal of components of the ventilation system and associated dust that was characteristically hazardous for lead were completed in 2010 by SAIC (EA 2018).

This area was subsequently evaluated during Phase I and II of the MMRP RI. Surface MEC clearance and intrusive investigations were conducted during the RI and several items classified as MEC were found. Abundant MD was identified in the subsurface in an area characterized as a potential disposal area. Based on the presence of MEC in the revised boundary of AOC 2, a MEC – Hazard Assessment (MEC-HA) was completed. Results of the MEC-HA are dependent on usage and the historical presence or absence of MEC removal actions and land use controls. The MEC-HA used input factors including the energetic material type; location of human receptors; site accessibility and contact hours; amount of MEC; depth of MEC; migration potential; MEC classification; and MEC size. These factors were evaluated for current use assuming minimal maintenance activities, no intrusive activities, and the continued use of current site controls. Following the protocols of the MEC-HA, there is a moderate potential explosive hazard existing under current conditions with no intrusive activities and limited access. An additional assessment was completed to determine if future land use changes would increase exposure of onsite personnel to potential MEC. If existing land use controls are removed due to future land use changes, the conclusion of the MEC-HA would result in a high potential explosive hazard.

2.4.9 Remainder RI Area

This area was subsequently evaluated during completion of the MMRP RI. Surface MEC clearance and limited intrusive investigations were conducted during the RI. These activities excluded the Eastern Landfill and the areas covered in fill (labeled as "High Anomaly Density, Fill" and noted as F1, F2, and F3 as shown on Figures 2-2 and 2-3). No MEC was observed within the remainder RI area.[12] Two isolated finds of MD were located along the road to the Eastern Landfill during the intrusive investigation and two isolated MD finds were located during surface MEC clearance. In Grid C8, a small fragment of unknown munitions size (classified as MD) was identified near the surface. In Grid D9, a 20-mm casing (MD) was identified immediately below the surface adjacent to the road to the north. Random anomalies were investigated in each direction surrounding these finds and each random anomaly was observed to be NMRD only. Samples were collected from

[12] The Remainder RI Area was in the area deemed as "low density" for purposes of the RI. Statistical sampling following VSP did not require an investigation of all anomalies in the Remainder RI Area.

these locations and did not identify elevated concentrations of MC. In Grid B7, 40-mm projectile identified as MD was found along the road during the surface MEC clearance. A historical find of MD, listed as an unclassified 37-mm fragment, was located adjacent to the road in Grid C10. Similarly, investigated anomalies in each direction resulted in finds of NMRD only. Given the location of the items along the road, they are thought to be likely associated with transport of materials (i.e. MD, sand, dust, etc.) from the backstop areas of the proof ranges (Buildings 14 and 16) to a disposal area (i.e., presumed to be AOC 1).

No soil samples were collected during the RI from the Remainder RI Area and groundwater samples collected from monitoring wells outside the MRSs but within the remainder RI Area did not indicate migration of MC. The Remainder RI Area is part of the area that was determined in the RI to have a 95% confidence that at least 99.37% of remaining anomalies were not MEC. Conversely, there is the possibility that approximately six anomalies per thousand are MEC. The likelihood that MEC is present is low and the pathway is considered incomplete.

Due to historical findings in and around the Remainder RI Area, the RI recommended this area for evaluation in the RAA with consideration of on-call UXO construction support during intrusive activities, as required, pending anticipated future site use.

2.4.10 Munitions Constituents Sampling

The MC portion of the investigation used existing historical information combined with the data collected during the MEC surface clearance, Building 14 inspection, DGM data collection, and the intrusive investigations to generate sample locations and the associated rationale for sampling.

Historically, groundwater sampling was conducted in this area that was referred to as “The Bunkers and Shell Ranges Area” and comprised of Buildings 14, 15, 16, and 30 and the surrounding areas where former buildings associated with the proof ranges have been removed. During previous investigations, MW-66, MW-68, MW-17, MW-73, MW-86, and MW-104 were installed, of that only MW-86 and MW-104 are screened in the surficial aquifer. MRSs 2, 3, 4, and 5, and AOCs 1 and 2 are in the immediate area of these wells.

This groundwater in this area was primarily evaluated for chlorinated volatile organic compounds as well as select metals (including arsenic, antimony, lead, nickel, and vanadium); of that lead was the only analyte sampled as part of the HTW RI that duals as MC. An HHRA was conducted and the results indicated no unacceptable risk for antimony, lead, nickel, or vanadium in groundwater. No other potential MC were evaluated under the HHRA.

As part of the MMRP RI, a total of 117 soil samples were collected from 60 locations in August 2016 and 64 additional soil samples were collected in October 2016. These samples were comprised of backstop sand, process dust, surface soil, and subsurface soil from depths ranging from the surface to 15 ft bgs. Following a phased analytical approach, a total of 100 soil samples were analyzed for metals, while a subset was submitted for analysis of one or more of the following: Resource Conservation and Recovery Act (RCRA) Toxicity Characteristic Leaching Procedure (TCLP) metals, polycyclic aromatic hydrocarbons (PAHs), and/or explosives. Results were compared to state and federal risk-based screening criteria and reviewed by a senior risk assessor.

No explosives were detected and no PAHs were detected from the subset of samples analyzed for those analytes. Samples collected from the Building 14 backstop sand exceeded the PADEP soil-to-groundwater criteria for lead and zinc. Samples collected from the dust material associated with the Building 14 air handling unit in the ventilation/fan room exceeded the PADEP soil-to-groundwater criteria for antimony, lead, and zinc with concentrations of lead also exceeding the PADEP direct contact and USEPA Regional Screening Level for Industrial Soil criteria. Samples collected from dust and backstop sand were also analyzed for RCRA TCLP metals and were both characteristically hazardous for lead. The samples collected from the process materials predominantly exceeded soil-to-groundwater criteria; however, the process materials are underlain by impervious surfaces and are not exposed to precipitation. One detection of lead exceeded the PADEP soil-to-groundwater protection criterion; however, subsequent sampling below and around, the exceedance confirmed that the exceedance was isolated.

To understand potential impacts to groundwater, historical data was reviewed for wells in the RI area. The data was reviewed for explosives and select metals that were associated with the proof ranges. Historically no explosives have been detected in groundwater. No upgradient wells screened in the shallow aquifer have had historical exceedances of either antimony or lead. One historical detection of total lead (10.7 µg/L in 2008) from one downgradient monitoring well (MW-104) immediately adjacent to Building 14 exceeded the most conservative screening criterion (PADEP Residential Use Aquifer). No detections of lead from seven additional analyses, including three for total lead and four for dissolved lead, were greater than screening levels. No other downgradient wells, shallow or deep, have historically exceeded the screening criterion for lead. No antimony has been detected in monitoring wells above screening criteria. Several exceedances of antimony were noted in historical groundwater samples collected from groundwater springs. Results of dust from the ventilation/fan room have shown elevated concentrations of antimony, lead, and zinc that is likely the sources of metals observed in the springs. The analytical results from spring and groundwater sampling indicates that impact to groundwater are likely associated with Building 14 and water flowing through the building carrying MC out of the building into the groundwater. The analytical results indicate that groundwater is not impacted beyond the MRS 5 boundary.

2.5 NATURE AND EXTENT OF CONTAMINATION

As previously stated, MRS 2, MRS 3, MRS 4, and the Remainder RI Area have a 95 percent confidence level that 99.37% of remaining anomalies are not MEC and no source of MC remains. Conversely, there is the possibility that approximately six anomalies per thousand are MEC in these areas. No source of MEC was found to be present in these areas, the likelihood that MEC is present is low and the pathway is considered incomplete. The extent of the impacts from munitions-related activities and the associated MC from historic activities within the fYNOP indicate three primary areas with quantifiable impact, including MRS 5, AOC 1, and AOC 2. The extents of potential MEC-related impacts (**Figure 2-2**, **Appendix A**) and MC-related impacts (**Figure 2-3**, **Appendix A**) are discussed below.

2.5.1 MRS 5 – Building 14 Proof Range

The Building 14 sand elevator shaft, target area with backstop sand, and the air handling system in the ventilation/fan room (including ductwork and the existing dust pile) down to the concrete foundation are impacted with MC and the backstop area has the potential for MEC to be present.

Abundant MD was observed on the surface of the sand in the backstop during RI activities and MPPEH was identified in the sand; therefore, the potential exists that MEC may be present as well. The existing backstop sand in the target area was determined to be characteristically hazardous for lead based on waste characterization sampling and analysis. Waters interacting with this material may dissolve, or transport mechanically, MC associated with this source.

Only MC was observed within the dust pile in the dust house. Concentrations of antimony, lead, and zinc within the process dust were several orders of magnitude above screening criteria. Based on analysis, this material was also characteristically toxic for lead based on waste characterization sampling and analysis. Discussions pertaining to sampling results of standing water in Building 14 are included below in the groundwater discussions.

2.5.2 AOC 1 – SWMU 20/21 (37-mm Suspect MD and Sand Disposal Area)

The high anomaly density area associated with a potential disposal area and small arms range is impacted. There were no exceedances of screening criteria in samples collected in this area. No MEC was found in this area during the RI; however, spent 0.45-caliber small arms ammunition, 0.45-caliber casings and 37-mm and/or 40-mm MD was observed in a 100-ft by 100-ft high-density anomaly area within 24 in. bgs.

No MD was found outside of the approximately 100-ft by 100-ft high-density anomaly area (EA 2018). There were no anomalies of any type identified on the steep slopes to the north and to the east. Similarly, the more gradual slopes to the south and west showed a precipitous drop in anomaly density. The spent 0.45-caliber small arms ammunition, and 0.45-caliber casings indicated that this graded area was likely used as a small arms range. The presence of slag and burned 37-mm and/or 40-mm MD indicated that this area was also likely used as a disposal area. There was no evidence that this area served as an open burn/open detonation area as the soils are relatively undisturbed at a depth of 24 in. bgs and no evidence of slag or MD was found outside the 100-ft by 100-ft high anomaly density area. No MC or PAHs were identified at concentrations approaching criteria, and the vertical and horizontal extent of sand, likely backstop sand, was limited. The extent of impacts associated with this area is presented on **Figure 2-2** and **Figure 2-3** in **Appendix A**.

2.5.3 AOC 2 – Centralized Area between Buildings 14 and 16 and Building 16 Backstops

Munitions-related impacts were observed in a 2.2-acre area east of MRS 5, west of the former location of Building 16, north of MRS 3 and MRS 2, and east of the road running between Building 14 and Building 16 (**Figures 2-2** and **2-3**, **Appendix A**). Munitions debris and MEC were found within this area up to 12 in. bgs as well as an apparent disposal area comprised of 20-mm MD and MEC from a sand layer between Buildings 14 and 16 within approximately 36 in. bgs. All investigated anomalies surrounding AOC 2 were classified as NMRD. Surface and subsurface soil samples collected within AOC 2 did not exceed screening levels except for one isolated lead

detection in a subsurface sample. Finally, samples associated with a soil stockpile within AOC 2 was not characteristically toxic for metals.

2.5.4 Standing Water and Groundwater Contamination

The northern portion of MRS 5 within Building 14 was observed to have an open roof and standing water within the northern elevator shaft and sand conveyor system. Samples collected from the standing water indicate a long residence time (high pH and conductivity), exceedances of total lead, and one exceedance of dissolved lead. No upgradient wells within the shallow aquifer exceeded screening levels for MC and only one sample (10.7 µg/L in 2008) from one monitoring well (MW-104) exceeded screening levels for lead. This exceedance was followed by seven analyses without a subsequent exceedance.

Historical samples collected from floor drains associated with the ventilation system detected antimony and lead; however, no water was observed flowing from springs or within floor drains during the MMRP RI. Based on the concentrations of MC and metals associated with the backstop sand and process dust, it is assumed that the process materials operate as a potential source of metals. No impacts were observed in groundwater beyond the MRS 5 boundary.

2.6 CONTAMINANT FATE AND TRANSPORT

No source of MEC or MC was identified in MRS 1, MRS 2, MRS 3, MRS 4, or the Remainder RI Area. Based on review of historical documentation, findings from historical investigations, and the results of the RI, only isolated concentrations of antimony, lead, or zinc exceeded screening criteria; no explosives were detected; and no PAHs exceeded screening criteria. Based on the results of the RI, potential sources of MEC remain for MRS 5, AOC 1, and AOC 2 and a potential source of MC remains for MRS 5. The conceptual site models for MEC and MC are listed in **Tables 2-1** and **2-2**, respectively.

Based on previous investigations and MMRP RI characterization activities, the majority of the MEC was found in the top 20 in. bgs and MD is located within 36 in. bgs. It is possible for natural processes, such as water erosion from storm events and natural mass wasting processes to result in the movement, relocation, or unearthing of MEC and MD; therefore, increasing the probability of exposure by human receptors. Per the Township of York, PA Building Construction Code, the effective frost line is 30 in. bgs; therefore, MEC and MD within 30 in. of the ground surface would typically be affected by frost heave and possibly impact the current MEC exposure within MRS 2, MRS 3, MRS 4, AOC 1, and AOC 2. Due to the protective cap on MRS 1 and the presence of Building 14 at MRS 5, frost heave is unlikely to change the current MEC exposure probability. Similarly, impact and/or displacement due to intrusive human activities is a potential factor that could impact the fate of residual MEC and increase the probability of human exposure to MEC.

2.6.1 MRS 1 – Burial Area (Parking Lot)

No MEC has been found at MRS 1. Munitions-related finds are limited to MD in the subsurface up to depths of approximately 20 ft bgs. No MC were detected in groundwater and no other MC were identified in the area during previous investigations. The area is currently paved and land use controls are in place for this area. Future use as a parking area is not expected to change. Based on a general lack of source, few MD findings during historical activities, the existence of a protective

covenant, and the low likelihood that MEC is present, the pathway is considered incomplete; however, if intrusive activities occur, the pathway will be considered potentially-complete.

2.6.2 MRS 2 – Burial Area (Building 14 Misfire Pit)

MRS 2 is located east of Building 14 and is associated with a 1-acre area inclusive of a small (4 ft square and 6 ft deep) concrete-covered pit termed the misfire pit. The pit, and an area comprising approximately 400 ft^2 was investigated several times between 1993 through 2007. The pit contained MEC prior to subsequent removal actions to a depth of approximately six ft bgs; however, during the 2007 MMRP SI, no MEC or MD was found and the MRS was recommended for no further action. Frost heave may eventually cause migration of items within the frost zone (up to three feet bgs) toward the surface, causing such items to present a future surficial pathway if no removal action occurs within potential source areas. During field investigations, no MEC or MD were identified. Based on the completion of historical removal actions and no presence of MEC or MD identified during subsequent investigations, the likelihood that MEC is present is low and the pathway is considered incomplete; however, if intrusive activities occur, the pathway will be considered potentially-complete.

2.6.3 MRS 3 – Burial Area (20-mm Dump)

MRS 3 is located southeast of Building 14, between Building 14 and the former location of the Building 16 firing point. This area was the reported location of a "dump" where 20-mm MD, and potentially MEC, was disposed of from the proof ranges. The MRS was listed as having an area of 1 acre; however, the acreage listed does not correspond to the area investigated. Historically, MD (to include one 37-mm projectile) was found and removed during the TCRA within surficial soils; however, no MEC have been historically found in the area. Frost heave may eventually cause migration of items within the frost zone (up to three feet bgs) toward the surface, causing such items to present a future surficial pathway if no removal action occurs within potential source areas. No MEC or MD were identified during the MMRP SI or during this investigation within, or immediately adjacent to, this MRS. Based on the completion of historical removal actions and no subsequent presence of MEC or MD, the likelihood that MEC is present is low and the pathway is considered incomplete; however, if intrusive activities occur, the pathway will be considered potentially-complete.

2.6.4 MRS 4 – Burial Area (Building 16 Potential Misfire Pit)

MRS 4 was historically associated with being the Building 16 Potential Misfire pit; however, no MEC or MD were identified during investigations. The MMRP SI recommended no further action for the MRS; however, investigations were limited to the suspect source area and the immediate surrounding area. No MEC or MD were identified within the MRS 4 boundary or within grids adjacent to the MRS 4 boundary during the MMRP RI investigation. Anomalies identified as NMRD were found within the upper three ft bgs. Frost heave may eventually cause migration of items within the frost zone (up to three feet bgs) toward the surface, causing such items to present a future surficial pathway if no MEC clearance occurs within potential source areas. Based on a lack of presence of MEC or MD during investigations, the likelihood that MEC is present is low and the pathway is considered incomplete; however, if intrusive activities occur, the pathway will be considered potentially-complete.

2.6.5 MRS 5 – Building 14 Proof Range

Backstop sand within Building 14 contains abundant 20-mm MD and no intrusive investigation occurred; therefore, the potential for MEC to be present within this MRS remains. No access to the elevator shaft is permitted due to the area filled with water and the classification of the elevator shaft as a Confined Space. Concentrations of metals exceeding screening levels were detected in backstop sand and the process dust within Building 14. Similarly, water within the elevator shaft that processed the backstop sand contained elevated concentrations of total and/or dissolved lead and historical sub-slab groundwater samples associated with the ventilation unit contained elevated concentrations of lead and antimony. No springs were observed during the RI.

Currently, the Harley-Davidson security team controls the fenced area surrounding Building 14, personnel entering the fenced area must receive annual awareness training, and locks are present on all building entrances. No groundwater is consumed onsite and no wells are located onsite. These controls restrict, but cannot eliminate, personnel access to MD and potential MEC. Assuming no changes to land usage and land use controls, a potentially-complete pathway exists for MEC in MRS 5.

2.6.6 AOC 1 – SWMU 20/21 (37-mm Suspect MD and Sand Disposal Area)

Abundant findings of MD were identified in a potential disposal area and/or small arms range. MD identified within this area is similar to projectiles identified between Buildings 14 and 16, some of that were classified as MEC. Additionally, sand matching the characteristics of the Building 14 backstop sand was identified in the western portion of AOC 1. Though no MEC was identified during historical or current investigations, the presence of backstop sand and abundant MD indicates the potential presence of MEC in the subsurface within approximately 36 in. of the land surface. No MEC is present on the surface following Phase I surface clearance activities. The area is surrounded by an orange snow fence and it is within the overall fenced area controlled by security forces. A dig permit is required by Harley-Davidson to perform excavations in this area. All of these factors that limit the likelihood of interaction with MD or potential MEC. Though no MEC was identified during the MMRP RI fieldwork, the presence of abundant MD of similar caliber to MEC identified onsite indicates a potential source. Frost heave may eventually cause migration of items within the frost zone (up to three feet bgs) toward the surface, causing such items to present a future surficial pathway if no MEC clearance occurs within potential source areas. Surface MEC clearance activities were conducted that removed one potential source of MEC; however, MEC is potentially-present in the subsurface that may be found during intrusive activities. Under current land use controls, an excavation permit is required to conduct intrusive activities in this area that reduces, but does not eliminate, the potential for exposure. Therefore, a potentially-complete pathway exists for MEC in AOC 1.

Backstop sand found in the western portion of AOC 1 was observed/sampled; however, no samples collected in an area surrounding AOC 1 exceeded screening criteria for metals, explosives, or PAHs.

