PROPOSED PLAN – FINAL REMEDY
FORMER YORK NAVAL ORDNANCE PLANT
1425 EDEN ROAD
YORK, PA 17402

Prepared for:
Former York Naval Ordnance Plant Remediation Team

December 11, 2018
Revised July 2, 2019

Prepared by:

Groundwater Sciences Corporation

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Respectfully submitted,

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July 2, 2019

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LIST OF ACRONYMS AND ABBREVIATIONS

11DCA	1,1-dichloroethane
11DCE	1,1-dichloroethene
Act 2	Pennsylvania Land Recycling and Environment Remediation Standards Act, Act 2 of 1995, 35 P.S. § 6026.101
AMF	American Machine & Foundry Company
AMO	AMO Environmental Decisions, Inc.
AOC	area of concern
ARAR	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CAO	Corrective Actions Objectives
BSRA	Bunker and Shell Range Area
cis12DCE	cis-1,2-dichloroethene
COC	constituents of concern
COPC	chemicals of potential concern
CPA	Central Plant Area
CTE	central tendency exposure
CVOC	chlorinated volatile organic compounds
CP	Cleanup Plan
CP/FR	Cleanup Plan/Final Report
CSM	Conceptual Site Model
DNAPL	dense non-aqueous phase liquid
DoD	United States Department of Defense
EI	Environmental Indicator
ERLC	Eden Road Logistics Center
FR	Final Report

FSP	Field Sampling Plan
fYNOP	former York Naval Ordnance Plant
gpm	gallons per minute
GSC	Groundwater Sciences Corporation
GWHHRA	Groundwater Human Health Risk Assessment
GWTS	groundwater extraction and treatment system
Harley-Davidson	Harley-Davidson Motor Company Operations, Inc.
HASP	health and safety plan
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
ILCR	incremental lifetime cancer risk
in.	inch
IRA	interim remedial actions
Langan	Langan Engineering and Environmental Services, Inc.
LUA	land use area
mg/l	milligrams per liter
mm	millimeter
MMRP	Military Munitions Response Program
MNA	Monitored Natural Attenuation
MOA	Memorandum of Agreement
MSC	Medium Specific Concentration
MTBE	methyl tertiary-butyl ether
NBldg4	North Building 4
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NIR	Notice of Intent to Remediate

NPA	North Plant Area
NPBA	Northeast Property Boundary Area
NPDES	National Pollutant Discharge Elimination System
PADEP	Pennsylvania Department of Environmental Protection
PADER	Pennsylvania Department of Environmental Resources
PAHs	polycyclic aromatic hydrocarbons
Part 1 RAA	Remedial Alternatives Analysis Report
Part 1 SRI	Part 1 Supplemental Remedial Investigation
Part 2 SRI	Part 2 Supplemental Remedial Investigation
PCBs	polychlorinated biphenyls
PRCP	Post-remediation Care Plan
PCE	tetrachloroethene
PP-FR	Proposed Plan - Final Remedy
RA	Risk Assessment
RAA	Remedial Alternative Analysis
RCRA	Resource Conservation and Recovery Act
REWAI	R.E. Wright Associates, Inc.
RFA	RCRA Facility Assessment
RfC	reference concentration
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
SAIC	Science Applications International Corporation
SHS	Statewide Health Standard
SMP	Soil Management Plan
SPA	South Plume Area

SPBA	Southern Property Boundary Area
SRI	Supplemental Remedial Investigation
SSS	Site-Specific Standard
SV_{GW-NR}	PADEP nonresidential groundwater screening values for VI
SVOCs	semi-volatile organic compounds
SWMU	Solid Waste Management Unit
TCA	1,1,1-trichloroethane
TCE	trichloroethene
TI	Technical Impracticability
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VI	vapor intrusion
VOCs	volatile organic compounds
WPL	West Parking Lot

EXECUTIVE SUMMARY

This Proposed Plan – Final Remedy (PP-FR) presents the proposed remedy to address the presence of hazardous substances at the former York Naval Ordnance Plant (fYNOP), located at 1425-1445 Eden Road, Springettsbury Township, York, Pennsylvania (fYNOP or Site). The December 2018 version of this report was reviewed by the United States Environmental Protection Agency (USEPA) in a letter dated March 19, 2019. As a result, the report was revised to address the USEPA comments.