2.6.7 AOC 2 – Centralized Area between Buildings 14 and 16 and Building 16 Backstops

The revised boundary of AOC 2 contains the presumed 20-mm disposal area, including two 20 mm classified as MEC; two 37-mm projectiles classified as MEC; and abundant findings of 37-mm and 40-mm MD. These items were found in shallow subsurface soil within 36 in. of the surface. AOC 2 is within the larger fenced area controlled by Harley-Davidson security. AOC 2 is currently not demarcated or flagged. Despite this area overlapping the road adjacent to Building 16, no finds were identified on the access road. Unlike the secondary controls in place at MRS 5 (fence, padlocked doors, awareness training) and AOC 1 (demarcated orange fence), AOC 2 is present within the unfenced and unmarked area between Buildings 14 and 16. Surface MEC clearance activities were conducted that removed one potential source of MEC; however, MEC is potentially-present in the subsurface that may be found during intrusive activities. Additionally, frost heave may eventually cause migration of items within the frost zone (up to 36 in. bgs) toward the surface, causing such items to present a future surficial pathway if no MEC clearance occurs within potential source areas. Under current land use controls, an excavation permit is required to conduct intrusive activities in this area that reduces, but does not eliminate, the potential for exposure. Therefore, a potentially-complete pathway exists for MEC in AOC 2.

2.6.8 Remainder Remedial Investigation Area

A surface clearance was conducted in the Remainder RI Area (excluding the Eastern Landfill and the three fill areas F1, F2, and F3) using a handheld ferrous magnetometer and a subset of anomalies identified within the Remainder RI Area were intrusively investigated. Munitions-related finds were limited to MD found adjacent to roadways likely traversed between Buildings 14 and 16 and a likely disposal area (e.g., AOC 1). No munitions-related usage or findings has historically been referenced during review of historical documentation or during investigations of the Eastern Landfill. No identified/known source of MEC remains in the Remainder RI Area.

Currently, the Harley-Davidson security team controls the fenced area surrounding the Remainder RI Area, personnel entering the fenced area must receive annual awareness training, and intrusive activities are controlled by a permit process. Based on a lack of presence of MEC or MD during investigations, the likelihood that MEC is present is low and the pathway is considered incomplete; however, the pathway would be considered potentially-complete due to frost heave causing items to surface within the frost zone (up to three ft bgs) or during intrusive activities.

2.7 PROPOSED FUTURE SITE USE

The expected future uses for the Site are industrial use for all areas. Under the industrial land use, new buildings or structures may be constructed for offices, warehousing and storage in the fYNOP area. This is consistent with the current site usage; however current buildings and structures may be demolished and removed to allow for new construction in the area. During the MMRP RI, it was noted that this area was likely to remain undisturbed and unimproved; however, expansion due to a change in operations indicates an increased potential for intrusive activities and improvements within the MMRP RI Study Area, including the areas designated as MRSs and AOCs. No residential use is expected or proposed for the fYNOP area.

3. DEVELOPMENT OF THE EVALUATION PROCESS

3.1 INTRODUCTION AND DESCRIPTION OF THE EVALUATION PROCESS

The purpose of this chapter is to assemble pertinent information that will be used in the screening, development, and evaluation of remedial alternatives for building materials and soil at the Site (Chapters 4 and 5). Specific goals of this chapter are as follows:

- Identify federal, state, and local ARARs (Section 3.2)
- Establish CAOs for the Site (Section 3.3)
- Define the area of attainment to be addressed by the remedial action (Section 3.4)
- Identify general response actions to meet CAOs (Sections 3.5).

This information will be used by the stakeholders in development of the Remedial Action Work Plan for the Site.

3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The development and evaluation of remedial alternatives includes a comparison of alternative site remedies to ARARs. The selected remedial action for the Site must satisfy all ARARs unless specific waivers have been granted.

The remedial action must comply with all applicable or relevant and appropriate laws, regulations, and standards promulgated by the federal government.

3.2.1 Definition of Applicable or Relevant and Appropriate Requirements

The USEPA defines "applicable" and "relevant and appropriate" in the revised NCP, codified at 40 CFR 300.5 (1994), and has incorporated these definitions in its CERCLA Compliance with Other Laws Manual (USEPA 1988a). Site remediation must comply with ARARs, except where waived according to Section 121(d) of CERCLA.

A requirement under CERCLA[13]/Superfund Amendments and Reauthorization Act (SARA), as amended, may be either "applicable" or "relevant and appropriate" to a site-specific remedial action, but not both.

- **Applicable Requirements**—These cleanup standards are standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances.
- **Relevant and Appropriate Requirements**—These cleanup standards are standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other

[13] Though site work is currently under RCRA, ARAR requirements are presented under CERCLA and SARA.

circumstance at a site, address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the site. In some circumstances, a requirement may be relevant, but not appropriate, for the site-specific situation.

3.2.2 Classifications of Applicable or Relevant and Appropriate Requirements

ARARs for remedial action alternatives at the Site can be generally classified into one of the following three functional groups:

1. **Chemical-Specific—**Health-based or risk-based numerical values or methodologies that establish cleanup levels or discharge limits for particular contaminants. Typical examples of chemical-specific ARARs include maximum contaminant levels (MCLs).

2. **Location-Specific—**Requirements that restrict remedial actions based on the characteristics of the site or its immediate environs. Typical examples of location-specific ARARs include federal/state wetlands protection guidelines.

3. **Action-Specific—**Requirements that set controls or restrictions on the design, implementation, and performance levels of activities related to the management of hazardous substances, pollutants, or contaminants. Typical examples of action-specific ARARs include National Pollutant Discharge Elimination System (NPDES) requirements or Clean Air Act requirements.

To be consistent with the definition of ARARs, the following groups of ARARs were considered during the identification process:

- Federal requirements
- Federal criteria, advisories, and guidance documents, and
- State of Pennsylvania criteria, advisories, and guidance documents.

3.2.3 To Be Considered Guidance

Federal and Pennsylvania guidance documents or criteria that are not generally enforceable, but are advisory, do not have the status of potential ARARs. Guidance documents or advisories to be considered in determining the necessary level of cleanup for protection of human health or the environment may be used where no specific ARARs exist for a chemical, action, or location, or where such ARARs are not sufficient to afford protection.

3.2.4 Identification of Applicable or Relevant and Appropriate Requirements

Table 3-1 (Appendix B), presents the federal and state/local ARARs evaluated for the Site. The list of ARARs were identified and evaluated based on their potential applicability or relevance and appropriateness in accordance with USEPA guidance (USEPA 1988a and 1988b). An analysis of the ARARs is provided below.

Chemical-Specific ARARs:

- ***PA Land Recycling and Environmental Remediation Standards Act (Act 2), 25 PA Code, Chapter 250*** – MSCs including Statewide Health Standard for inorganic substances in groundwater and soil that are promulgated for site remediation. Applicable to MC in soils and residual process material leaching to groundwater.

Location-Specific ARARs:

- ***50 CFR 17, 58 PA Code, Chapter 75 (Threatened and Endangered Species Act)*** – Not applicable for the Site per consultation with PADEP as discussed in Section 2.3.7.

Action-Specific ARARs:

- ***PA Erosion Control Regulations, 25 PA Code, Chapter 102 (Sediment and Erosion Control)*** – applicable to proposed remedies involving excavation of MC and residual process material (sands) and soils in the MRSs and AOCs.

- ***40 CFR 268.7 RCRA Hazardous Waste Generators*** – applicable to proposed remedies involving excavation of MC and residual process material deemed to be hazardous waste.

- ***40 CFR 268.40 RCRA Land Disposal Restrictions*** – applicable to proposed remedies involving excavation and movement of excavated materials from their original location that triggers the RCRA Land Disposal Restrictions.

- **40 CFR Part 266, Subpart M Resource Conservation and Recovery Act (RCRA) Military Munitions Rule** – applicable if MEC is transported and disposed of off-site because MEC meets the definition of solid waste (used or fired military munitions). Applicable if any MEC is transported offsite, or out of the MRS, for the purposes of disposal or treatment prior to disposal per 40 CFR 262.202(c).

- ***Department of Transportation (DOT) Hazardous Materials Transport (49 CFR 107 and 171-179)*** – Regulations for the transportation of hazardous materials including packaging, marking, labeling and transportation methods.

3.3 CORRECTIVE ACTION OBJECTIVES

The CAOs consist of qualitative medium-specific goals for reducing human health and environmental risks and hazards and/or meeting established regulatory requirements and are used during the analysis and selection of remedial alternatives. The future use of a property impacts the viability and scope of the CAOs, with a description of fYNOP restructuring activities and future use described in Chapter 3.3.2. Several guidance documents use Remedial Action Objectives (RAOs) synonymously with CAOs. For the purposes of this analysis, the terms are interchangeable and will be used based on the source of the term (e.g., guidance documents). **Table 3-2** (**Appendix B**), presents the CAOs for the fYNOP.

A summary of the CAOs[14] are listed below for soil and process materials:

For potential soil exposures impacting human health:

A. Prevent direct contact exposures to chemicals where concentrations of munitions constituents exceed PADEP direct-contact MSCs in soil.
B. Prevent Direct Contact exposure to MEC in the soil at the Site.
C. Prevent exposure to MEC in subsurface soil (below 2 feet).

For exposures associated with Building 14 process materials impacting human health:

A. Prevent direct-contact exposures to waste process materials including MC and MD in Building 14 and inappropriate relocation (e.g., improper handling or transport) of waste process materials.
B. Prevent exposure to MPPEH, and potential MEC, in Building 14.

3.3.1 Development of Corrective Action Objectives

Regulatory standards that have been established to protect human health and the environment are typically set as CAOs in instances where they are considered to be ARARs. If no such standards exist, target cleanup levels are developed based on concentrations that result in levels of exposure that are protective of human health and the environment. CAOs are a function of the goal of the investigation and the reasonably anticipated land use of the MRSs, AOCs, and the Remainder RI Area (Reference Section 3.3.2). CAOs may change as more information becomes available, such as identification of MEC in the future, changes in screening criteria, changes in environmental conditions[15], or changes future land use.

As previously stated there are no known MC impacts at MRS 1, 2, 3, 4 or the Remainder RI Area. The process materials at MRS 5 are contained inside Building 14 on an impervious surface and there is no impacted soil identified at AOC 1. One isolated exceedance of lead in subsurface soil was observed in AOC 2; however, there is source material still present and soils may be impacted over time. Therefore, there are no current risks but potential for future risks during intrusive activities. Residential receptors should be protected from MC in process materials/soil in excess of PADEP direct contact MSCs in soil as listed in **Table 3-3**.

No groundwater cleanup was required for MEC or MC and no groundwater is currently in use at the Site; therefore, no direct protection criteria are required. Groundwater within the fYNOP is being evaluated for other contaminants of concern and corrective actions under a separate action (GSC 2018b).

[14] Groundwater within this portion of the fYNOP is being evaluated for environmental contaminants and corrective actions are being performed as noted in the Proposed Plan – Final Remedy, Groundwater Sciences Corporation [GSC] (GSC December 2018b).
[15] No hazardous material surveys have been conducted in any of the remaining structures. Buildings onsite may contain other materials than those listed here that require disposal as hazardous waste. These materials require investigation, sampling, and analysis prior to disposal.

CAOs for MEC are defined differently than for chemical compounds, as there are no established risk-based "values" to use for MEC.

USEPA provides the following definition for MEC RAOs (USEPA, 2005):

> "*RAOs for a munitions response are the preliminary goals pertaining to the depth of that response action and are used for planning purposes. RAOs are directly related to the specific media that are identified in your CSM [conceptual site model] as potential pathways for MEC exposure (e.g., vadose zone, river bottom, wetland area). The RAOs for response depths for munitions are a function of the goal of the investigation and the reasonably anticipated land use on the range*."

USACE defines RAOs for MEC as follows (USACE, 2005):

> "*A RAO for MEC would be a description of a method likely to be protective of the particular exposure pathway(s) identified at the site; e.g., levels of cleanup such as surface removal, removal to depth or the implementation of LUCs [land use controls]*."

Based on the above, the CAOs for the MMRP RI Study Area include:

- For MEC in soil and Building 14 process materials, reduce the unacceptable hazard for current and future potential human receptors, including Harley-Davidson employees and subcontractors, property workers/contractors, and visitors, such that the likelihood of encounter is negligible. MEC could be present in areas where a MEC clearance has not been completed. Based on the findings of previous investigations, MEC may remain onsite within two media of concern, including the Building 14 process materials or soil within approximately 36 in. of ground surface.
- For MC in soil exceeding the PADEP Direct-Contact or Industrial Soils criteria, prevent the unacceptable hazard for current and future human receptors, including Harley-Davidson employees and subcontractors, property workers/contractors, and visitors, such that the likelihood of encounter is negligible. This CAO will also apply to process materials.

3.3.2 Restructuring Activities and Future Use

Several phases of restructuring activities have occurred at the facility, including two primary events within the MMRP RI Study Area. From 2002 to 2004, during construction and grading activities completed by Plexus and associated with Building 3, excess material was placed in a debris pile to the north of the Building 30 location. From 2010 to 2011, portions or all of Buildings 14, 15, 30, and 60 were demolished with debris placed north of Building 30 and south of Buildings 15 and 30. Also during the restructuring project, soil was stockpiled in the northeast portion of the fYNOP following excavation from associated construction/demolition activities and the excavation of two stormwater management ponds. In some locations, fill material may overlie the original ground surface by as much as 15 ft.

Also, as part of the restructuring project, a security fence was installed in 2012 to further restrict access to the northeast portion of fYNOP. Currently, no Harley-Davidson employee or contractor

accesses this area daily. The fYNOP team conducts quarterly inspections of fencing, warning signs, barriers, and locks for the remaining buildings and backstops. Personnel and contractors entering this area must also participate in awareness training prior to entering the area.

Restructuring activities are ongoing and planned for the near future to include expansion of Building 3 and the associated access roads and parking areas as well as the existing infrastructure (to include underground utilities). The restructuring activities are expected to encroach on the western portion of the MMRP RI Study Area.

Future development of the Site may include the western portion of the RI Study Area that is adjacent to the current plant expansion. Development of the eastern portion of the RI Study Area is less likely as this area contains a natural gas pipeline, the topography is less suitable for development (sloping), further from site operations and it is closer to the property boundary shared with adjacent residences.

3.4 AREA OF ATTAINMENT AND PRELIMINARY REMEDIAL ACTION AREAS

As a result of historical investigations and the MMRP RI findings, the following was determined:

MRS 1, 2, 3, and 4 and Remainder RI Area – No known impact from MEC or MC was identified. However, due to the statistical possibility that MEC remains, the CAOs developed for these areas recommend protective measures to prevent human contact with potential MEC. Some protective measures are currently in place to protect human health.

MRS 5 – Process materials with elevated concentrations of MC present a source, especially antimony and lead, that may impact shallow groundwater. Additionally, the backstop contains MD and MPPEH that may be MEC; therefore, the potential for encountering MEC in the area is considered moderate. Protective measures are currently in place to protect human health.

AOC 1 – MD-impacted areas and the area where backstop sand was observed during the RI present a potential source of MEC (as shown on Figure 2-2). The potential for encountering MEC in this area is considered moderate. Protective measures are currently in place to protect human health.

AOC 2 – MD-impacted areas and the area where backstop sand was observed during the RI present a potential source of MEC (as shown on Figure 2-2). MEC has been found in AOC 2 and the potential for encountering MEC in this area is considered moderate. Protective measures are currently in place to protect human health.

3.5 GENERAL RESPONSE ACTIONS

General response actions describe those actions, that will satisfy the CAOs developed in Section 3.3. Based on the contaminant type (MEC and MC), the media of concern (surface and subsurface soil), and uses of the MRSs/AOCs, the basic method of protection from MEC is either to prevent or manage activities that may encounter MEC or to remove the MEC hazard at each MRS/AOC. "No Action" is evaluated to satisfy 40 CFR 300.430(e)(6), that requires consideration of no action as a baseline against which other alternatives are compared. Therefore, the following general response actions were developed to satisfy the CAO:

- ***No action*** – Leave the Site "as is" with no provision for monitoring and control; typically used for a baseline with that to compare other General Response Actions;
- ***LUCs*** – LUCs for MEC generally include physical and/or administrative/legal mechanisms that minimize the potential for exposure by limiting land use, access, and activities. This includes, but is not limited to, the exclusion of residential use, requirement for UXO construction support during intrusive activities, and boundary changes;
- ***MEC Removal and/or Treatment*** – Technologies to support the General Response Action for MEC removal and treatment include MEC detection, MEC removal, and MEC treatment (*in situ* or *ex situ*). MEC removal mitigates explosive hazards to current and future receptors by identifying and physically removing MEC items from the MRSs/AOCs. A full MEC clearance would be required to allow for unlimited use and unrestricted exposure (UU/UE) to satisfy the requirement of the Defense Environmental Restoration Program Manual, defined as: "site conditions that indicate a 'no probability' of encountering MEC based on a comprehensive assessment of current and previous land use" (Engineering Manual [EM] 385-1-97) (USACE, 2008a);
- ***MC Removal*** – Removal of process materials that were characteristically hazardous for lead or other MC from Building 14 that includes backstop sand and process dust.

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4. IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

4.1 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

The first step in a technology screening for site remediation is to examine a variety of available remedial technologies and to identify those technologies that warrant further consideration based on the applicability of the technology for the site-specific conditions. This section identifies the applicable technologies and process options available that are appropriate for MEC in the surface and subsurface and for MC in surface media. Remedial technologies, as used in this Alternatives Analysis, refer to general categories of technologies. Process options refer to specific technologies. For example, the "Institutional Controls" GRA includes "Access Restrictions" as a remedial technology, that subsequently includes such process options as fencing, warning signs, security patrols, and potential deed/zoning restrictions.

Various technologies are screened in this chapter for their ability to address MEC or MC at the Site. The primary focus of this screening evaluation is on the effectiveness and implementability of each option, with less emphasis on cost, as follows.

Effectiveness
The effectiveness evaluation is focused on the following elements:

- The potential effectiveness of process options in handling the estimated areas or volumes of media and in meeting the CAOs
- The potential impacts to human health and the environment during the demolition and implementation phase
- The reliability and proven effectiveness of the process with respect to the COCs and the site-specific conditions.

Implementability
The implementability evaluation includes both the technical and institutional (administrative) feasibility of implementing each technology or process option. This initial technology screening eliminates technology types or process options that are clearly ineffective or unworkable at the Site. These institutional aspects include:

- The potential for obtaining regulatory approval
- The availability of necessary equipment and skilled workers to implement the technology
- The availability of treatment, storage, and disposal services
- The time required for implementation
- Ability to achieve the applicable remediation standards within a reasonable time frame.

Cost
The screening of alternatives is intended to evaluate the technical feasibility and implementability of remedial technologies in addressing the CAOs under site-specific operating conditions. For this screening evaluation, a qualitative cost analysis has been presented only if costs were uncommonly prohibitive or if other process options within the same technology type were comparably effective

and implementable. Preliminary relative cost estimates for the remedial technologies are presented in Chapter 5 as part of each of the remedial alternatives developed from the technologies retained in this chapter.

4.1.1 No Action

There are no technologies or process options associated with this response action. This option has been retained in accordance with the requirements of Subpart F of the NCP, that specifies that it must be fully evaluated as a basis for comparison with the other remedial alternatives. This option excludes the application of new or revised LUCs nor existing efforts to contain, remove, treat, or dispose contaminants at the Site.