The intent of this document is to clearly define the proposed site-wide remedy so that a consensus can be reached with the USEPA and the Pennsylvania Department of Environmental Protection (PADEP). After agreement of the proposed Site-wide remedy presented in this document, a Cleanup Plan (CP) will be prepared and submitted to USEPA and PADEP to satisfy the requirements of the Pennsylvania Land Recycling and Environmental Remediation Standards Act (Act 2), and to provide additional design details to satisfy the needs of both programs.

The elements of the remedy proposed in this PP-FR to address Corrective Actions Objectives (CAOs) are based on results of the Remedial Alternatives Analysis Report Part 1 (Part 1 RAA) and subsequent discussions with USEPA and the PADEP to streamline the remedy selection process for the Site. A CAO table was developed and finalized in conjunction with USEPA and PADEP and forms the basis of the proposed remedy in this PP-FR for the Site. As a result of that process, all parties agreed that development of numerous remedial alternatives and a rigorous comparison of those remedial alternatives would not be beneficial to the remedy selection process. The elements of the proposed remedy are essentially comprised of the interim remedies currently in place at the fYNOP with modifications and additions to fully address the CAOs. Attainment of the Site-Specific Standard (SSS) under Act 2 will be demonstrated in a Final Report (FR) that will be submitted to the PADEP for review and approval.

The elements of this PP-FR consist of the following:

- On the fYNOP:

- A groundwater extraction and treatment system (GWTS) that mitigates known and potential off-Site migration of groundwater containing chlorinated hydrocarbons tetrachloroethene (PCE), trichloroethene (TCE), and their degradation products. This system has pumping centers in the West Parking Lot (WPL) and the Southeast Property Boundary Area (SPBA). Groundwater is treated at a treatment plant and discharged to the Codorus Creek.

- Environmental covenants that restrict land use to nonresidential, restrict use of groundwater, require practices to protect workers during excavations, and require maintenance of caps over certain areas.

- Mapping (recording) existing caps and impervious areas.

- Designation of a Technical Impracticability (TI) Area where attainment of the PADEP Statewide Health Standard (SHS) in groundwater is believed to be impracticable. This area extends off the fYNOP to the west side of Codorus Creek in the vicinity immediately west of the WPL. The plume areas outside of the TI Area will undergo monitored natural attenuation (MNA). For the proposes of this report, MNA refers to monitoring groundwater for the presence of volatile organic compounds (VOCs) to confirm declining trends in concentrations due to the natural attenuation processes of dilution, dispersion, aqueous diffusion, sorption, and abiotic degradation.

- Off the fYNOP:

  - An environmental covenant already exists on the former Cole Steel property (for other reasons independent of the fYNOP) which restricts groundwater use and prohibits residential land use.

  - A Post-remediation Care Plan (PRCP) that requires periodic assessment and verification of continued nonuse of groundwater and periodic notifications to property owners of potentially complete exposure pathway to groundwater by utility workers.

Additional remedial actions include groundwater monitoring and surface water monitoring. Remedial alternatives to the groundwater extraction system in the WPL will be evaluated in the future. This includes interception of spring-fed groundwater discharges at certain spring locations, in-stream treatment of spring-fed discharge and certain spring locations, and the development of a mixing zone in Codorus Creek located downstream of certain spring-fed groundwater discharge points.

This report is being submitted concurrent with a separate report defining the proposed remedy for the Military Munitions Response Program (MMRP) and Bunker and Shell Range Area (BSRA) at the fYNOP.