- ***Effectiveness—*** Ineffective in protecting human health from MEC and potential MC onsite.

- ***Implementation—***Since there are no technologies or process options it is easily implementable.

- ***Cost—***No costs are associated with this technology.

4.1.2 Land Use Control Technologies

LUCs are administrative measures developed to protect human health and safety from the presence of hazards, including explosive hazards. LUCs are measures that limit access or use of a property to protect people from site hazards or provide warnings of a potential site hazard. LUCs can include engineering controls and physical barriers (e.g., fencing); educational programs (e.g., public notification of residual MEC concerns); and administrative and legal controls (e.g., zoning restrictions, easements, covenants) that help to minimize the potential for human exposure to MEC (USACE, 2009).

LUCs could reduce the potential for MEC encounters or contact with MC impacted media by limiting MRS access, restrict site activities, provide hazard warnings, and educate potential receptors on MEC avoidance. Primarily, LUCs would include a protective covenant to exclude residential use of the Site. LUCs at the Site may also include a requirement that UXO construction support be provided during intrusive activities. A LUC Implementation Plan (LUCIP) or similar plan is typically required to be developed to determine how controls will be established, recorded, and enforced.

- ***Effectiveness—*** LUCs are effective in protecting human health from both MEC and any associated MC in process materials/soil or groundwater.

- ***Implementation—***Since there are no technologies or process options it is easily implementable.

- ***Cost—***Minimal costs are associated with this technology.

4.1.3 Munitions and Explosives of Concern Clearance Technologies

Technologies to support the GRA for anomaly clearance include detection, segregation, removal, and disposal. Anomaly clearance mitigates the explosive hazards associated with potential MEC to current and future receptors by identifying and physically removing the MEC items from the MRS.

Process options for anomaly detection include detectors for analog (mag & dig) investigations and DGM. All anomaly detection methods use some type of magnetometer with the most common detection methods using a ferrous magnetometer. A detailed listing of the different technologies associated with anomaly detection and removal can be found in EM 200-1-15 (USACE 2015). Each MRS/AOC investigated will require an understanding of the equipment detection abilities and limitations, including factors such as the maximum possible depth of anomalies, type of soil, and depth of the water table.

A handheld ferrous magnetometer is an electronic instrument that locates buried anomalies by detecting irregularities in the earth's magnetic field caused by metallic anomalies. This is a passive system that emits no electromagnetic (EM) radiation and detects only ferrous metals and is highly effective for this process as it will detect metallic items on, and near, the surface that may be MEC; is highly implementable as it is light and compact, can be used in any traversable terrain, and is widely available from a variety of sources; and has low cost for purchase/rental and operation. Detection of 20, 37, and 40-mm diameter items with a handheld magnetometer may not be reliable below a depth of about 5 in. for a 20 mm, 12 in. for a 37 mm or 13 in. for a 40 mm. Hand held single electromagnetic induction sensors (commonly referred to as All Metals Detectors) detect both ferrous and non-ferrous metallic objects. These instruments are typically used in anomaly avoidance, mag and dig operations, and to support excavations. Detection of 20, 37, and 40 mm diameter items with All Metals Detectors may not be reliable below a depth of 17 in. DGM with electromagnetic induction (EMI) is an industry standard for MEC detection. Detects both ferrous and non- ferrous metallic objects. Provides for anomaly discrimination based on signal type and intensity. Detection of 20, 37, and 40-mm diameter items may not be reliable below a depth of about 8 in. for a 20 mm, 16 in. for a 37 mm or 17 in. for a 40 mm. The depth of detection is related to the size and number of items.

Detection of partial rounds (i.e. fragments or portions of 20, 37, and 40 mm diameter rounds) like most of the items found at fYNOP, are not expected to be detected down to the maximum depths listed in the paragraph above. The depth of detection for a handheld electromagnetic induction sensor or magnetometer being used to detect a single isolated fragment at fYNOP is expected to be closer to 6-12 in. bgs depending on size (20 mm vs 40 mm) and orientation. Similarly, the depth of detection for DGM being used to detect a single isolated fragment at fYNOP is expected to be 8-16 in. bgs based on size and orientation. As noted during the RI, single anomies including MD fragments were detected at depths down to about 12 in. and larger NMRD or concentrations of fragments/disposal areas containing process material and fragments were found at depths greater than 12 in. bgs due the size of the mass.

Anomaly segregation, removal, and disposal process options include area-wide manual and mechanized excavation and sifting in 1-2 foot lifts (depending on depth of anomaly detection/impact). The use of mechanized equipment is industry standard and can be effective at

reducing removal time, especially for deeper anomalies. Manual excavation is also easily implementable and while costs are moderate due to manpower, there are very few additional costs on top of the manpower needed.

Material removed would be sifted to remove MPPEH. MPPEH would be inspected, classified as MEC or MD, and appropriately disposed. Any MEC found during the course of a MEC clearance would require either blow in place (BIP) and/or consolidated shot treatment prior to disposal. MD and NMRD would be disposed of appropriately offsite.

- ***Effectiveness—***Electromagnetic induction geophysical meters and handheld magnetometers are effective at limited depths, and these have proven effective in prior investigations.

- ***Implementation—***Since all technologies or process options associated with MEC clearance are readily available and commonly employed on similar sites it is easily implementable.

- ***Cost—***The costs associated with the handheld magnetometer is low, while the costs for purchase/rental of electromagnetic induction geophysical meters is moderate. The costs for mechanized removal and sifting and for manual removal of anomalies are similar and are characterized as moderate.

4.1.4 Excavation and Removal of Process Materials

MRS 5, AOC 1 and 2 have presumed backstop sand and MRS 5 has process dust associated with past firing operations that will require removal.

Process material removal involves excavating impacted material from the Site. A backhoe or excavator may be used to perform the removal in AOC 1 and 2 (down to a depth of 12-36 in. below surface as identified during the RI); however, other tools or equipment may be used due to access restrictions especially in Building 14 (MRS 5) where access is currently limited. Material removed would be sifted to remove MPPEH. MPPEH would be inspected, classified as MEC or MD, and appropriately disposed. The sifted material would be stockpiled appropriately in a location where no potential MEC or MC hazard exists. No soils are scheduled for offsite removal from Harley-Davidson property at this time.

- ***Effectiveness—***Excavation is a well-proven and highly effective method for removing impacted material from a site. Selective excavation is highly effective for the removal of well-defined, localized volumes of contaminant-impacted material. Excavation must be combined with other offsite disposal options. Confirmatory sampling (including sidewall and bottom samples) may be conducted in areas containing processing materials to verify removal and no impact to remaining surrounding soils.

- ***Implementability—***The required services and equipment for excavation are readily available. Various engineering controls (e.g., dust suppression) and the use of personal

protective equipment may be required during excavation. Safety precautions for MEC clearance would need to be employed during excavation.

- ***Cost—***This option is moderately expensive; however, no specialized equipment is required, standard construction equipment can be used for material handling with the exception of Building 14 (MRS 5) where access is currently limited. The costs may be moderate to high if all or a portion of Building 14 needs to be removed to get access to process materials.

4.2 APPLICABILITY OF TECHNOLOGIES TO EACH MRS, AOC, AND THE REMAINING RI AREA

The applicability of retained technologies is discussed below and summarized in Table 4-1.

4.2.1 Land Use Control Technologies

LUCs are applicable for all areas where MEC potentially remains, to prevent human contact with potential MEC. These areas include MRS 1, 2, 3, 4, and 5, AOC 1 and 2 and the Remainder RI Area (including the areas covered by fill and the Eastern Landfill). LUCs (i.e. a protective covenant) is currently in place at MRS 1 to minimize the potential for human exposure to subsurface soils; however, an amendment to the protective covenant would be required for awareness training and UXO construction support during intrusive activities.

4.2.2 Munitions and Explosives of Concern Clearance Technologies

MEC clearance technologies are applicable at MRS 2, 3, 4, and 5, AOCs 1 and 2, and the Remainder RI Area (excluding the Eastern Landfill). Although there was no identified impact from MEC in MRSs 2, 3, 4, 5, and the Remainder RI Area, there is a statistical possibility that MEC remains. There is a likelihood that future development may occur in some of these areas, mainly in the western part of the RI Study Area. MEC clearance technologies includes both MEC clearance to various depths and UXO construction support during intrusive activities.

MEC clearance depths may vary from area to area and even within areas. Specific high density anomaly locations have been identified that have a higher probability for MEC. The high probability areas may be cleared separately and with different technologies rather than clearing the entire MRS or AOC.

Portions of the Remainder RI Area were covered with fill during prior site work. These fill areas prevented full investigation of the subsurface during the RI. This technology would include removal of the fill covering these areas to allow access to these areas for clearance actions.

4.2.3 Excavation and Removal of Process Materials

Excavation and Removal of Process Materials is applicable at MRS 5, AOC 1 and AOC 2. Process materials (process dust associated with past firing operations) within MRS 5, with elevated concentrations of MC, present a source that may impact shallow groundwater. Additionally, MRS 5 and certain areas within AOC 1 and AOC 2 contain process materials and backstop sand with

the potential for MC, MD, and MPPEH that may be MEC; therefore, the potential for encountering MEC in these areas is considered moderate. Excavation or removal of process material and backstop sand is applicable to these areas.

5. DEVELOPMENT AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

In this section, technologies that were retained from the initial screening are grouped into remedial alternatives.

5.1 DEVELOPMENT OF REMEDIAL ALTERNATIVES[16]

The following potential remedial alternatives were developed for the fYNOP MRSs, AOCs, and the Remainder RI Area from the technologies that were retained from the development of alternatives in Chapter 4. The five possible alternatives for further evaluation are:

- **Alternative 1 – No Action**

  No additional actions would be undertaken at MRS 1-5, AOCs 1 and 2, or the Remainder RI Area.

- **Alternative 2 – LUCs**

  The LUC components include continued maintenance of the site security force and fencing (maintain existing perimeter fence and add fencing for each applicable MRS/AOC), signage on fencing (as appropriate), annual awareness training, including Recognize, Retreat, and Report, for personnel entering and working in the MRSs/AOCs/Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, construction support (i.e. on-call oversite/support by qualified unexploded ordnance (UXO) personnel during excavation activities) for intrusive activities within MRSs 1-4, AOCs 1-2, and the Remainder RI Area, and maintenance of locks/prevention of entry into Building 14 (AOC 5). LUCs would require annual inspections to ensure compliance and assess the efficacy of the controls.

- **Alternative 3 – Focused Surface and Subsurface MEC Clearance, Removal of Process Materials, and LUCs**

  Perform a focused surface and subsurface MEC and process material clearance in MRS 5 (1 acre), AOC 1 (1 acre), and AOC 2 (2.2 acre), and maintain LUCs in other areas. Depths to achieve focused surface and subsurface MEC and process material clearance would vary based on location. Focused surface and subsurface clearance in AOC 1 and AOC 2 would include removal of process materials, MD, and MPPEH to depth. Depth of removal for the anomalies and/or process materials would vary. Focused surface and subsurface clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

  To complete the focused MEC clearance, perform vegetation clearance activities, excavation-sifting-processing of known process materials/backstop sand-containing

[16] Groundwater within the fYNOP is being evaluated for other contaminants of concern and corrective actions under separate action (GSC 2018b).

disposal areas in MRS 5 (to foundation depth), AOC 1 (to 36 in bgs) and AOC 2 (to 24 in. bgs), followed by 100% Mag-and-Dig of anomalies surrounding the sand-containing disposal areas in AOCs 1 and 2 using digital geophysical mapping (DGM) data (collected during the RI) and 100 % mag and dig of excavations to ensure removal. Step out gridding using 100% Mag-and-Dig would be performed in any area where MD is found along the boundary of AOC 1 and 2. Remove and sift the existing soil/fill stockpiles within and to the east of AOC 2 (labeled as F1 and F2 on Figure 5-1) and the existing soil stockpile to the south of MRS 4 (labeled as F3 on Figure 5-1). Conduct 100% Mag-and-Dig of anomalies in the areas under these stockpiles.

The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRSs/AOCs/Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, and construction support (i.e. on-call oversite/support by qualified unexploded ordnance (UXO) personnel during excavation activities) for intrusive activities within MRSs 1-4, and AOCs 1-2 (for intrusive activities below clearance depths), and the Remainder RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

- **Alternative 4 – Surface and Subsurface MEC Clearance, Removal of Process Materials to Achieve UU/UE[17] for the Western Portion of the RI Study Area and LUCs**

  Perform a complete (100%) surface and subsurface MEC clearance to achieve UU/UE within AOC 1 and the western portion[18] of the Remainder RI Area (including MRSs 2, 3, 4, and 5 and AOC 2), and maintain LUCs in other areas. Depths expected to achieve UU/UE would be up to 36 in. bgs for the entirety of AOC 2, 24 in. bgs for the entirety of AOC 1 and 12 in. bgs for the entirety of MRSs 2-4 and for the remaining area within western portion of the RI Study Area (Figure 5-1). Clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

  To complete the clearance, perform vegetation removal activities in the western portion of the RI investigation area, fill areas (labeled as F1, F2, and F3 on Figure 5-1) and AOC 1 including the surrounding grids. Conduct excavation-sifting-processing of soils in AOC 1 and AOC 2. Conduct surface and subsurface clearance in the Remainder RI Area that would include use of DGM, followed by intrusive investigations and removal of all anomalies identified during DGM. Any disposal areas containing process materials in the remainder RI Area would be excavated to depth. Remove and sift the existing soil/fill stockpiles within and to the east of AOC 2 (labeled as F1 and F2 on Figure 5-1) and the existing soil/fill stockpile to the south of MRS 4 (labeled as F3 on Figure 5-1). Conduct 100% Mag-and-Dig of anomalies in the areas under these stockpiles to remove all

[17] UU/UE for MEC/MC soil concerns only, as previously stated groundwater is being addressed under a separate action.
[18] This area is demarcated by the blue line on Figure 5-1. The area west of the blue line has been termed the "western portion" of the remainder RI area. This area is approximately 7.6 acres.

anomalies (expected depth to be 12 in. bgs). Any disposal areas containing process materials beneath the existing soil/fill stockpiles would be excavated to depth.

The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRS 1 and the eastern portion of the Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, and construction support (i.e. on-call oversite/support by qualified UXO personnel during excavation activities) for intrusive activities within MRS 1 and the Eastern portion of the Remainder RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

- **Alternative 5 –Surface and Subsurface MEC Clearance and Removal of Process Materials to Achieve UU/UE[19] for the Complete RI Study Area and LUCs**

  Perform a complete (100%) surface and subsurface MEC clearance to achieve UU/UE for soil within the complete RI study area including MRSs 2-5 and AOCs 1-2 excluding the Eastern Landfill (Figure 5-1) and maintain LUCs in MRS 1 and the Eastern Landfill. Depths expected to achieve UU/UE would be up to 36 in. bgs for the entirety of AOC 2, 24 in. bgs for the entirety of AOC 1 and 12 in. bgs for the entirety of the remaining area within the RI Study Area. Clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

  To complete the clearance, perform vegetation removal activities in the entirety of the investigation area, fill areas (labeled as F1, F2, and F3 on Figure 5-1) and AOC 1 including the surrounding grids. Conduct excavation-sifting-processing of soils in AOC 1 and AOC 2. Conduct surface and subsurface clearance in the remainder RI Area including MRSs 2-4 that would include use of DGM, followed by intrusive investigations and removal of all anomalies identified during DGM. Any disposal areas containing process materials in the remainder RI Area would be excavated to depth. Remove and sift the existing soil/fill stockpiles within and to the east of AOC 2 (labeled as F1 and F2 on Figure 5-1) and the existing soil/fill stockpile to the south of MRS 4 (labeled as F3 on Figure 5-1). Conduct 100% Mag-and-Dig of anomalies in the areas under these stockpiles to remove all anomalies (expected depth to be 12 in. bgs). Any disposal areas containing process materials beneath the existing soil/fill stockpiles would be excavated to depth.

  The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRS 1 and the Eastern Landfill in the Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, and construction support (i.e. on-call oversite/support by qualified UXO personnel during excavation activities) for intrusive activities within MRS 1 and the Eastern Landfill in the Remainder

[19] No groundwater issues are associated with the MMRP. Groundwater within this portion of the fYNOP was evaluated for HTW corrective actions under the Site-Wide CAO table from June 2017 (Groundwater Sciences Corporation [GSC] 2017).

RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

5.2 DESCRIPTION OF EVALUATION CRITERIA

This section discusses the evaluation criteria used to perform the detailed analysis of alternatives. The NCP established nine evaluation criteria to address these statutory requirements. The criteria fall into three categories: threshold criteria, primary balancing criteria, and modifying criteria. Section 5.2 presents an evaluation of each potential remedial alternative based on threshold and primary balancing criteria. Modifying criteria (state or support agency acceptance and community acceptance) will be evaluated after the public comment period on the cleanup plan. Such criteria are also presented in PA Act 2, Chapter 3, Section 304(j) for consideration of the following criteria to be eligible for selection as a remedy.

5.2.1 Threshold Criteria

The following threshold criteria are requirements that each alternative must achieve in order to be eligible for selection as a remedy:

Overall Protection of Human Health and the Environment — This is a threshold criterion that must be met. It assesses whether each alternative provides adequate protection of human health and the environment within the scope of the proposed alternative. The effectiveness in reducing the explosive hazard is evaluated as part of this criterion.

Compliance with ARARs — This is a threshold criterion that must be met. It is used to evaluate whether each proposed alternative meets the identified federal and/or state ARARs identified in Table 3-1.

5.2.2 Primary Balancing Criteria

Long-Term Effectiveness and Permanence — This criterion evaluates the magnitude of the hazards remaining at the Site after corrective action objectives have been met. The long-term effectiveness of a corrective action also considers the adequacy and reliability of any controls used to manage the residual hazards that remain at the Site.

Reduction of Toxicity, Mobility, or Volume through Treatment — Preferably, a removal alternative will reduce toxicity, mobility, or volume through treatment. This criterion considers the following factors:

- Removal processes employed and the materials it will treat;
- Amount of hazardous materials to be destroyed or treated;
- Degree of reduction expected in toxicity, mobility or volume;
- Degree to that the removal will be irreversible; and
- Type and quantity of residuals that remain after removal activities.

Per Army guidance (USACE, 2009), toxicity and mobility factors are not specifically relevant to MEC; therefore, the reduction of volume through the removal of MEC is the primary factor for MEC. Accordingly, the evaluations in this section will only look at the reduction of volume.

Short-Term Effectiveness — This criterion addresses the effects of an alternative during the implementation phase, until the removal objectives are met. More specifically, each alternative will be evaluated for:

- Protection of the community and workers during the corrective action;
- Adverse environmental impacts resulting from construction and implementation; and
- Time required to meet the removal objectives.

Implementability — This criterion assesses the ease or difficulty of implementing the alternatives by considering the following types of factors as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility, including activities needed to coordinate with other offices and agencies and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).
- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources; the availability of services and materials; and the availability of prospective technologies.

5.2.3 Modifying Criteria

State or Support Agency Acceptance and Community Acceptance — The preferred alternative should be acceptable to State and support agencies. Also, the concerns of the community should be considered in presenting alternatives that would be acceptable to the community.

5.3 INDIVIDUAL EVALUATIONS OF REMEDIAL ALTERNATIVES

5.3.1 Alternative 1 – No Action

Per the NCP and Act 2, a No Action alternative is always assessed. This alternative provides a comparative baseline against that other alternatives can be evaluated. Under this alternative, no action will be taken, and any process materials or anomalies (MPPEH that is potentially MEC) will be left in place without further investigation or removal. The No Action alternative equates to a determination to do no remediation and to provide no controls and it does not consider any existing controls.

5.3.1.1 Overall Protection of Human Health and the Environment

Alternative 1 is not protective of human health and the environment. Residual process materials or anomalies (MPPEH that is potentially MEC) in media and Building 14 (MRS 5) will be left in place and the potential hazard to human health will not be minimized. Corrective action goals will not be met. No action does not indicate a repeal of existing site controls.

5.3.1.2 Compliance with ARARs

As no action will be initiated, there are no action-specific ARARs that are applicable.

5.3.1.3 Long-term Effectiveness

Alternative 1 is ineffective in the long term because potential hazards posed by MEC and/or MC will not be mitigated.

5.3.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 1 will not reduce the amount of potential MEC and/or MC. Therefore, the volume associated with MEC and/or MC will not be reduced and is not applicable.

5.3.1.5 Short-Term Effectiveness

Under Alternative 1, neither workers nor the community would be subjected to any additional exposure hazards from removal activities, transportation, or disposal since no actions will be implemented. Although no time is needed to implement this alternative, corrective action objectives will not be met.

5.3.1.6 Implementability

Implementation of Alternative 1 poses no technical difficulties because no equipment will be used and no technology will be implemented. There will be no schedule delays as no action is being taken. This alternative will not hinder conducting additional corrective actions and future remedial actions will not be affected. This alternative would not be affected by environmental conditions because no actions are implemented.

5.3.1.7 State and Community Acceptance

This alternative would limit any future use of the Site. The Site would remain in its present state and continue to deteriorate. This alternative would likely not receive state or community acceptance because potential MEC hazards and any contaminants of concern above CAOs would not be addressed.

5.3.1.8 Costs

Total costs associated with Alternative 1 are not applicable as no action will occur.

5.3.2 Alternative 2 – Land Use Controls

Alternative 2 includes implementing LUCs described in Section 5.1 (Figure 5-1). LUCs are applicable for MRS 1, 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area.

5.3.2.1 Overall Protection of Human Health and the Environment

Alternative 2 is protective of human health. The implementation and maintenance of protective covenants provides warnings of potential hazards due to MEC and MC. Subsurface MEC exposure is also mitigated through these covenants that provide control and UXO supervision of intrusive work.
The use of LUCs will inform potential human receptors of hazards associated with MEC, reduce the probability of accidental interaction with MEC, but will not purposefully reduce the concentration of MEC or MC as the primary source areas of process materials or anomalies (MPPEH that is potentially MEC) would remain. MEC would be removed if found during intrusive activities; thus, potentially decreasing the volume of MEC over time in the MRSs and AOCs.

5.3.2.2 Compliance with ARARs

There are no location-specific or chemical-specific ARARs associated with this action. The identified action-specific ARARs (**Table 3-1**) are applicable only for actions associated with transportation and disposal of MEC. The requirements of 40 CFR Part 266, Subpart M will be achieved if MEC is transported and disposed of off-site; therefore, Alternative 2 meets this criterion. The requirements of 40 CFR Part 266, Subpart M are inapplicable if MEC is BIP or disposed through consolidated shots.

5.3.2.3 Long-term Effectiveness

The LUC alternative is moderately effective in providing long-term effectiveness by restricting site access and use, that minimizes human encounters to the potential explosive hazards at the Site. The long-term effectiveness of Alternative 2 is dependent on the maintenance of covenants and conductance of the UXO construction support. As noted in Section 4.1.2, a LUCIP would need to be developed to describe the controls and delineate responsibility for enforcement and maintenance of the controls to ensure residual hazards are adequately addressed. This alternative does not allow for future UU/UE of the MMRP RI Study Area including the MRSs, and AOCs.

5.3.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Although the LUC alternative does not include intentional removal or treatment of MC or MEC, MEC may be removed during UXO construction support (if found). Therefore, the volume of MEC may decrease over time. All onsite MC sources associated with process materials would remain onsite indefinitely. This alternative does not meet the statutory preference for treatment.

5.3.2.5 Short-Term Effectiveness

This alternative would pose no additional health hazards to the community related to implementation in the short-term because no large-scale removal, transportation, or disposal of

MC or MEC would take place. This alternative has the potential to adversely affect human health during the removal of MEC if discovered during the UXO construction support. Workers may be exposed to MEC during potential MEC removal. This exposure will be minimized by using UXO personnel to be onsite during construction and remove MEC (if found). UXO personnel are trained and experienced in identifying MEC, proper response procedures, and MEC safety requirements. Also, safety elements associated with EM 385-1-1, including personal protective equipment, would be followed during UXO construction support and MEC removal (if found) activities. All MC onsite associated with process materials would remain onsite indefinitely.

5.3.2.6 Implementability

Making the LUCs and UXO construction support a permanent covenant onsite would not be technically challenging, should not be susceptible to significant schedule delays, and would not limit or prevent future removal and/or remedial activities. There would be no technical or administrative limitations to prevent continued implementation of the existing LUCs.

5.3.2.7 State and Community Acceptance

This criterion is not evaluated formally until comments from stakeholders are received. These comments will be documented in the Cleanup Plan.

5.3.2.8 Costs

Estimated capital and O&M costs associated with Alternative 2 are presented in Table 5-2. Costs for this alternative primarily consist of LUCs, training, fence maintenance, cap maintenance and five-year reviews. No costs for UXO Construction Support have been applied to this alternative. The estimated 30-year present worth cost is $789,439. Costs to maintain security forces, the fence line, performing awareness training, and performing site inspections are considered low.

5.3.3 Alternative 3 – Focused Surface and Subsurface MEC Clearance, Removal of Process Materials, and LUCs

Perform a focused surface and subsurface MEC and process material clearance in MRS 5, AOC 1, and AOC 2 and maintain LUCs in other areas (Figure 5-1). Depths to achieve focused surface and subsurface MEC and process material clearance would vary based on location. Focused surface and subsurface clearance in AOC 1 and AOC 2 would include removal of process materials, MD, and MPPEH to depth. Depth of removal for the anomalies and/or process materials would vary. Focused surface and subsurface clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRSs/AOCs/Remainder RI Area, prevention of future residential site use, prevention of the consumption of groundwater, and construction support (i.e. on-call oversite/support by qualified unexploded ordnance (UXO) personnel during excavation activities) for intrusive activities within MRSs 1-4, and AOCs 1-2 (for intrusive activities below clearance depths), and the Remainder RI

Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

5.3.3.1 Overall Protection of Human Health and the Environment

Alternative 3 is protective of human health, specifically residential receptors. The most likely potential MEC hazards and MC risks would be mitigated through MEC clearance and MC removal. Non-residential risks to human receptors at MRS 5, AOC 1 and AOC 2 will be reduced by the actions of this alternative. The use of LUCs will prevent future residential use of the Site and inform the public of hazards associated with remaining MEC.

5.3.3.2 Compliance with ARARs

The identified action-specific ARARs (**Table 3-1**) are applicable only for actions associated with this alternative. The requirements of 40 CFR Part 266, Subpart M will be complied with if MEC is transported and disposed of off-site; however, it is anticipated that any MEC will be BIP or disposed using a consolidated shot. Disturbing the process material/backstops will also trigger ARARs for controlling fugitive dust emissions and will trigger ARARs for erosion-control measures. Action-specific ARARs only apply if the action is taken; therefore, Alternative 3 meets this criterion.

5.3.3.3 Long-term Effectiveness

This alternative is effective in the long-term by removing contaminated soil and process materials to depth of detection in the areas with the highest anomaly density (AOC 1, AOC 2 and MRS 5). Furthermore, a focused surface MEC clearance (down to depth of detection, depth of process materials (36 in. bgs), and/or the frost line [30 in.] would also provide protection in the long term by reducing explosive hazards from MRSs 2-5, AOCs 1 and 2. The LUCs will be maintained, thus ensuring the continued effectiveness of the controls.

5.3.3.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 3 will involve the removal of MEC-impacted soils and removal of potential MEC within surface soils within the highest anomaly density areas. Additionally, the removal of the process materials, including backstop sand and dust, will eliminate the remaining onsite MC sources. The removed material will require TCLP sampling and analysis and, if the samples exceed criteria, the material will require disposal as hazardous waste. Following excavation and processing of soils, soils will be stockpiled onsite and reused if clean or disposed of appropriately offsite. MEC would be processed and disposed of during the MEC clearance activities (if found) by trained personnel. The volume of MEC present onsite would be reduced through this alternative.

5.3.3.5 Short-Term Effectiveness

There will be potential short-term worker and community exposures associated with Alternative 3. Workers may be exposed during excavation activities and MEC clearance. A health and safety plan that identifies appropriate personal protective equipment (PPE) for workers will minimize

and/or eliminate exposures from process materials or backstop materials. Mitigation measures during excavation, such as erosion and dust control, will minimize/eliminate potential short-term impacts to the environment. The community will be protected during soil transport by inspecting vehicles before and after use, decontaminating as needed, covering the transported waste, observing safety protocols, following pre-designated routes, and limiting the distance to the disposal facility.

The exposure to MEC will be minimized by using UXO personnel to perform MEC clearance and process MPPEH (if found). UXO personnel are trained and experienced in identifying MEC, proper response procedures, and MEC safety requirements. Also, safety elements associated with EM 385-1-1, including personal protective equipment, would be followed during the sign installation, periodic surface sweeps, and MPPEH processing (if found).

5.3.3.6 Implementability

There may be some technical limitations to implementing MEC clearance and process material/soil removal for Alternative 3. MEC clearance would be conducted in vegetated areas that contain some infrastructure. Complete vegetation removal may be required to gain access to certain areas. Also, the process materials in Building 14 may be difficult to access without partial building demolition or use of hand tools. However, both excavation and MEC clearance are standard operations that are easily completed with available equipment and resources.

5.3.3.7 State and Community Acceptance

This criterion is not evaluated formally until comments from stakeholders are received. These comments will be documented in the subsequent Remedial Action Work Plan.

5.3.3.8 Costs

Estimated capital and O&M costs associated with Alternative 3 are presented in Table 5-3. Costs for this alternative primarily consist of LUCs, training, MPPEH clearance (MRS 5, AOC 1, AOC 2 and beneath existing soil piles F1 and F2), process material and backstop removal and five-year reviews. No costs for UXO Construction Support have been applied to this alternative. The estimated 30-year present worth cost is $3,872,516.

5.3.4 Alternative 4 – Surface and Subsurface MEC Clearance, Removal of Process Materials to Achieve UU/UE for the Western Portion of the RI Study Area and LUCs

Perform a complete (100%) surface and subsurface MEC clearance to achieve UU/UE within AOC 1 and the western portion of the Remainder RI Area (including MRSs 2, 3, 4, and 5 and AOC 2), and maintain LUCs in other areas which are inaccessible or unable to be disturbed. Depths to achieve removal of all MEC are expected to be up to 36 in. bgs for the entirety of AOC 2, 24 in. bgs for the entirety of AOC 1 and 12 in. bgs for the entirety of MRSs 2-4 and for the remaining area within western portion of the RI Study Area (Figure 5-1). Clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRS 1 and the eastern portion of the Remainder RI Area, prevention of future residential site use, and construction support (i.e. on-call oversite/support by qualified UXO personnel during excavation activities) for intrusive activities within MRS 1 and the Eastern portion of the Remainder RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

5.3.4.1 Overall Protection of Human Health and the Environment

Alternative 4 is protective of human health, including residential receptors. All known and potential MEC hazards and MC risks would be mitigated through MEC clearance and MC removal. Non-residential risks to human receptors at MRS 5, AOC 1 and AOC 2 will be reduced by the actions of this alternative. The use of LUCs will prevent future residential use of the areas that will not be remediated to UU/UE status and inform the public of hazards associated with remaining MEC.

5.3.4.2 Compliance with ARARs

The identified action-specific ARARs (**Table 3-1**) are applicable only for actions associated with this alternative. The requirements of 40 CFR Part 266, Subpart M will be complied with if MEC is transported and disposed of off-site; however, it is anticipated that any MEC will be BIP or disposed of using a consolidated shot. Disturbing the process material/backstops will also trigger ARARs for controlling fugitive dust emissions and will trigger ARARs for erosion-control measures. Action-specific ARARs only apply if the action is taken; therefore, Alternative 4 meets this criterion.

5.3.4.3 Long-term Effectiveness

This alternative is highly effective in providing long-term effectiveness by removing contaminated soil and process materials from the Site. Furthermore, a complete surface MEC clearance (down to depth of detection, depth of process materials (36 in. bgs), and/or the frost line (30 in. bgs) would also provide protection in the long term by removing explosive hazards from the focused removal of MEC at AOC 1, and eastern portion of the remainder RI Area and the complete removal of MEC at MRS 2-5, AOC 2 and the western concentrated portion of the remainder RI Area. The LUCs will be maintained at MRS 1, AOC 1, the remainder RI Area (Eastern Landfill), and the eastern portion of the RI Area, thus ensuring the continued effectiveness of the controls.

5.3.4.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 4 will involve the removal of MEC-impacted soils and removal of potential MEC within surface soils. Additionally, the removal of the process materials, including backstop sand and dust, will eliminate the remaining onsite MC sources. Following excavation and processing of soils, soils will be stockpiled onsite and reused if clean or disposed of appropriately offsite. The removed process material will require TCLP sampling and analysis. If the samples exceed criteria, the material will require disposal as hazardous waste. MEC would be processed and disposed of

during the MEC clearance activities (if found) by trained personnel. The volume of MEC present onsite would be reduced through treatment (demolition) as part of this alternative.

5.3.4.5 Short-Term Effectiveness[20]

This alternative involves a significant amount of earthwork which will affect the short-term effectiveness. There will be potential short-term worker and community exposures associated with the earthwork discussed in Alternative 4. Workers may be exposed during excavation activities and MEC clearance. A health and safety plan that identifies appropriate personal protective equipment (PPE) for workers will minimize and/or eliminate exposures from process materials or backstop materials. Mitigation measures during excavation, such as erosion and dust control, will minimize/eliminate potential short-term impacts. The community will be protected during soil transport by inspecting vehicles before and after use, decontaminating as needed, covering the transported waste, observing safety protocols, following pre-designated routes, and limiting the distance to the disposal facility.

The exposure to MEC will be minimized by using UXO personnel to perform MEC clearance and process MPPEH (if found). UXO personnel are trained and experienced in identifying MEC, proper response procedures, and MEC safety requirements. Also, safety elements associated with EM 385-1-1, including personal protective equipment, would be followed during the sign installation, periodic surface sweeps, and MPPEH processing (if found).

5.3.4.6 Implementability

There may be some technical limitations to implementing MEC clearance and process material/soil removal. MEC clearance would be conducted in vegetated or developed areas. Vegetation removal may be required to gain access to certain areas. Also, the process materials in Building 14 may be difficult to gain equipment access to the area. However, both excavation and item clearance are standard operations that are easily completed with available equipment and resources.

5.3.4.7 State and Community Acceptance

This criterion is not evaluated formally until comments from stakeholders are received. These comments will be documented in the subsequent Cleanup Plan.

5.3.4.8 Costs

Estimated capital and O&M costs associated with Alternative 4 are presented in Table 5-4. Costs for this alternative primarily consist of LUCs, training, MPPEH clearance (UU/UE for western area, AOC 1 and screening of F1/F2), process material and backstop removal and five-year reviews. The estimated 30-year present worth cost is $4,813,740.

[20] As previously stated groundwater is being addressed under a separate cover and this alternative would not provide protection to groundwater.

5.3.5 Alternative 5 – Surface and Subsurface MEC Clearance and Removal of Process Materials to Achieve UU/UE for the Complete RI Study Area and LUCs

Perform a complete (100%) surface and subsurface MEC clearance to achieve UU/UE within the complete RI study area including MRSs 2-5 and AOCs 1-2 excluding the Eastern Landfill (Figure 5-1) and maintain LUCs in MRS 1 and the Eastern Landfill. UU/UE requires removal of all anomalies. Clearance will be completed for residential exposure, and depths to achieve UU/UE are expected to be up to 36 in. bgs for the entirety of AOC 2, 24 in. bgs for the entirety of AOC 1, and 12 in. bgs for the entirety of the remaining area within the RI Study Area. Clearance in MRS 5 would include removal of process materials, MD, and MPPEH within the impacted areas of Building 14. This alternative includes demolition of Building 14 and Building 16 Remnants.

The LUC components include continued maintenance of the site security force and fencing signage on fencing (as appropriate), annual awareness training for personnel entering and working in the MRS 1 and the Eastern Landfill in the Remainder RI Area, prevention of future residential site use, and construction support (i.e. on-call oversite/support by qualified UXO personnel during excavation activities) for intrusive activities within MRS 1 and the Eastern Landfill in the Remainder RI Area. LUCs would require annual inspections to ensure compliance and to assess the efficacy of the controls.

5.3.5.1 Overall Protection of Human Health and the Environment

Alternative 5 is protective of human health and would eliminate all risks to human health or the environment due to MEC or MC.

5.3.5.2 Compliance with ARARs

The identified action-specific ARARs (Table 3-1) are applicable only for actions associated with this alternative. The requirements of 40 CFR Part 266, Subpart M will be complied with if MEC is transported and disposed of off-site; however, MEC is anticipated to be disposed of by BIP or a consolidated shot. Disturbing the process material/backstops will also trigger ARARs for controlling fugitive dust emissions and potentially may trigger ARARs for erosion-control measures. All ARARs related to MC will be achieved by removing the potential sources. Action-specific ARARs only apply if the action is taken. Therefore, Alternative 5 meets this criterion.

5.3.5.3 Long-term Effectiveness

This alternative is highly effective in providing long-term effectiveness by removing all sources of MEC or MC. This alternative gives Harley-Davidson the most unrestricted future use of their more easily developed lands.

5.3.5.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

This alternative would remove all sources of MEC and MC and represents full reduction of potential toxicity, mobility, and volume.

5.3.5.5 Short-Term Effectiveness

This alternative involves a significant amount of earthwork which will affect the short-term effectiveness. There will be potential short-term worker and community exposures associated with the earthwork discussed in Alternative 5. Workers may be exposed during excavation activities and MEC clearance. A health and safety plan that identifies appropriate personal protective equipment (PPE) for workers will minimize and/or eliminate exposures from process materials or backstop materials. Mitigation measures during excavation, such as erosion and dust control, will minimize/eliminate potential short-term impacts. The community will be protected during process material transport by inspecting vehicles before and after use, decontaminating as needed, covering the transported waste, observing safety protocols, following pre-designated routes, and limiting the distance to the disposal facility.

The exposure to MEC will be minimized by using UXO personnel to perform the MEC clearance and remove MEC (if found). UXO personnel are trained and experienced in identifying MEC, proper response procedures, and MEC safety requirements. Also, safety elements associated with EM 385-1-1, including personal protective equipment, would be followed during the sign installation, periodic surface sweeps, and MEC removal (if found) activities.