1 INTRODUCTION

This Proposed Plan – Final Remedy (PP-FR) presents the proposed site-wide remedy to address the presence of hazardous substances at the former York Naval Ordnance Plant (fYNOP) also referred to as the "Site" herein (a Site location map is provided on **Figure 1.0-1)**. The intent of this document is to clearly define the proposed site-wide remedy so that a consensus can be reached with the United States Environmental Protection Agency (USEPA) and the Pennsylvania Department of Environmental Protection (PADEP). After agreement of the proposed Site-wide remedy presented in this document, a Cleanup Plan (CP) will be prepared and submitted to USEPA and PADEP to satisfy the requirements of Act 2, and to provide additional design details to satisfy the needs of both programs. As stated in the September 9, 2005 letter from USEPA and PADEP to Harley-Davidson Motor Company Operations, Inc. (Harley-Davidson), under the One Cleanup Program Memorandum of Agreement, once agreement of the final Site-wide remedy is reached, USEPA will publish a draft Final Decision for public input and proceed to a final Decision using USEPA's Final Guidance on Completion of Corrective Action at RCRA Facilities (Federal Register, February 23, 2003).

A Remedial Alternatives Analysis Report Part 1 (Part 1 RAA) (GSC, 2014) was submitted to the USEPA and the PADEP on December 3, 2014. PADEP approved the report on January 23, 2015. USEPA provided comments on the Part 1 RAA and recommended the development of a Corrective Actions Objectives (CAO) Table, following the Resource Conservation and Recovery Act (RCRA) First format (https://www.epa.gov/hw/toolbox-corrective-action-resource-conservation-and-recovery-act-facilities-investigation-remedy), to facilitate the remedy selection process. The CAO Table was developed and finalized cooperatively with USEPA and PADEP, and it forms the basis of the proposed remedy in this PP-FR for the Site. As a result of that process, all parties agreed that development of numerous remedial alternatives and a rigorous comparison of those remedial alternatives would not be beneficial to the remedy selection process.

The elements of the overall remedy proposed in this PP-FR address the CAOs and are based on results of the Part 1 RAA and subsequent discussions with USEPA/PADEP to streamline the remedy selection process for the Site. The elements of the proposed remedy are essentially comprised of the interim remedies currently in place at the Site with modifications and additions to fully address the CAOs. The elements of the proposed remedy are compared to criteria detailed in

the Part 1 RAA to provide the justification for the proposed remedy in substantial compliance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), as defined in 40 CFR Parts 9 and 300 (USEPA, 1994a), and the Pennsylvania Land Recycling and Environmental Remediation Standards Act, Act 2 of 1995, 35 P.S. § 6026.101 (Act 2). Attainment of the Site-Specific Standard (SSS) under Act 2 will be demonstrated in a Final Report (FR) that will be submitted to the PADEP for review and approval.

This report is being submitted concurrent with a separate report defining the proposed remedy for the Military Munitions Response Program (MMRP) and Bunker and Shell Range Area (BSRA) at the fYNOP.

1.1 Regulatory Framework and Responsible Parties

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, the United States Department of Defense (DoD) and the Department of Navy, environmental assessments and remedial activities at the Site 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.

Groundwater Sciences Corporation (GSC) prepared this report on behalf of the fYNOP Remediation Team. 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.

Remedial environmental investigations began at the Site in 1984. Initially, work was reported to and reviewed by the Pennsylvania Department of Environmental Resources (PADER), Waste Management Division. In 1989, USEPA performed a RCRA Facility Assessment (RFA) of the facility. As a result of this assessment, 73 Solid Waste Management Units (SWMUs) were identified as needing further investigation. The locations of these SWMUs are shown on **Figure 1.1-1** as blue squares, which in some cases overlap where processes, like tanks, are closely spaced. This figure also points out the location and describes 31 Areas of Concern (AOCs) that may have

contributed to the presence of hazardous substances detected in soil and groundwater at the Site. Implementation of the Final Remedy will also serve to close those SWMUs pursuant to RCRA.