5.3.5.6 Implementability

This alternative is the most labor intensive; however, can be completed using commonly-used equipment and common standard operating procedures. Vegetation clearance will be required and access to the elevator area of Building 14 requires confined space entry and management.

5.3.5.7 State and Community Acceptance

This criterion is not evaluated formally until comments from stakeholders are received. These comments will be documented in the Remedial Action Work Plan.

5.3.5.8 Costs

Estimated capital and O&M costs associated with Alternative 5 are presented in Table 5-5. Costs for this alternative primarily consist of LUCs, training, MPPEH clearance (Complete RI Study Area excluding the Eastern Landfill), process material and backstop removal and five-year reviews. The estimated 30-year present worth cost is $7,159,268.

5.4 COMPARATIVE ANALYSIS OF ALTERNATIVES

A Detailed Analysis of Alternatives was performed, and the remedial alternatives were compared to each other to identify the advantages and disadvantages relative to one another so key decision-making tradeoffs could be identified. As part of this process, each alternative was initially compared against the threshold criteria (Overall Protection of Human Health and the Environment and Compliance with ARARs) to determine if they met the statutory requirements necessary for further consideration. Then all other criteria were reviewed, comparing alternatives to each other **Table 5-6** (Appendix B) provides details on the comparison of alternatives for the evaluation criteria.

5.5 RECOMMENDATIONS

Based on the comparative analysis and the anticipated current and future site usage, Alternative 4 is recommended. This alternative removes process materials that present the only known onsite source of MC and will remove the most likely potential sources of MEC. UXO construction support requirements will be sufficiently protective of human health and the environment. This remedy is satisfactory for short-term and long-term effectiveness and can be implemented using commonly-applied processes and technologies. This recommendation is contingent upon stakeholder review and acceptance.

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Appendix A

Figures

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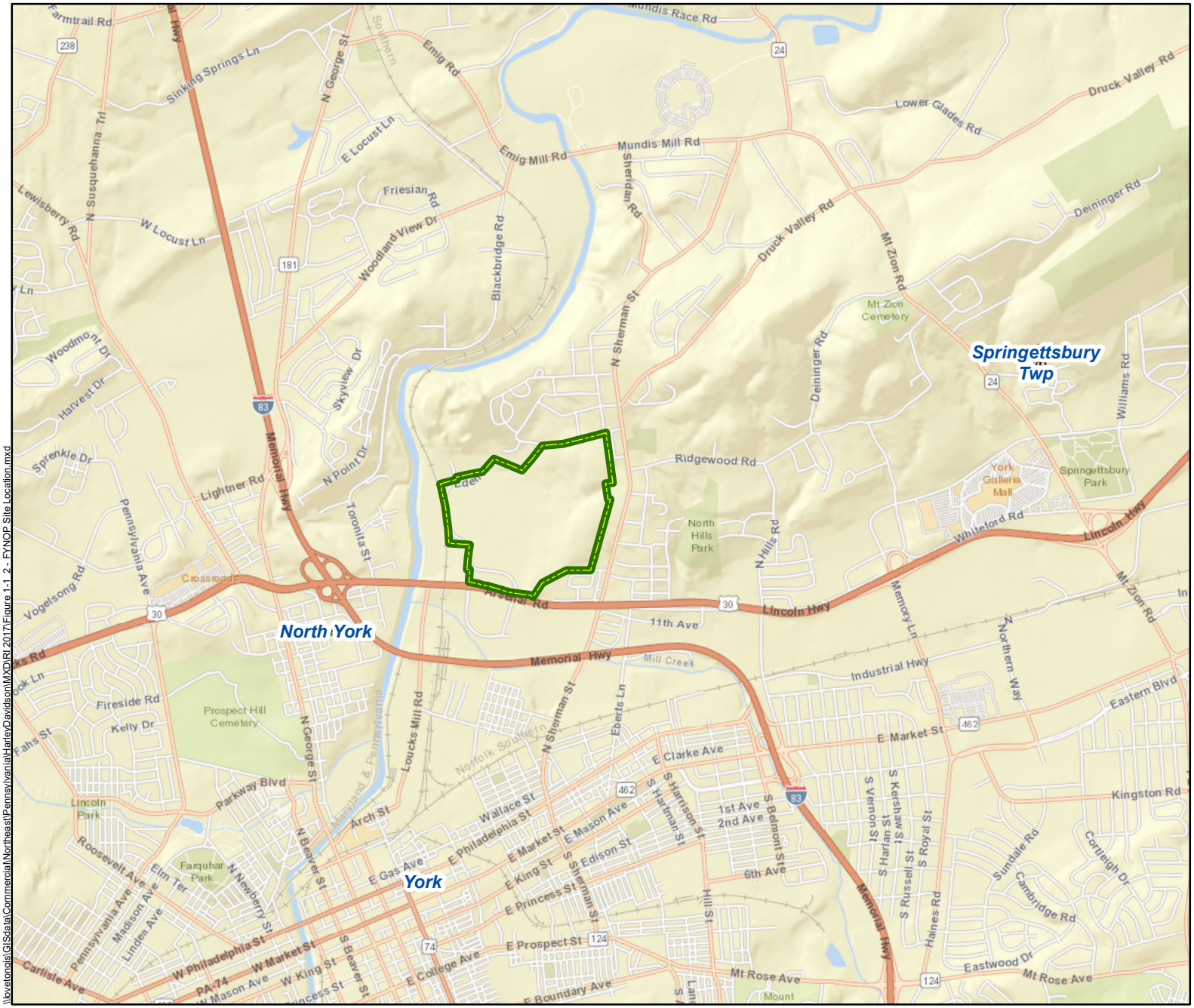

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Figure 1-1 Former York Naval Ordnance Plant Site Location

Aerial: ESRI, 2015
Projection: NAD 1983 State Plane
Pennsylvania South Feet
Date: June 2018

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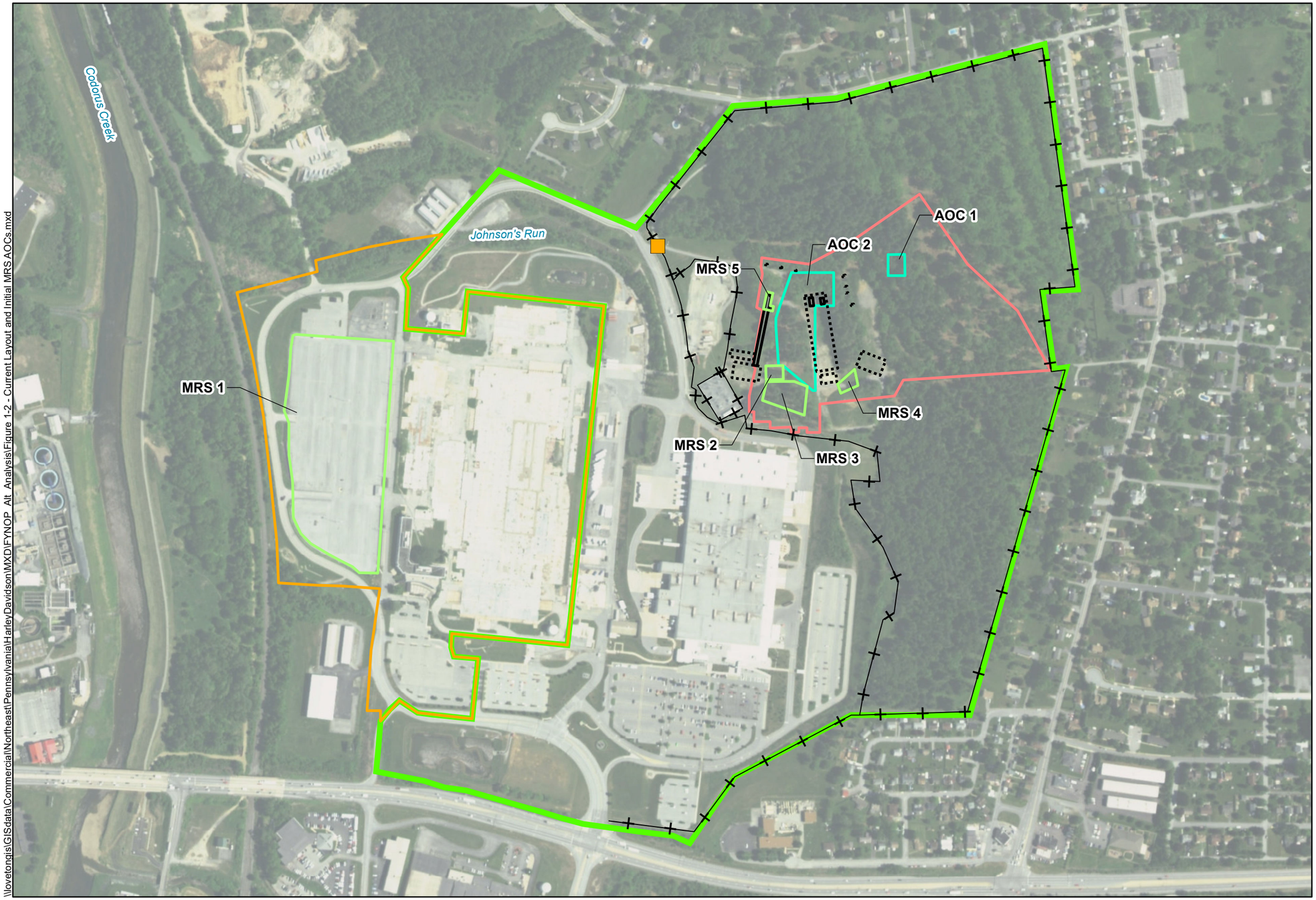

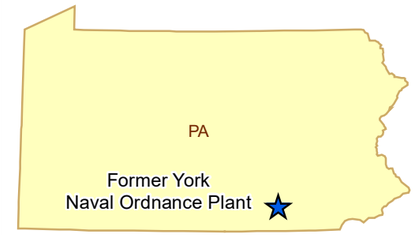

Legend

- Access Gate
- Fenceline
- Current AOC
- Current MRS Boundary
- Former Building Locations
- Current Building Locations
- Remedial Investigation Boundary
- West Campus
- Current Harley-Davidson Boundary

Notes:
AOC = Area of Concern
MRS = Munitions Response Site

Five munitions response sites (MRSs) and two areas of concern (AOCs) were designated by USACE as being present at the site. Collectively these areas were identified as two separate Munitions Response Areas (MRAs).

Figure 1-2 Current Site Layout, Munitions Reponse Sites, and Areas of Concern

Aerial: ESRI, 2015

Projection: NAD 1983 State Plane Pennsylvania South Feet

Date: June 2018

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\\lovetongis\GISdata\Commercial\Northeast\Pennsylvania\Harley-Davidson\MXD\FYNOP_Alt_Analysis\Figure 1-2 - Current Layout and Initial MRS AOCs.mxd

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Legend

- Current AOC Boundary
- Current MRS Boundary
- Former Building Locations
- Current Building Locations
- Remedial Investigation Boundary
- Former York Naval Ordnance Plant Boundary

Notes:
AOC = Area of Concern
MRS = Munitions Response Site

Utility Source: H-D Environmental Department, Liedos, Inc.

\\lovetongis\GISdata\Commercial\Northeast\Pennsylvania\Harley Davidson\MXD\FYNOP_Alt Analysis\Figure 2-1 - RI Area and Utilities.mxd

Figure 2-1 Military Munitions Response Program Area Study

Aerial: ESRI, 2015

Projection: NAD 1983 State Plane Pennsylvania South Feet

Date: June 2018

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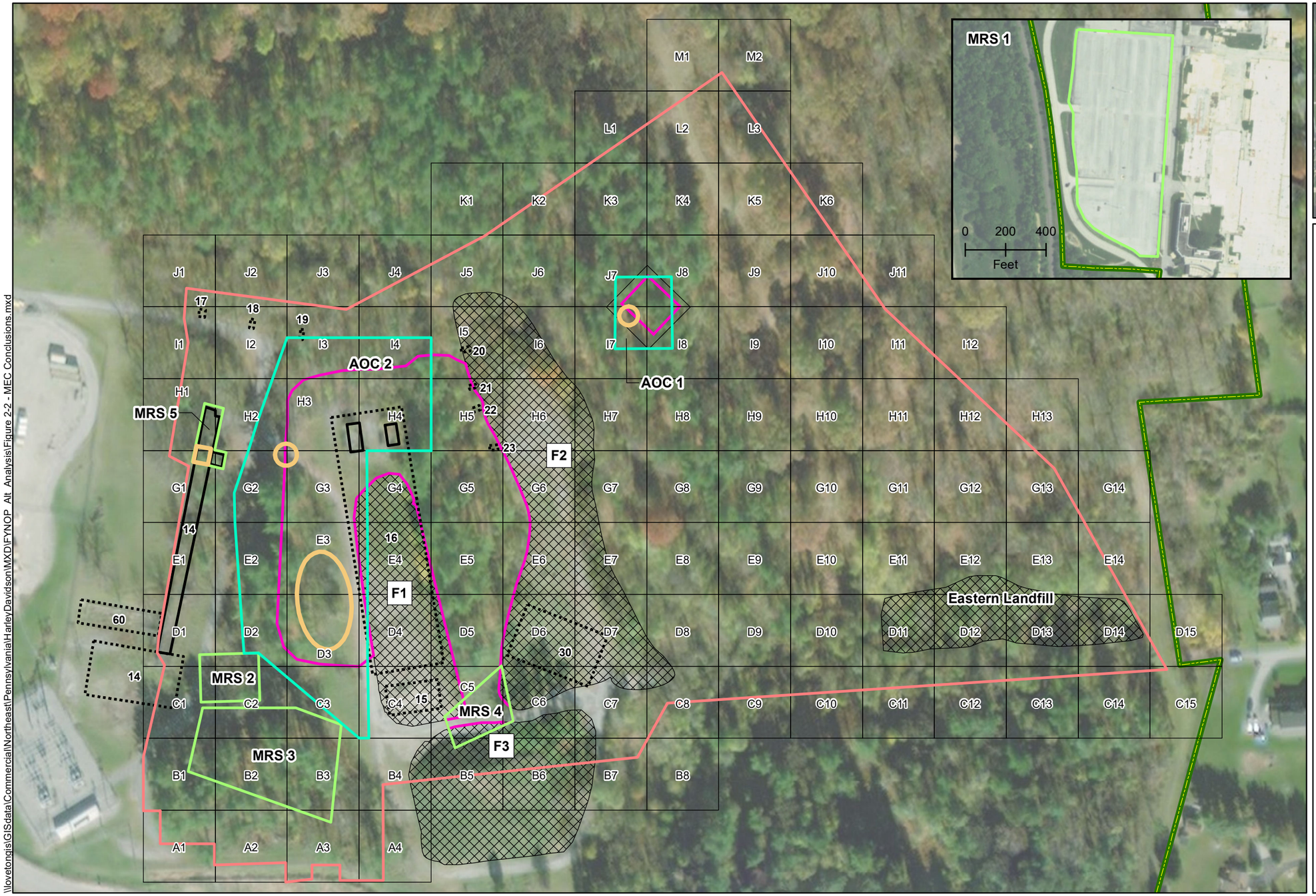

\\lovetongis\GISdata\Commercial\Northeast\Pennsylvania\HarleyDavidson\MXD\FYNOP_Alt_Analysis\Figure 2-2 - MEC Conclusions.mxd

Legend

- Current AOC
- Current MRS Boundary
- Sand Found
- High Anomaly
- High Anomaly Density
- Former Building Locations
- Current Building Locations
- 100x100 foot Survey Grid
- Remedial Investigation Boundary
- Former York Naval Ordnance Plant Boundary

Notes:
No Investigation occurred within High Anomaly Density areas during MMRP Remedial Investigation

AOC = Area of Concern
MRS = Munitions Response Site
MMRP = Military Munitions Response Program

Figure 2-2 Munitions and Explosives of Concern Results and Conclusions

Aerial: ESRI, 2015

Projection: NAD 1983 State Plane Pennsylvania South Feet

Date: June 2018

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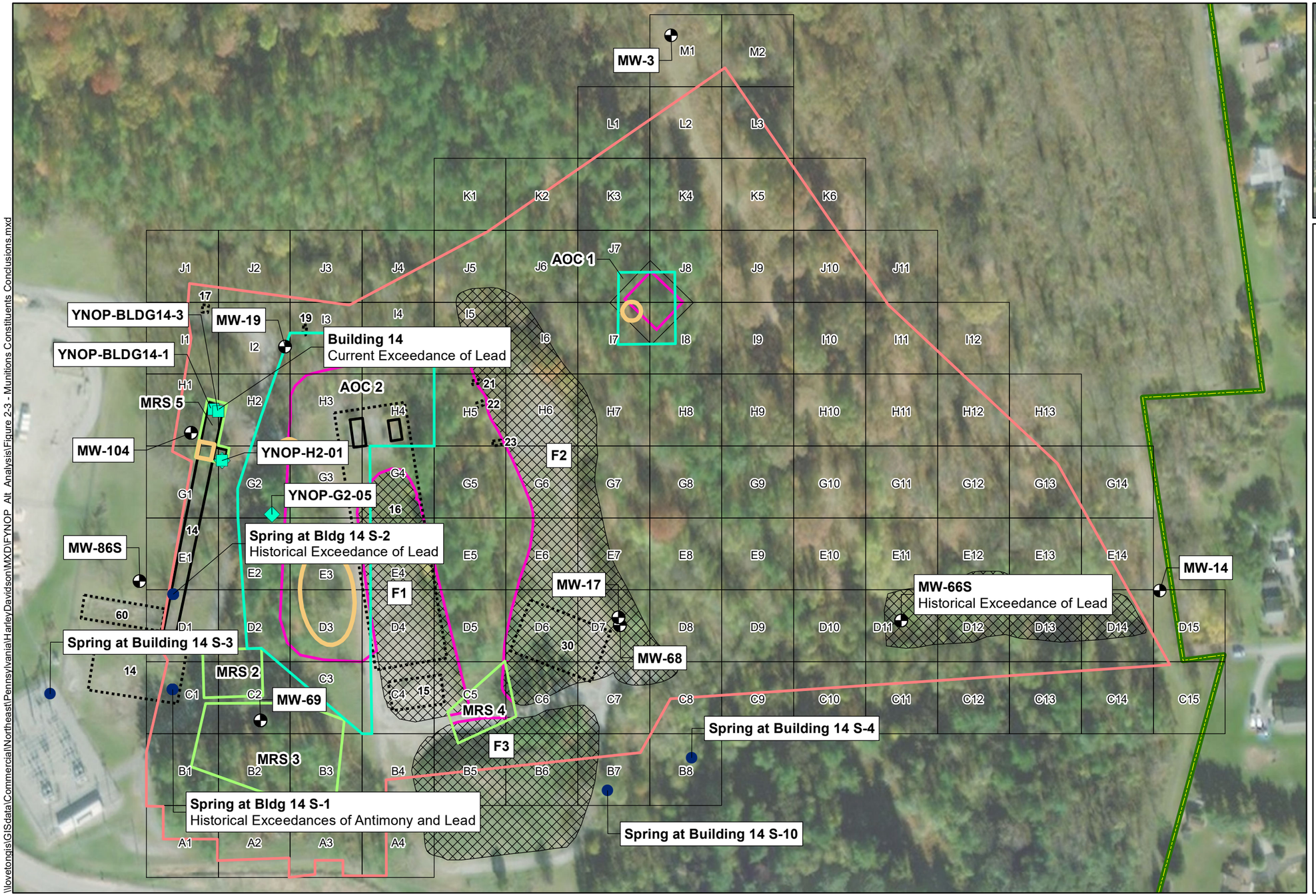