On May 20, 2002, fYNOP initially committed to USEPA's "Facility Lead Program" under the RCRA Corrective Action Program in response to USEPA's invitation to participate. That commitment was subsequently replaced when fYNOP entered into the One Cleanup Program established by the USEPA Region III and the PADEP pursuant to a Memorandum of Agreement (MOA) dated April 24, 2004.

The One Cleanup Program initiative began on February 7, 2005, when fYNOP submitted a Notice of Intent to Remediate (NIR) to a SSS to PADEP under the PADEP's Land Recycling Program established by Act 2. Public notice of the NIR under Act 2 was published in the *Pennsylvania Bulletin* on March 19, 2005. Participation in the program was acknowledged by letters dated July 15, 2005, and September 28, 2005, from James Burke of USEPA and Eugene DePasquale of PADEP to Sharon Fisher of Harley-Davidson. USEPA and PADEP also acknowledged the cost-sharing agreement between Harley-Davidson and the United States, and recognized that site assessment and remediation under the One Cleanup Program would be substantially consistent with the NCP although conducted within the Act 2 framework.

In September of 2005, USEPA issued a letter called Documentation of Environmental Indicator (EI) Determination. The findings of that letter indicated the following:

> "Based on a review of the information contained in this EI Determination, 'Current Human Exposures' are expected to be 'Under Control' at the Harley-Davidson Motor Company facility, USEPA ID # PAD 001 643 619, located at 1425 Eden Road, York, Pennsylvania under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility."

In August of 2014, USEPA reevaluated the RCRA Corrective Action EI for the Site, and changed the 'Current Human Exposures' to "IN – More information is needed to make a determination." The "Documentation of Environmental Indicator Determination" form signed by Griff Miller and Paul Gotthold from USEPA Region 3 was transmitted to the fYNOP Remediation Team by email

on August 27, 2014. Specifically, USEPA requested additional information be collected to further assess the potential vapor intrusion (VI) pathway in the off-Site residential area downgradient of the Southern Property Boundary Area (SPBA) portion of the Site.

As a result of additional investigations (GSC, 2015), USEPA "has determined that VI is not expected to be a significant exposure pathway for the off-Site residential area downgradient of the SPBA at this time. The Human Exposure EI has been revised to reflect that current human exposures are under control at the facility" (email dated August 10, 2015 from Griff Miller [USEPA] to Steve Snyder [GSC]).

1.2 Report Organization

This PP-FR report is organized as follows:

- Section 2 provides the Site background, including Site setting, historical use as an industrial site, physical characteristics, a summary of environmental investigations and remediation, nature and extent of contamination, contaminant fate and transport, interim remediation progress, and results of the risk assessments.

- Section 3 describes the CAOs and proposed corrective actions. The CAOs are presented for each media (groundwater, soil, surface water, etc.).

- Section 4 provides a summary of the proposed remedy organized geographically.

- Section 5 provides a justification for the proposed remedy, using threshold evaluation criteria and primary balancing criteria prescribed by USEPA guidance.

- Section 6 is a listing of references.

1.3 Revised Report

The December 2018 version of this PP-FR was reviewed by the USEPA in a letter dated March 19, 2019 (letter is included in **Appendix A**). As a result, this PP-FR was revised to address the USEPA comments.

2 BACKGROUND

This section provides a brief summary of the findings of remedial investigations (RI) of soil and groundwater pertinent to this PP-FR. Specifically, the following subsections summarize the Site setting and history, physical characteristics, previous investigations and remediation, nature and extent of contamination, and contaminant fate and transport.