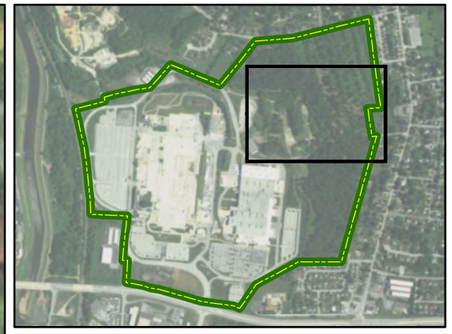

Legend

Sample Location

- Monitoring Well
- Spring

2016 Sample Collected and Analyzed

- Surface Soil Location
- Subsurface Soil Location
- Sand Found
- Current AOC
- Current MRS Boundary
- High Anomaly
- High Anomaly Density,
- Former Building Locations
- Current Building Locations
- 100x100 foot Survey Grid
- Remedial Investigation Boundary
- Former York Naval Ordnance Plant Boundary

Notes:
AOC = Area of Concern
MRS = Munitions Response Site

1. MW-104 was observed as dry during groundwater sampling events.

\\lovetongis\GISdata\Commercial\Northeast\Pennsylvania\HarleyDavidson\MXD\FYNOP_Alt. Analysis\Figure 2-3 - Munitions Constituents Conclusions.mxd

Figure 2-3 Munitions Constituents Conclusions

Aerial: ESRI, 2015

Projection: NAD 1983 State Plane Pennsylvania South Feet

Date: June 2018

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Feet

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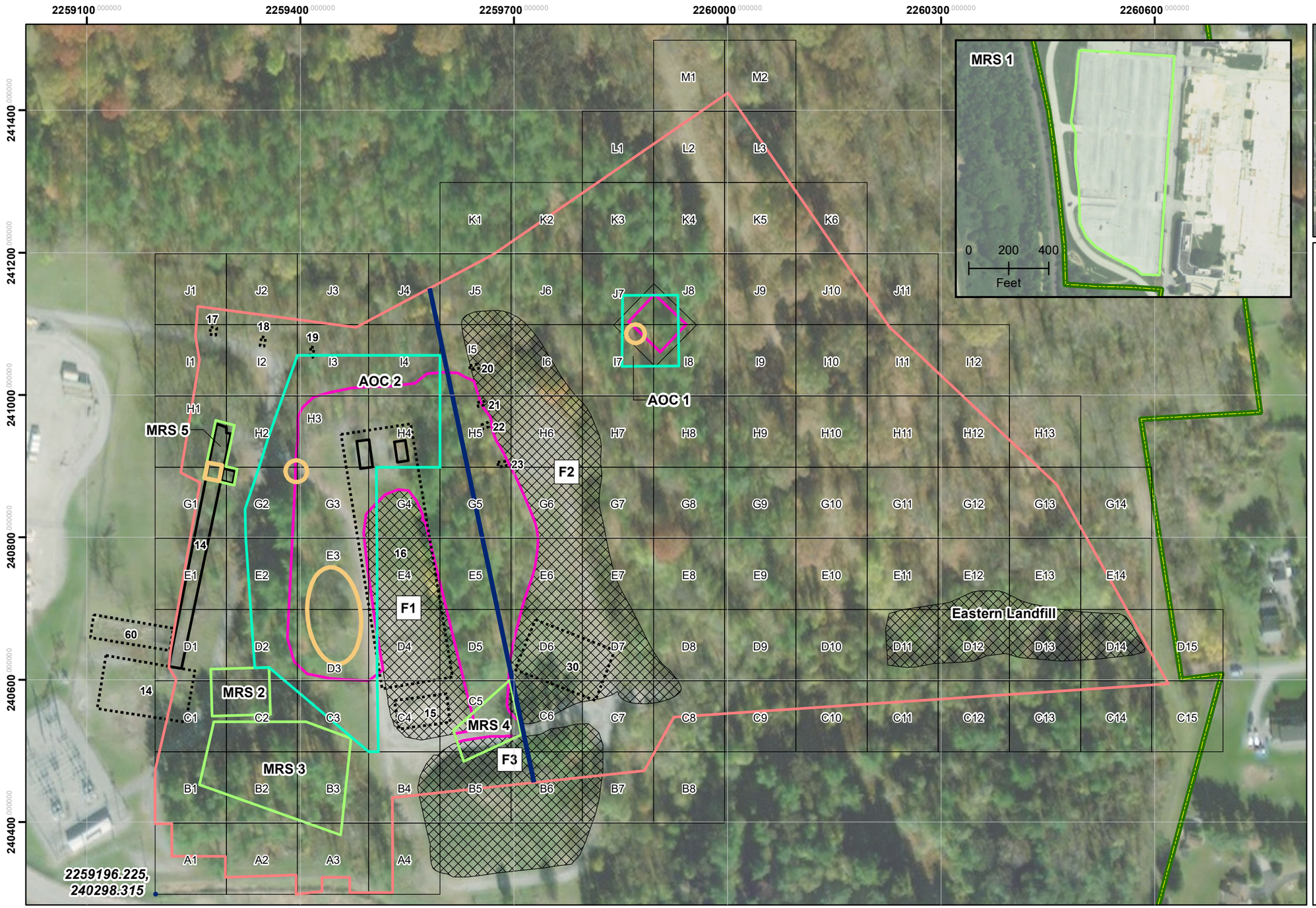

Legend

- Current AOC Boundary
- Current MRS Boundary
- Sand Found
- High Anomaly Density
- High Anomaly Density Fill
- Former Building Locations
- Current Building Locations
- Division of Remedial Investigation Area for Remedial Alternatives (RI)
- 100x100 foot Survey Grid
- Remedial Investigation Boundary
- Former York Naval Ordnance Plant Boundary

Notes:
No Investigation occurred within High Anomaly Density areas during MMRP Remedial Investigation

AOC = Area of Concern
MRS = Munitions Response Site
MMRP = Military Munitions Response Program

\\lovetongis\GIS data\Commercial\Northeast\PennsylvaniaHarleyDavidson\MXD\FYNOP_Alt_Analysis\Figure 5-1 Proposed Remedial Alternatives.mxd

Figure 5-1 Proposed Remedial Alternatives

Aerial: ESRI, 2015

Projection: NAD 1983 State Plane Pennsylvania South Feet

Date: June 2018

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Appendix B

Tables

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Table 2-1: Conceptual Site Model Conclusions for Munitions and Explosives of Concern

Location	Source	Interaction Pathway[1]	Mitigating Factors	Conclusion
MRS 1	No	Not Evaluated	Not Applicable/No Source	Incomplete[2]
MRS 2	No	Not Evaluated	Not Applicable/No Source	Incomplete[2]
MRS 3	No	Not Evaluated	Not Applicable/No Source	Incomplete[2]
MRS 4	No	Not Evaluated	Not Applicable/No Source	Incomplete[2]
MRS 5	Potential	Direct Contact	Access to Building 14 Under Security Control	Potentially-Complete[3]
AOC 1	Potential	Contact During Intrusive Activities	Area Under Security Control; Dig Permit Required	Potentially-Complete[3] (Condition 6)
AOC 2	Yes	Contact During Intrusive Activities	Area Under Security Control; Dig Permit Required	Potentially-Complete
Remainder RI Area	No	Not Evaluated	Not Applicable/No Source	Incomplete[3]

Notes:

1. The current and future receptors considered for MEC at fYNOP include authorized Harley-Davidson personnel, contractors, and visitors. Site use is not planned for change from industrial to residential. MC is only known to be present at concentrations posing a risk to human health or the environment within MRS 5; however, process materials were observed in several onsite areas and concentrations of MC may exceed screening levels.
2. The areas comprising the Remainder RI Area, MRS 2, MRS 3, and MRS 4 were combined and re-evaluated using VSP to calculate the probability of non-MEC-item anomalies. There is a 95 percent confidence that at least 99.37 percent of remaining anomalies are not MEC within these areas; therefore, the pathway was noted as incomplete under conditions where no intrusive activities are occurring. During intrusive operations, it is possible that MEC remains and that source-receptor interaction may occur.
3. The presence of anomalies indicates a potential for MEC to be present in these areas, but it has yet to be confirmed. For MRS 5 and AOC 1, the presence of subsurface anomalies in association with MD of the same caliber of onsite MEC indicates possible MEC.

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Table 2-2: Conceptual Site Model Conclusions for Munitions Constituents

Area	Source	Interaction Pathway	Mitigating Factors	Receptors[1]	Conclusion
MRS 1	No	Not Evaluated/ No Source	Not Applicable/ No Source	Not Evaluated/ No Source	Incomplete
MRS 2	No	Not Evaluated/ No Source	Not Applicable/ No Source	Not Evaluated/ No Source	Incomplete
MRS 3	No	Not Evaluated/ No Source	Not Applicable/ No Source	Not Evaluated/ No Source	Incomplete
MRS 4	No	Not Evaluated/ No Source	Not Applicable/ No Source	Not Evaluated/ No Source	Incomplete
MRS 5	Yes - Process Materials present	Ingestion Direct Dermal Contact Inhalation	Access to Building 14 Under Security Control	Human Receptors	Potentially-Complete
AOC 1	Yes - Process Materials present	Ingestion Direct Dermal Contact Inhalation	Area Under Security Control; Dig Permit Required	Human Receptors	Potentially-Complete
AOC 2	Yes - Process Materials present	Ingestion Direct Dermal Contact Inhalation	Area Under Security Control; Dig Permit Required	Human Receptors	Potentially-Complete
Remainder RI Area	No	Not Evaluated/ No Source	Not Applicable/ No Source	Not Evaluated/ No Source	Incomplete

Notes:

1. The current and future receptors considered for MC in soil (as process materials are present at fYNOP) include authorized Harley-Davidson personnel, contractors, recreational users, visitors, trespassers, and future residents.

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Table 3-1: Applicable and Relevant and Appropriate Requirements

Standard	Citation	Status	Requirement Synopsis	Action to Attain ARAR
Chemical Specific				
Process Material/ Soil and/or Groundwater	PA Land Recycling and Environmental Remediation Standards Act (Act 2), 25 PA Code, Chapter 250	Applicable	MSCs including Statewide Health Standard, Site-Specific Standard, and/or Background Standard, for organic and inorganic substances in groundwater and soil that are promulgated for site remediation.	MSCs for inorganic (MC) substances in soil and groundwater were compared to sampling results onsite to evaluate risk associated with metals and explosives.
Location Specific				
Threatened or Endangered Species	50 CFR 17, 58 PA Code, Chapter 75	Not Applicable	Potentially applicable if any endangered or threatened species or habitats are present where remediation activities may occur.	The fYNOP contains habitat that supports the State endangered short-eared owl, the State threatened upland sandpiper, and the Federal and State protected bald eagle (USACE 1995). The PNDI Coordination response indicates that no threatened or endangered species, exceptional value wetlands, habitats of concern, or species of concern are located on the Site within the MMRP RI area.
Action Specific				
Sediment and Erosion Control	PA Erosion Control Regulations, 25 PA Code, Chapter 102	Applicable if a corrective action is performed	Requires the implementation of measures to control erosion and stormwater runoff.	Substantive requirements are applicable to any soil disturbance activity that involves equal to or greater than 1 acre (0.4 hectare)
RCRA Hazardous Waste Generators	40 CFR 268.7	Applicable if a corrective action is performed	Establishes requirements for testing, recordkeeping and tracking by waste generators.	Requirements for removal and offsite disposal of hazardous waste
RCRA Land Disposal Restrictions	40 CFR 268.40	Applicable if a corrective action is performed	Disposal of hazardous waste.	Movement of excavated materials from their original location triggers the RCRA Land Disposal Restrictions.

Table 3-1: Applicable and Relevant and Appropriate Requirements

Standard	Citation	Status	Requirement Synopsis	Action to Attain ARAR
Resource Conservation and Recovery Act (RCRA) Military Munitions Rule	40 CFR Part 266, Subpart M	Applicable if a corrective action is performed	Identifies when conventional and chemical military munitions become solid wastes subject to RCRA waste management requirements.	Requirements will be applicable if MEC is transported and disposed of off-site because MEC meets the definition of solid waste (used or fired military munitions) transported offsite or from the MRS of use for the purposes of disposal or treatment prior to disposal per 40 CFR 262.202(c). 40 CFR Part 266 Subpart M is promulgated, related to a Federal environmental law, a standard of control or other requirement that specifically addresses a remedial action, and is substantive.
Department of Transportation (DOT) Hazardous Materials Transport	49 CFR 107 and 171-179	Applicable if a corrective action is performed	Establishes requirements for the transportation of hazardous materials including packaging, marking, labeling and transportation methods.	Requirements for transportation offsite for disposal of hazardous waste

Table 3-2: Former York Naval Ordnance Plant – Military Munitions Response Program Corrective Action Objectives

Priority/Time Frame:
1 = Short-term (current potential exposure requires action); 2 = Intermediate (implement prior to final remedy/cleanup); 3 = Part of Long-term final remedy/cleanup or action currently in place, but final remedy required; 4 = Existing control in place is the final remedy

Environmental Medium	Human Health Residential Onsite	Human Health Non-Residential Onsite	Human Health Residential Offsite	Human Health Non-Residential Offsite	Ecological Receptors	Cross-Medium Transfer	Resource Restoration
Soil	**A.** Prevent direct contact exposures to chemicals where concentrations of munitions constituents exceed PADEP direct contact Medium Specific Concentrations (MSCs) in soil.[21] I. Priority/Timing (Munitions Response Site [MRS]# 1): 4 Presumed Remedy: MRS 1 (inclusive of the West parking lot) is paved and a protective covenant is in place to exclude residential use and prevent exposure to soils. II. Priority/Timing (MRS# 2, 3, 4, Area of concern [AOC] 1, AOC 2, and remainder of RI area): 3 Presumed Remedy: Existing fencing and site security currently precludes residents from direct exposure or contact with these areas. A covenant should be put in place to exclude future residential use of the areas. Continue community awareness. **B.** Prevent Direct Contact exposure to Munitions and Explosives of Concern [MEC] (0-2 feet below ground surface) in the soil at the Site. I. Priority/Timing (MRS 5, AOC 1, AOC 2): 3. Presumed Remedy: Existing fencing and site security currently precludes residents from direct exposure or contact with this area. Excavation and removal of the impacted areas including those areas where backstop sand was identified during the investigation. Clearance to depth of detection of all anomalies. A covenant should be put in place to exclude future residential use of the area. Continue community awareness. **C.** Prevent exposure to MEC in subsurface soil (below 2 feet). I. Priority/Timing (MRS# 1): 3. Presumed Remedy: MRS 1 is paved and a protective covenant is in place at MRS 1 to exclude residential use of the MRS and the remaining fill area of the west parking lot and prevent exposure to soils. II. Priority/Timing (MRS# 2, 3, 4, and the remainder RI area excluding those areas covered with fill): 3. Presumed Remedy: Existing fencing and site security currently precludes residents from direct exposure or contact with these areas. A covenant should be put in place to exclude future residential use of the areas. Continue community awareness. III. Priority/Timing (the remainder RI area that was covered with fill, AOC 1, and AOC 2): 3. Presumed Remedy: Existing fencing and site security currently precludes residents from direct exposure or contact with this area. Removal of soil cover and clearance to depth of detection of all anomalies[22] and process materials should be completed for high-density areas to include AOC 1 and AOC 2 and the high-density areas that were unable to be investigated during the RI due to the depth of existing cover materials (e.g., soil or debris cover). A covenant should be put in place to exclude future residential use of property. Continue community awareness.	**A.** Prevent direct contact exposures to chemicals where concentrations of munitions constituents exceed PADEP direct contact MSCs in soil. I. Priority/Timing (MRS# 1): 4 Presumed Remedy: MRS 1 (inclusive of the West parking lot) is paved and a protective covenant is in place to prevent exposure to soils. Maintain existing remedies and amend the protective covenant to require awareness training and construction support during intrusive activities within the area.[23] II. Priority/Timing (MRS# 2, 3, 4, AOC 1 and 2, and the remainder RI area): 3 Presumed Remedy: Controls are in place to include existing fencing, site security, dig permits, awareness training for working or performing excavations in the area, and limited access. Maintain all existing controls and amend the controls to require UXO construction support during intrusive activities and continued awareness training within the areas. **B.** Prevent Direct Contact exposure to MEC (0-2 feet below ground surface) in the soil at the Site. I. Priority/Timing (AOC 1 and AOC 2): 3. Presumed Remedy: A surface clearance was performed, and controls are in place to include existing fencing, site security, dig permits, awareness training for working or performing excavations in the area, and limited access. Maintain existing controls and amend the controls to require UXO construction support and continued awareness training during intrusive activities. Excavation and removal of the impacted area including those areas where backstop sand was identified during the investigation. Clearance to depth of detection of all anomalies either over the entire area or in specific high density areas and maintain existing controls. **C.** Prevent exposure to MEC in subsurface soil (below 2 feet). I. Priority/Timing (MRS# 1): 3. Presumed Remedy: Presumed Remedy: MRS 1 is paved and there is a protective covenant is in place at MRS 1 and RI Remainder Area to exclude residential use of those areas. Maintain existing remedies and amend the protective covenant to require awareness training and UXO construction support during intrusive activities within the MRS 1 (inclusive of remaining fill area of the west parking lot. II. Priority/Timing (MRS# 2, 3, 4, and the eastern remainder RI area excluding those areas covered with fill): 3. Presumed Remedy: Controls are in place to include existing fencing, site security, dig permits, awareness training for working or performing excavations in the area, and limited access. Maintain all existing controls and amend the controls to require UXO construction support during intrusive activities within the areas. III. Priority/Timing (the remainder RI area that was covered with fill, AOC 1, and AOC 2): 3. Presumed Remedy: Controls are in place to include existing fencing, site security, dig permits, awareness training for working or performing excavations in the area, and limited access. Maintain all existing controls and amend the controls to require UXO construction support during intrusive activities and awareness training within the areas in advance of final remedy. Removal of soil cover and clearance to depth of anomalies and process materials should be completed for high-density areas unable to be investigated during the RI due to existing cover (e.g., soil/debris). Removal of soil cover and clearance to depth of anomalies and process materials MRS 5, AOC 1 and AOC 2.	NA (No known occurrence where fYNOP activities contributed to off-Site soils exceeding PADEP direct contact residential MSCs.)	NA (No known occurrence where fYNOP activities contributed to off-Site soils exceeding PADEP direct contact non-residential MSCs.)	NA	**A.** Prevent metals (MC) from leaching and impacting groundwater (GW) above respective GW MSCs. I. Priority/Timing (MRS# 1, 2, 3, 4, and Remainder RI Areas): 3 Presumed Remedy: GW not currently used on the Site, current owner restricts GW use except for sampling and remediation. Current property use is non- residential. Restrict future land use to non-residential and restrict groundwater use with an environmental covenant. II. Priority/Timing (AOC 1 and AOC 2): 3 Presumed Remedy: GW not currently used on Site, current owner restricts GW use except for sampling and remediation. Current property use is non-residential. Removal of the MD-impacted areas including those areas where backstop sand was identified during the investigation. Investigation and removal of anomalies to depth of detection. Continued awareness training.	NA (No sensitive soil resource identified.)