2.1 Site Setting and History

The fYNOP consists of 230 acres, divided into the East Campus and the West Campus. The East Campus, consisting of 172 acres, is the site of an active motorcycle manufacturing facility owned by Harley-Davidson. In June 2012, Harley-Davidson sold the 58 acre West Campus, which has been redeveloped as a 775,000 square foot distribution center called the Eden Road Logistics Center (ERLC) and is currently owned by NP York 58, LLC. As shown on **Figure 2.1-1**, the fYNOP is bordered on the south by Route 30 and industrial/commercial properties; on the west by an industrial/commercial property (Heuristic, formerly 84 Lumber), a railroad line, uninhabited wetland/wooded areas, the Codorus Creek levee, and northward flowing Codorus Creek; and on the southeast, east and north by residential properties. The West Parking Lot (WPL), Central Plant Area (CPA), and numerous other Site features are called out on this figure. The northeastern and eastern third of the fYNOP is undeveloped woodlands. The south-central area is occupied by the Harley-Davidson manufacturing facility. The ERLC building is located on the western third of the fYNOP.

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 on the Site included manufacturing and assembly of 20 and 40-millimeter (mm) twin/quadruple guns and mounts, 37-mm guns and carriages, 3 inch (in.) 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 ranges (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 the Site 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 and Harley-Davidson merged. In 1973 Harley-Davidson moved its motorcycle assembly operations to the Site. Besides motorcycles, the plant also produced bomb casings and other munitions-related items.

2.1.1 **Physical Characteristics**

The Site is located in central York County, north of the City of York, PA (**Figure 1.0-1**). This area is drained by the Codorus Creek, a tributary to the Susquehanna River with a 237 square mile drainage area above the point where it enters the Site. Hills rim the Site on the north and east, forming somewhat of a bowl-like topographical configuration. The eastern one third of the Site is fairly steeply sloping to the west (4 to 20%), forming an upland area to the east of the flat-lying CPA, shown on **Figure 2.1-1.** From the base of the hills to the Codorus Creek, the land surface underlying the CPA slopes very gently (0.5%) to the west.

The surface of the Site is immediately underlain by either fill (associated with industrial and roadway construction), residual soil produced from the weathering of the underlying bedrock, or alluvium. From R.E. Wright Associates, Inc. (REWAI, 1986), natural residual soils are comprised of sandy silt, clayey silts, and silt loam deposits from four primary soil series (Duffield, Glenelg, Elk and Chester). These soil series are derived primarily from parent bedrock formations consisting of quartzitic sandstone and limestone.

Two geologic rock types underlie the Site. Solution-prone gray carbonate bedrock (limestone and dolostone) underlies the flat lowland (western) portion of the Site. Quartzitic sandstone underlies the more steeply sloping hills and upland area on the eastern part of the Site. The limestone is a karstic carbonate aquifer with groundwater migrating through solution-enhanced discontinuities and

overlying unconsolidated materials. The quartzitic sandstone is a much less permeable aquifer; with minimal primary porosity, groundwater flows through tight bedding plane partings, joints and fractures. Groundwater flow is generally westward, from the upland area at the eastern part of the Site toward Codorus Creek; however, localized groundwater flow is controlled by an active groundwater extraction and treatment system (GWTS) that intercepts groundwater that would otherwise flow to Codorus Creek.

2.1.2 **Previous Investigations and Remediation**

Numerous environmental investigations and remedial efforts have been conducted at the Site. In 1984, an investigation was performed to evaluate potential environmental impacts in the eastern portion of the facility (Gettysburg Electronics, 1984). Groundwater investigations beginning in 1986 revealed the presence of volatile organic compounds (VOCs) in groundwater directly under the Site. The interim remedy for addressing the VOCs in groundwater included: groundwater capture via extraction wells; treatment of the extracted groundwater using air stripping in association with thermal treatment or carbon adsorption to control off-gasses; and discharge of the treated groundwater into an unnamed tributary of Codorus Creek, locally called Johnsons Run. The current GWTS was constructed in 1990 and has continued operations to date. The status of the GWTS is reported to the PADEP and USEPA via annual reports. The discharge point for treated groundwater was moved from Johnsons Run to the Codorus Creek after National Pollutant Discharge Elimination System (NPDES) renewal permitting in 2007. The current location of the discharge point is shown on **Figure 2.1-1**.