[21] Contaminants of concern (COC) refer to munitions constituents associated with past MMRP operations and include metals alone (antimony, copper, lead, nickel, or zinc).

Table 3-2: Former York Naval Ordnance Plant – Military Munitions Response Program Corrective Action Objectives

Priority/Time Frame:
1 = Short-term (current potential exposure requires action); 2 = Intermediate (implement prior to final remedy/cleanup); 3 = Part of Long-term final remedy/cleanup or action currently in place, but final remedy required; 4 = Existing control in place is the final remedy

Environmental Medium	Human Health Residential Onsite	Human Health Non-Residential Onsite	Human Health Residential Offsite	Human Health Non-Residential Offsite	Ecological Receptors	Cross-Medium Transfer	Resource Restoration
Waste Process Materials	**A.** Prevent direct-contact exposures to waste process materials including MC (COCs) and MD in Building 14 and inappropriate relocation of waste process materials.[24] I. Priority/Timing (MRS# 5): 3 Presumed Remedy: Existing fencing, secured building openings, and site security currently prevent residents from direct exposure or contact with the waste process materials in this building. Remedy includes removal of process materials and MD within Building 14 (MRS 5). **B.** Prevent exposure to MPPEH in Building 14. I. Priority/Timing (MRS# 5): 3. Presumed Remedy: Existing fencing, secured building openings, and site security currently prevent residents from direct exposure or contact with MPPEH in this building. Remedy includes removal of MPPEH from within Building 14 (MRS 5).	**A.** Prevent direct contact exposures to waste, and inappropriate relocation of waste process materials. I. Priority/Timing (MRS# 5): 3 Presumed Remedy: Removal of waste process materials and MD within Building 14 (MRS 5). **B.** Prevent exposure to MEC and process materials in soil. II. Priority/Timing (MRS# 5): 3. Presumed Remedy: Removal of MPPEH within Building 14 (MRS 5).	NA (No Off-Site waste)	NA (No Off-Site waste)	NA	**A.** Prevent potential for leaching of COCs (MC) during removal of process materials. I. Priority/Timing (MRS# 5): 3 Presumed Remedy: Removal of waste process materials (including MC in sands and dust material, MD or MPPEH) within Building 14 (MRS 5)	NA
Groundwater	No groundwater issues are associated with the MMRP under current use and current conditions. Groundwater within this portion of the fYNOP was evaluated for HTW corrective actions under the Site-Wide CAO table from June 2017 (Groundwater Sciences Corporation [GSC] 2017)						
Surface Water	No surface water issues are associated with the MMRP. Surface water within this portion of the fYNOP was evaluated or HTW corrective actions under the Site-Wide CAO table for HTW dated June 2017 (GSC 2017)						
Air	No air issues are associated with the MMRP. Air within this portion of the fYNOP was evaluated or HTW corrective actions under the Site-Wide CAO table from June 2017 (GSC 2017).						
Other	None	None	None	None	None	None	None

[22] Anomalies include munitions-related finds (e.g., Material Potentially Posing an Explosive Hazard [MPPEH], Munitions and Explosives of Concern [MEC], Munitions Debris [MD], and Non-Munitions Related Debris/Finds [NMRD]).
[23] Awareness Training (including the three R's - recognize, retreat, and report) is recommended due to potential for exposure to MEC in the surface soil (0-2 feet below ground surface) at the site. Construction support involves oversite by unexploded ordnance (UXO) technicians.
[24] Waste process materials can include MC (COCs) in dust and backstop sand associated with test firing of ammunition, as well as MD and MPPEH that are located in Building 14 (MRS 5). MC concentrations in Building 14 were identified as exceeding TCLP values.

Table 3-3: Potential Munitions Constituents Preliminary Remedial Goals for the Former York Naval Ordnance Plant[1]

Analyte	Unit	PADEP Residential MSCs for Soil	PADEP Industrial MSCs for Soil	USEPA MCL	USEPA Tap Water	PADEP Non-Residential Groundwater
Antimony	mg/kg	88	1,300	6	7.8	6
Copper	mg/kg	8,100	120,000	1,300	800	NSL
Lead	mg/kg	500	1,000	15	15	5
Nickel	mg/kg	4,400	64,000	NSL	390	100
Zinc	mg/kg	66,000	190,000	NSL	6,000	NSL

Notes:
[1]Although there are no current risks to receptors given current site conditions, these goals would be required to be met if changes occur to site use, existing site protective measures, or intrusive activities are required.
EPA – United States Environmental Protection Agency
mg/kg – milligram per kilogram or parts per thousand equivalent.
MCL – Maximum contaminant level.
MSC – Median specific concentration.
NSL – No screening level is published.
PADEP – Pennsylvania Department of Environmental Protection

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Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
LUCs	**Administrative Controls**	**Dig Restrictions**	Implement policies to restrict intrusive work by contractors until they have reviewed and signed receipt of information on anomaly avoidance and encounter protocols or they employ construction support if contractors are going intrusive in areas where construction support is required.	**Moderate to High** If enacted and combined with educational control, these controls would be effective in providing notification of potential hazards and safety protocols to contractors performing intrusive activities.	**High** Administratively and technically feasible and could easily fit within existing procedures.	**Low** As dig restrictions are already in place, minor administrative costs would be required to modify current policy to include construction support if contractors are going intrusive in areas where construction support is required.	**Retained** The additional dig restrictions via contractor control policies provide an effective and implementable method of disseminating information and controlling potential exposures.	MRS 1, 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
	Educational Controls	**Information on anomaly avoidance and encounter protocols**	**Education** Provide written or digital information describing the potential explosive hazards and anomaly avoidance and encounter protocols.	**Moderate** If implemented along with dig restrictions (see above), would be effective in providing awareness and safety protocols to receptors performing intrusive work. Increased knowledge would provide additional reduction in direct contact with potential MEC.	**High** Would require only minor administrative actions (printing and distribution).	**Low** Would require minor administrative and printing costs.	**Retained** Informational pamphlets, if combined with dig restrictions, would provide a low cost and effective means of preventing direct contact with potential MEC by construction and maintenance workers.	MRS 1, 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
MEC Clearance	**Subsurface MEC Detection**	**Analog Magnetometers**	Electronic instrument that locates buried military munitions by detecting irregularities in the earth's magnetic field caused by materials in munitions. This is a passive system that emits no electromagnetic (EM) radiation and detects only ferrous metals. This technology is typically used in anomaly avoidance, mag and dig operations, and excavations. This technology may be used in dry and wet environments (i.e., vegetated areas, wetlands, shorelines, lakes, etc.). The technology is well developed, compatible with site characteristics, and can be used to identify surface and buried MEC.	**Low to Moderate** Has a 90% probability of detection of 20, 37, and 40 mm items to a depth of 14 inches.	**High** Light and compact. Can be used in any traversable terrain. Widely available from a variety of sources. High industry familiarization. Minimal to no impacts to cultural or natural resources.	**Low** Magnetometers have a low cost for purchase/rental and operation compared to other detection systems.	**Retained** Is effective, implementable and cost effective for identifying anomalies.	MRS 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area (excluding the Eastern Landfill)

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
		Analog Electromagnetic Induction (EMI) All Metals Detectors	Electromagnetic induction sensors detect both ferrous and non-ferrous metallic objects. Usually used in anomaly avoidance, mag and dig operations, and excavations. This technology may be used in dry and wet environments (i.e., vegetated areas, wetlands, shorelines, lakes, etc.). This technology is well developed, compatible with site characteristics, technically feasible, and can be used to identify surface and buried MEC.	**Low to moderate** Effective at detecting surface and shallow bury items (less than 18 inches). Less effective at detecting smaller items at deeper depths.	**High** Light and compact. Can be used in any traversable terrain. Widely available from a variety of sources. Minimal to no impacts to cultural or natural resources.	**Low** Analog EMI detectors have a low cost for purchase/rental and operation compared to other detection systems.	**Not Retained** Low confidence at detecting items deeper than 18 inches.	

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
		DGM using EMI	EMI sensors linked with Global Positioning System (GPS) provides for mapping of ferrous and non-ferrous metal anomalies. Can be implemented on man portable or towed array platforms.	**Moderate** DGM is an industry standard for MEC detection. Detects ferrous and non-ferrous metallic objects. Provides for anomaly discrimination based on signal type and intensity. Detection of 60 mm diameter items may not be reliable below a depth of about 26 inches.	**Low to Moderate** Can be used in most traversable terrain. Widely available but requires specialized knowledge and training to collect and interpret data. Requires clearing of forested areas for equipment access.	**Moderate** Has a moderate purchase cost compared to other technologies. Lower costs can be realized when using arrays of multiple detector sensors.	**Retained** Is effective, implementable and cost effective for identifying anomalies.	MRS 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area (excluding the Eastern Landfill)

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
		Sub Audio Magnetics (SAM)	SAM is a patented methodology by that a total field magnetic sensor is used to simultaneously acquire both magnetic and EM response of subsurface conductive items.	**Moderate to High** Detects both ferrous and non-ferrous metallic objects. Capable tool for detection of deep MEC.	**Low** High data processing requirements. High power requirements. Has longer than average setup times. Low industry familiarization and limited availability. Requires clearing of forested areas. Minor impacts to cultural or natural resources based on clearing of areas for high quality data collection.	**High** Has a high operating cost and low availability.	**Not Retained:** High costs, low industry familiarization and limited availability do not offset the added effectiveness of detecting deep MEC.	

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
		Airborne Laser and Infrared (IR) Sensors	Airborne laser and IR technologies can be used to identify objects by measuring their thermal energy signatures. UXO or DMM on or near the soil surface may possess different heat capacities or heat transfer properties than the surrounding soil, and this temperature difference theoretically can be detected and used to identify MEC.	**Low** Detects both ferrous and non-ferrous objects. Low industry familiarization . Effectiveness increases when used for wide area assessment in conjunction with other airborne technologies.	**Low** Requires aircraft and an experienced pilot. Substantial data processing and management requirements. Available from few sources. Minimal to no impacts to cultural or natural resources	**High** Aircraft and maintenance costs must be included. Processing costs are higher than other methods.	**Not Retained** Not cost effective and difficult to implement.	
	MPPEH Removal (Prior to Classification)	**Manual Excavation**	**Manual Excavation** Excavation of individual anomalies with hand tools (shovels).	**Moderate to High** Effective at exposing shallow, low-density small item anomalies in loose soils.	**Moderate** Readily implementable in clear open areas. Would be more difficult forested land due to tree roots. More labor intensive for items deeper than 24 inches. Does not require heavy equipment and is less disruptive to natural resources.	**Moderate** Manpower intensive but does not require use of heavy equipment.	**Retained** Is effective, implementable and cost effective for removal of the relatively shallow MEC. May need to be combined with mechanical excavation for deeper items.	MRS 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area (excluding the Eastern Landfill)

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
		Mechanical Excavation	**Mechanical Excavation** Excavation of individual or groups of anomalies with assisted with mechanized equipment.	**Moderate to High** Effective at exposing and removing potential MEC anticipated. Less precise than hand methods.	**Moderate** Equipment is readily available and requires less manpower than manual excavation. For very low- density shallow items (<24 inches) mobilization and set up of equipment may require more effort than manual excavation.	**Moderate** Has lower labor requirements and equipment is relatively lower cost.	**Retained** Effective, implementable, and cost effective for deeper buried items. May need to be combined with manual excavation if shallow items are also present.	MRS 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area (excluding the landfill)

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
		Mechanical Excavation and Sifting	Mechanical excavation of a specified area to a specified depth. Removes all items larger than the specified screen size.	**Moderate to High** Soils are sandy with minimal gravel fraction and so are readily separable by sifting. The most effective method of removing all anomalies and it does not rely on prior detection for anomaly removal. However, it would be an inefficient process and large effort for the low density of MD present.	**Low** Equipment is readily available. The process option is very destructive and would require clearing all vegetation and existing infrastructure. Extensive restoration would be needed following the action.	**Very High** Large area of excavation and extensive post action restoration.	**Retained** Effective but inefficient in low anomaly density areas; increased efficiency in high anomaly density areas. Very destructive of existing natural resources and infrastructure.	

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
	MEC Disposal/ Treatment	**BIP**	Destruction of MEC by detonation with an explosive charge.	**High** Each item is individually destroyed and verified by qualified personnel. BIP can release MC and MD, that can be restricted by engineering controls.	**Low to Moderate** Technology is well developed, technically feasible, and compatible with site characteristics.	**Moderate to High** Significant costs may result in engineering controls.	**Retained** Retained for items that cannot be safely moved.	MRS 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area (excluding the Eastern Landfill)
		Consolidated Shots	Movement of MEC may be considered acceptable. MEC is destroyed by demolition at a location beyond the vicinity of detection.	**Moderate to High** Limited to use for MEC deemed safe to move by UXO-qualified personnel.	**Low to Moderate** Same techniques as BIP but may require larger area and greater controls. However, items may be moved to area where no buildings, persons, etc. are located within blast exclusion zone, so may increase short-term protectiveness and therefore implementability.	**Moderate** Labor intensive, requires materials for larger scale operation.	**Retained** Retained because the shot can be completed in locations far from populated or sensitive structures.	MRS 2, 3, 4, and 5, AOC 1 and 2 and Remainder RI Area

Table 4-1: Screening of Technologies

GRA	Technology	Process Option	Description	Effectiveness	Implementability	Cost	Screening Result	Applicability
Process Material/ Backstop Removal	**Excavation**	**Mechanical Removal**	A backhoe or excavator is used to excavate or scoop materials up and transfer to trucks or stockpiles awaiting offsite disposal.	**Moderate to High** Fast and commonly used for material removal at a variety of sites. May be less effective at accessing small quantities of materials and materials inside of buildings or structures.	**Moderate to High** Equipment is readily available. However, the process option is very destructive and would require clearing all vegetation and existing infrastructure. Extensive restoration would be needed following the action.	**Moderate to High** Difficult excavation of materials in the building. Likely to involve partial building demolition to get to process materials.	**Retained** Effective but inefficient method in low anomaly density areas. Very destructive of existing natural resources and infrastructure.	MRS 5, AOC 1 and 2
Notes: Yellow highlights indicate MEC clearance process options retained for alternative assembly. Effectiveness: High = highly (very) effective; Moderate = moderately effective; Low = poorly effective Implementability: High = highly implementable (easy or readily feasible); Moderate = moderately implementable; Low = poorly implementable (difficult or infeasible) Costs: High = grossly disproportionate cost, Moderate = acceptable costs, Low= minimal costs								

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TABLE 5-1 ALTERNATIVE 1 COSTING: NO ACTION
THE FORMER YORK NAVAL ORDNANCE PLANT - YORK, PENNSYLVANIA

A. CAPITAL COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Total Cost
1	**No Action**				
	Not applicable	Not applicable	$0	0	$0
	Capital Cost Total				**$0**
B. O&M COSTS					
1	**Five-Year Reviews**				
1.1	Five-Year Reviews	Not applicable as no action will occur.	$0	0	$0
	O&M Costs Total				**$0**

B. 30-YEAR PRESENT WORTH FOR O&M ACTIVITIES[1]

30-Year O&M Present Worth = (O&M) x (P/A), 0.7% for 30 years $0

C. COST SUMMARY

Cost Element	Cost ($)
Capital Costs	
Annual O&M (30 Years)	$0
30-Year Present Worth Costs	**$0**

Notes:

[1] - Costs calculated using a real discount rate of 0.7% - 2017 rate from the OMB circular A-94.

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TABLE 5-2 ALTERNATIVE 2 COSTING: LAND USE CONTROLS
THE FORMER YORK NAVAL ORDNANCE PLANT - YORK, PENNSYLVANIA

A. CAPITAL COSTS

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Total Cost
1	**LUCs - MRSs 1, 2, 3, 4, and 5; AOCs 1 and 2; Remainder RI Area**				
1.1	Land Use Control Planning Document	LS	$40,000	1	$40,000
1.2	Land Use Control Planning Meeting	LS	$15,000	1	$15,000
1.3	MPPEH Training and Follow Up	LS	$1,000	1	$1,000
1.4	Training Letter/Brochure Printing and Distribution	EA	$0.45	1000	$450
	Subtotal				$56,450.00
2	**Contingency**	--	--	0.25	$14,113
	Capital Costs Total				**$70,563**
B. O&M COSTS					
1	**Five-Year Reviews**				
1.1	Five-Year Reviews[1]	Meet once every 5 years for 30 years, includes travel and report.	$15,000	6	$90,000
2	**Fence Maintenance and Signage - MRSs 2-5 & AOCs 1 and 2**				
2.1	Annual Signage Inspections and Repairs	Annual Signage and Fence Repair	$15,000	30	$450,000
2.2	Annual Fence Inspections	Annual Inspection	$1,500	30	$45,000
2.3	Fence Maintenance and Replacement - 1 Replacement per 30 Years	Linear Foot of Fence	$26	5000	$130,000
3	**Cap Maintenance - MRS 1**				
3.1	Annual Inspections	Annual Inspection	$1,000	30	$30,000
3.2	Annual Repairs Costs				
3	**Annual Reporting**				$0
2.5	Annual Report Preparation	Annual Report Preparation	$2,000	30	$60,000
4	**Contingency on O&M Total**				$0
2.7	Contingency	--	--	25%	$0
	O&M Costs Total				**$805,000**

C. TOTAL 30-YEAR PRESENT WORTH[2]

30-Year O&M Present Worth = (O&M) x (P/A), 0.7% for 30 years	**$718,876**

D. COST SUMMARY

Cost Element	Cost ($)
Capital Costs	$70,563
Annual O&M (30 Years)	$718,876
30-Year Present Worth Costs	**$789,439**

Notes:

[1] - Although this site action is not being performed under CERCLA and five year reviews are not required, they are typically performed on MMRP sites and sites where risk remains.

[2] - Costs calculated using a real discount rate of 0.7% - 2017 rate from the OMB circular A-94.

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TABLE 5-3 ALTERNATIVE 3 COSTING : FOCUSED SURFACE AND SUBSURFACE MPPEH CLEARANCE, REMOVAL OF PROCESS MATERIALS, AND LAND USE CONTROLS THE FORMER YORK NAVAL ORDNANCE PLANT - YORK, PENNSYLVANIA

A. CAPITAL COSTS[1]

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity	Total Cost
1	**LUCs (All Sites)**				
1.1	Land Use Control Planning Document	LS	$40,000	1	$40,000
1.2	Land Use Control Planning Meeting	LS	$15,000	1	$15,000
1.3	MPPEH Training and Follow Up	LS	$1,000	1	$1,000
	Subtotal				$56,000.00
2	**Focused MPPEH Clearance (MRS 5 and AOCs 1 and 2) and Beneath Existing Soil Piles F1 and F2**				
2.1	Documents (APP, RAP/RAWP, ESS etc.)	LS	$100,000	1	$100,000
2.2	Equipment Mobilization/Demobilization and Decontamination	LS	$10,000	1	$10,000
2.3	Land Surveying with UXO Avoidance (UXOTII)	LS	$15,000	1	$15,000
2.4	Brush Clearing with UXO Avoidance; Erosion Controls; Mowing Equipment	acre	$20,000	4.7	$94,000
2.5	Movement and Stockpiling of Top Layers of fill in area F1	cubic yard	$19	33880	$643,720
2.6	Mag and Dig of all anomalies in AOC 1, AOC 2, F1 and F2 - UXO Team includes SUXOS, UXOSO/QCS, 2-UXOTIII, 4-UXOTII, 4-UXOTI - 12-Man Team; Mobilization, Demobilization, Daily and Weekend Per Diem) average 0.1 acres per day	days	$11,224	39	$439,607
2.7	UXO Team for overnight watch (2-man team)	days	$3,219	3	$9,657
2.8	Magnetometer Rental (per 8 units)	week	$1,000	8	$7,833
2.9	Disposal - Munitions Debris & Disposal Certification (shipping, documentation, and insurance - minimum one ton per shipment)	tons	$4,000	2	$8,000
2.10	DGM of F1 and F2	acre	$10,000	2	$20,000
2.11	Mapping and Geographic Information Services	days	$520	39	$20,367
2.12	Vehicle charge, car or van (2 Vehicles; 1 Month)	month	$2,000.00	4	$8,000
2.13	Demolition of Building 14 and Building 16 Remnants (No Hazmat Survey or Hazardous materials Disposal)	LS	$367,770	1	$367,770
2.14	Removal Action - Project Reporting	LS	$50,000	1	$50,000
2.15	Management, Permitting and Site Services - Including Onboarding and Training	15% of cost		15%	$269,093.07
	Subtotal				$2,063,046.85
3	**Process Material and Backstop Excavation (MRS 5 and AOCs) [2]**				
3.1	Equipment Mobilization/Demobilization and Decontamination	LS	$21,000	1	$21,000
3.2	UXO Team (SUXOS, UXOSO/QCS, 1-UXOTIII, 2-UXOTII, 2-UXOTI - 7-Man Team; Screening MRS 5 soil pile)	days	$7,143	10	$71,425
3.3	UXO Technician III (Equipment Operator to move Process Materials)	days	$1,020.36	10	$10,204
3.4	Mechanical Excavation/Removal[3] (60 cy for MRS5, 1,111 cy for AOC2, and 370 cy for AOC1) exclusive of volume from Task 2 above [Digging, Sifting, and Stockpiling]	cubic yard	$80	1541	$123,280
3.5	Dust Suppresion (water truck or tank)	days	$650	10	$6,500
3.6	Certified Industrial Hygienist (Dust Process Removal)	day	$1,000	10	$10,000
3.7	Hazardous Waste Transport/Disposal (Assume All Mass/Volume is Characteristically Hazardous	tons	$150	1101	$165,107
3.8	Screening of Munitions Debris	days	$1,200	2	$2,400
3.9	Site Restoration (Includes AOC 1, AOC 2, Soil Pile F1, and Soil Pile F2)	acre	$20,000	4.7	$94,000
3.10	Mapping and Geographic Information Services	days	$520	10	$5,200
3.11	Decontamination	days	$500	10	$5,000
3.12	Remedial Action Closure Report	lump sum	$50,000	1	$50,000
3.13	Management, Permitting and Site Services	15% of cost		15%	$110,170
	Subtotal				$844,636.17
	Contingency	--	--	25%	$740,921
	Capital Costs Total				**$3,704,604**

B. O&M COSTS

1	**Five-Year Reviews**				
1.1	Five-Year Reviews[4]	Meet and Update Every Five Years	$15,000	6	$90,000
	O&M Costs Total				**$90,000**

C. TOTAL 30-YEAR PRESENT WORTH[5]

30-Year O&M Present Worth = (O&M) x (P/A), 0.7% for 30 years	**$72,975**

D. COST SUMMARY

Cost Element	Cost ($)
Capital Costs	$3,704,604
Annual O&M (30 Years)	$72,975
30-Year Present Worth Costs	**$3,777,579**

Notes:

1. This preliminary estimate is based on currently available sampling and analysis data and generalized concepts. This is not a final construction cost.
2. Costs do not include Building Demolition/removal or Hazardous Material survey
3. This includes process materials in MRS 5, AOC 1, and AOC 2.
4. Although this site action is not being performed under CERCLA and five year reviews are not required, they are typically performed on MMRP sites and sites where risk remains.
5. Costs calculated using a real discount rate of 0.7% - 2017 rate from the OMB circular A-94.
6. Costs do not include the additional cost of UXO construction support in areas where LUCs remain.
7. Area F1 is approximately 1.5 acres in size of fill approximately 15 ft deep. Assumes approximately 14 feet of non impacted material (no sifting) and remaining foot will be sifted. 33880 cy to be excavated and stockpiled and 1 ft approximately 2420 cy to be excavated, sifted, and stockpiled.
8. Area F2 is approximately 0.5 acres of fill approximately 1 ft deep on average. Assumes all 806 cy will be sifted.
9. Assumed the Acreages/depths for soil stockpiling, management, and screening differ for each area, including:
   AOC2 (2.2 acres x 36" moved in 12" lifts); AOC1 (0.5 acres x 24" moved in 12" lifts)
10. Assumed the following volumes for Mechanical Excavation/Removal[3] (60 cy for MRS5, 1,111 cy for AOC2, and 370 cy for AOC1) exclusive of volume from Task 2.

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TABLE 5-4 ALTERNATIVE 4 COSTING: COMPLETE MPPEH CLEARANCE FOR THE WESTERN STUDY AREA AND AREA OF CONCERN 1 AND LAND USE CONTROLS
THE FORMER YORK NAVAL ORDNANCE PLANT - YORK, PENNSYLVANIA

A. CAPITAL COSTS[1]

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Total Cost
1	**LUCs (All Sites)**				
1.1	Land Use Control Planning Document	LS	$40,000	1	$40,000
1.2	Land Use Control Planning Meeting	LS	$15,000	1	$15,000
1.3	MPPEH Training and Follow Up	LS	$1,000	1	$1,000
	Subtotal				$56,000.00
2	**MPPEH Clearance (UU/UE for Western Area, AOC-1; Screening of F1/F2 piles)**				
2.1	Documents (APP, RAP/RAWP, ESS etc.)	LS	$100,000	1	$100,000
2.2	Equipment Mobilization/Demobilization and Setup	LS	$10,000	1	$10,000
2.3	Surveying with UXO Avoidance	LS	$15,000	3	$45,000
2.4	Brush Clearing with UXO Avoidance; Erosion Controls; Mowing Equipment	acre	$20,000	9.12	$182,400
2.5	Soil Screening of Western Area Soils and AOC 1 - UXO Team includes SUXOS, UXOSO/QCS, 2-UXOTIII, 4-UXOTII, 4-UXOTI - 12-Man Team; Mobilization, Demobilization, Daily and Weekend Per Diem) average .2 acres per day	days	$11,224	76	$853,024
2.6	UXO Team for overnight watch (2-man team)	days	$3,219	3	$9,657
2.7	Schoenstedt rental (12-Man Team- 6 units)	week	$480	15	$7,296
2.8	Disposal - Munitions Debris & Disposal Certification (Shipping, documentation, and insurance - minimum one ton per shipment)	tons	$4,000	4	$19,174
2.9	Movement and Stockpiling of Top Layers of fill in area F1 (30,000 cy)	cubic yard	$19	33880	$643,720
2.10	DGM of remaining portion of the Western Area	acre	$10,000	9.12	$91,200
2.11	Site Restoration (Western Area)	acre	$20,000	9.12	$182,400
2.12	Mapping and Geographic Information Services	days	$520	76	$39,520
2.13	Vehicle charge, car or van (2 Vehicles; 1 Month)	month	$2,000.00	3.8	$7,600
2.14	Demolition of Building 14 and Building 16 Remnants (No Hazmat Survey or Hazardous materials Disposal)	LS	$367,770	1	$367,770
2.15	Removal Action - Project Reporting	LS	$50,000	1	$50,000
2.16	Management, Permitting and Site Services - Including Onboarding and Training	15% of cost		15%	$391,314.17
	Subtotal				$3,000,075.29
3	**Process Material and Backstop Excavation (MRS 5 and AOCs)** [2]				
3.1	Equipment Mobilization/Demobilization and Decontamination	LS	$21,000	1	$21,000
3.2	UXO Team (SUXOS, UXOSO/QCS, 1-UXOTIII, 2-UXOTII, 2-UXOTI - 7-	days	$7,143	10	$71,425
3.3	UXO Technician III (Equipment Operator to move Process Materials)	days	$1,020.36	10	$10,204
3.4	Mechanical Excavation/Removal[3] (60 cy for MRS5, 1,111 cy for AOC2, and 370 cy for AOC1) exclusive of volume from Task 2 above [Digging, Sifting, and Stockpiling]	cubic yard	$80	1541	$123,280
3.5	Dust Suppresion (water truck or tank)	days	$650	10	$6,500
3.6	Certified Industrial Hygienist (Dust Process Removal)	day	$1,000	10	$10,000
3.7	Hazardous Waste Transport/Disposal	tons	$150	1101	$165,107
3.8	Screening of Munitions Debris	days	$1,200	2	$2,400
3.9	Mapping and Geographic Information Services	days	$520	10	$5,200
3.10	Decontamination	days	$500	10	$5,000
3.11	Remedial Action Closure Report	lump sum	$50,000	1	$50,000
3.12	Management, Permitting and Site Services	15% of cost		15%	$96,070
	Subtotal				$736,536.17
	Contingency	--	--	25%	$948,153
	Capital Costs Total				**$4,740,764**

B. O&M COSTS

1	**Five-Year Reviews**				
1.1	Five-Year Reviews[4]	Meet and Update Every Five Years	$15,000	6	$90,000
	O&M Costs Total				**$90,000**

C. TOTAL 30-YEAR PRESENT WORTH[5]

30-Year O&M Present Worth = (O&M) x (P/A), 0.7% for 30 years	**$72,975**

D. COST SUMMARY

Cost Element	Cost ($)
Capital Costs	$4,740,764
Annual O&M (30 Years)	$72,975
30-Year Present Worth Costs	**$4,813,740**

Notes:

1. This preliminary estimate is based on currently available sampling and analysis data and generalized concepts. This is not a final construction cost.
2. Costs do not include Building Demolition/removal or Hazardous Material survey
3. This includes process materials in MRS 5, AOC 1, and AOC 2.
4. Although this site action is not being performed under CERCLA and five year reviews are not required, they are typically performed on MMRP sites and sites where risk remains.
5. Costs calculated using a real discount rate of 0.7% - 2017 rate from the OMB circular A-94.
6. Costs do not include the additional cost of UXO construction support in areas where LUCs remain.
7. Area F1 is approximately 1.5 acres in size of fill approximately 15 ft deep. Assumes approximately 14 feet of non impacted material (no sifting) and remaining foot will be sifted. 33880 cy to be excavated and stockpiled and 1 ft approximately 2420 cy to be excavated, sifted, and stockpiled.
8. Area F2 is approximately 0.5 acres of fill approximately 1 ft deep on average. Assumes all 806 cy will be sifted.
9. Assumed the Acreages/depths for soil stockpiling, management, and screening differ for each area, including:
   AOC2 (2.2 acres x 36" moved in 12" lifts); AOC1 (0.5 acres x 24" moved in 12" lifts)
10. Assumed the following volumes for Mechanical Excavation/Removal[3] (60 cy for MRS5, 1,111 cy for AOC2, and 370 cy for AOC1) exclusive of volume from Task 2.

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TABLE 5-5 ALTERNATIVE 5 COSTING: COMPLETE MPPEH CLEARANCE FOR THE REMEDIAL INVESTIGATION STUDY AREA AND LAND USE CONTROLS
THE FORMER YORK NAVAL ORDNANCE PLANT - YORK, PENNSYLVANIA

A. CAPITAL COSTS[1]

Item No.	Cost Categories and Items	Description	Unit Cost	Quantity (#)	Total Cost
1	**LUCs (All Sites)**				
1.1	Land Use Control Planning Document	LS	$40,000	1	$40,000
1.2	Land Use Control Planning Meeting	LS	$15,000	1	$15,000
1.3	MPPEH Training and Follow Up	LS	$1,000	1	$1,000
	Subtotal				$56,000.00
2	**MPPEH Clearance (Complete RI Study Area Excluding Eastern Landfill)**				
2.1	Documents (APP, RAP/RAWP, ESS etc.)	LS	$100,000	1	$100,000
2.2	Equipment Mobilization/Demobilization and Decontamination	LS	$10,000	1	$10,000
2.3	Surveying with UXO Avoidance	LS	$15,000	5	$75,000
2.4	Brush Clearing with UXO Avoidance; Erosion Controls	acre	$20,000	26.86	$537,200
2.5	Soil Screening of Western Area Soils and AOC 1 - UXO Team includes SUXOS, UXOSO/QCS, 2-UXOTIII, 4-UXOTII, 4-UXOTI - 12-Man Team; Mobilization, Demobilization, Daily and Weekend Per Diem) average .2 acres per day	days	$11,224	134.3	$1,507,383
2.6	UXO Team for overnight watch (2-man team)	days	$3,219	3	$9,657
2.7	Schoenstedt rental (12-Man Team- 6 units)	week	$480	27	$12,893
2.8	Disposal - Munitions Debris & Disposal Certification (shipping, documentation, and insurance - minimum	tons	$4,000	6	$27,174
2.9	Movement and Stockpiling of Top Layers of fill in area F1 (30,000 cy)	cubic yard	$19	33880	$643,720
2.10	DGM of RI area	acre	$10,000	26.86	$268,600
2.11	Site Restoration	acre	$20,000	26.86	$537,200
2.12	Mapping and Geographic Information Services	days	$520	134.3	$69,836
2.13	Vehicle charge, car or van (2 Vehicles; 1 Month)	month	$2,000.00	12	$24,000
2.14	Demolition of Building 14 and Building 16 Remnants (No Hazmat Survey or Hazardous materials Disposal)	LS	$367,770	1	$367,770
2.15	Removal Action - Project Reporting	LS	$50,000	1	$50,000
2.16	Management, Permitting and Site Services - Including Onboarding and Training	15% of cost		15%	$636,064.97
	Subtotal				$4,876,498.09
3	**Process Material and Backstop Excavation (MRS 5 and AOCs)[2]**				
3.1	Equipment Mobilization/Demobilization and Decontamination	LS	$21,000	1	$21,000
3.2	UXO Team (SUXOS, UXOSO/QCS, 1-UXOTIII, 2-UXOTII, 2-UXOTI - 7-Man Team; Screening MRS 5	days	$7,143	10	$71,425
3.3	UXO Technician III (Equipment Operator to move Process Materials)	days	$1,020.36	10	$10,204
3.4	Mechanical Excavation/Removal[3] (60 cy for MRS5, 1,111 cy for AOC2, and 370 cy for AOC1) exclusive of volume from Task 2 above [Digging, Sifting, and Stockpiling]	cubic yard	$80	1541	$123,280
3.5	Dust Suppresion (water truck or tank)	days	$650	10	$6,500
3.6	Certified Industrial Hygienist (Dust Process Removal)	day	$1,000	10	$10,000
3.7	Hazardous Waste Transport/Disposal (Assume All Mass/Volume is Characteristically Hazardous; Volume from Line 3.4)	tons	$150	1101	$165,107
3.8	Screening of Munitions Debris	days	$1,200	2	$2,400
3.9	Mapping and Geographic Information Services	days	$520	10	$5,200
3.10	Decontamination	days	$500	10	$5,000
3.11	Remedial Action Closure Report	lump sum	$50,000	1	$50,000
3.12	Management, Permitting and Site Services	15% of cost		15%	$96,070
	Subtotal				$736,536.17
	Contingency	--	--	25%	$1,417,259
	Capital Costs Total				**$7,086,293**

B. O&M COSTS

1	**Five-Year Reviews**				
1.1	Five-Year Reviews[4]	Meet and Update	$15,000	6	$90,000
	O&M Costs Total				**$90,000**

C. TOTAL 30-YEAR PRESENT WORTH[5]

30-Year O&M Present Worth = (O&M) x (P/A), 0.7% for 30 years	**$72,975**

D. COST SUMMARY

Cost Element	Cost ($)
Capital Costs	$7,086,293
Annual O&M (30 Years)	$72,975
30-Year Present Worth Costs	**$7,159,268**

Notes:

1. This preliminary estimate is based on currently available sampling and analysis data and generalized concepts. This is not a final construction cost.
2. Costs do not include Building Demolition/removal or Hazardous Material survey
3. This includes process materials in MRS 5, AOC 1, and AOC 2.
4. Although this site action is not being performed under CERCLA and five year reviews are not required, they are typically performed on MMRP sites and sites where risk remains.
5. Costs calculated using a real discount rate of 0.7% - 2017 rate from the OMB circular A-94.
6. Costs do not include the additional cost of UXO construction support in areas where LUCs remain.
7. Area F1 is approximately 1.5 acres in size of fill approximately 15 ft deep. Assumes approximately 14 feet of non impacted material (no sifting) and remaining foot will be sifted. 33880 cy to be excavated and stockpiled and 1 ft approximately 2420 cy to be excavated, sifted, and stockpiled.
8. Area F2 is approximately 0.5 acres of fill approximately 1 ft deep on average. Assumes all 806 cy will be sifted.
9. Assumed the Acreages/depths for soil stockpiling, management, and screening differ for each area, including:
   AOC2 (2.2 acres x 36" moved in 12" lifts); AOC1 (0.5 acres x 24" moved in 12" lifts)
10. Assumed the following volumes for Mechanical Excavation/Removal[3] (60 cy for MRS5, 1,111 cy for AOC2, and 370 cy for AOC1) exclusive of volume from Task 2.

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Table 5–6. Summary of Comparative Analysis of Remedial Alternatives
The Former York Naval Ordnance Plant - York, Pennsylvania

NCP Evaluation Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Threshold Criteria	***Result***	***Result***	***Result***	***Result***	***Result***
1. Overall Protectiveness of Human Health and the Environment	Not Protective	Protective	Protective	Protective	Protective
2. Compliance with ARARs	Not compliant	Compliant	Compliant	Compliant	Compliant
Balancing Criteria	***Ranking***	***Ranking***	***Ranking***	***Ranking***	***Ranking***
3. Long-Term Effectiveness and Permanence	NA	1	2	3	3
4. Reduction of Toxicity, Mobility, or Volume through Treatment	NA	1	2	3	3
5. Short-term Effectiveness	NA	3	2	2	1
6. Implementability	NA	3	2	2	1
7. Cost	NA	3	2	2	1
	$0	$ 789,439	$ 3,777,579	$ 4,813,740	$ 7,159,268
Balancing Criteria Score	Not applicable	11	10	12	9

Any alternative considered "not protective" for overall protectiveness of human health and the environment or "not compliant" for compliance with ARARs, it is not eligible for selection as the recommended alternative. Therefore, that alternative is not ranked as part of the balancing criteria evaluation.

Scoring for the balancing criteria is as follows: Most favorable = 3, second most favorable = 2, least favorable = 1. The alternative with the highest total balancing criteria score is considered the most feasible.

ARAR = Applicable and Relevant or Appropriate Requirement. NCP = National Contingency Plan.

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