Various soil remedial efforts have also been conducted on the Site and are specified in the Soils Remedial Investigation (RI) report (Science Applications International Corporation [SAIC], 2009), as well as in several other follow-on interim remedial reports.

In 1998, a Site-wide RI was initiated. The results of that study—including more detailed summaries of soil, groundwater, sediment, and surface water sampling—are provided in a draft report entitled "Interim Site-wide Remedial Investigation Report, Harley-Davidson Motor Company, York, Pennsylvania Facility" (Langan Engineering and Environmental Services, Inc. [Langan], 2002). The purpose of the RI work was to characterize the Site for the development of appropriate remedial measures. This was facilitated through the investigation of potential source areas, further

development of the conceptual site model, and evaluation of migration and exposure pathways. The report resulted in the need to prepare a comprehensive document that compiled the remedial site activities completed and developed a scope of work to address data gaps. The fYNOP Remediation Team addressed that need with the Field Sampling Plan (FSP) for Supplemental Remedial Investigations (SRI) (SAIC, 2006).

In December 2009, the fYNOP Remediation Team submitted to both agencies a report entitled Draft Supplemental Remedial Investigations Soils Report (SAIC, 2009). The report was accepted and approved by USEPA and PADEP as final and complete under the One Cleanup Program, as recorded in a letter from both agencies to Sharon Fisher of Harley-Davidson dated March 17, 2010. Areas of soil exceedances of PADEP Statewide Health Standard Medium Specific Concentrations (MSCs) for direct contact (nonresidential) and soil to groundwater (residential used aquifers) were delineated. Subsequently, numerous areas were remediated by the following actions:

- Bldg 67 and Metal Chip Bin area removal/closure (demolished/sampled 6/10-7/10, Closure Report 3/10);
- UST Tank 009 removal and release characterization (tanks removed and sampled 7/10, SCR 1/12, RACR 11/15);
- Building 51 Hazardous waste storage facility demo and closure (closed and demolished 8/11, Final Closure Report 6/12);
- Former industrial wastewater conveyance line cleaning/abandonment (closed and sampled in 2011, Closure Report 6/10);
- Former Bldg 41/WWTP demo/removal (closure and removal of SWMU 4/11 – 3/12, Closure Report 6/12);
- Former vapor degreaser pit removals in Bldg 4 (demolition and remediation 8/11, Closure Report 6/12);
- Closure of former Electrical Transformer Areas (final sampling and closure and removal of areas in 2011, Closure Report 6/12);
- Source characterization activities of the former W Bldg 2 Corridor and Bldg 58 Areas (Source Area Investigations 6/12 – 6/13, Summary Report Part 2 SRI 4/13).

In September 2011, a report entitled Supplemental Remedial Investigation (SRI) Groundwater Report (Part 1) (Part 1 SRI) was completed (GSC, 2011). This report summarized environmental investigations completed on the Site from 1984 through 2006, and developed conclusions regarding Site groundwater conditions based on analysis of the entire body of information and data collected from 1984 to 2010. The report contains a description of the site-specific geology, hydrogeology, nature and extent of constituents of concern (COCs) and the fate and transport of the COCs in groundwater. Also included are an exposure pathway assessment and recommendations for further investigation to close specific data gaps.

In August 2016, a report titled Supplemental Remedial Investigation (SRI) Groundwater Report (Part 2) (Part 2 SRI) (GSC, 2016) was submitted for USEPA/PADEP review. This report addressed the data gaps identified in the Part 1 report. PADEP approved the report December 8, 2016. USEPA provided comments in a letter dated January 27, 2017, requesting additional explanation and illustrations be provided for the SPBA. The remainder of the report was submitted in final form with minor edits in March 2018.

In November 2018, a report titled Southern Property Boundary/South Plume Areas Supplemental Remedial Investigation and Interim Groundwater Remediation Report (GSC, 2018) was submitted for USEPA/PADEP review. This report included the refined Conceptual Site Model (CSM) for the SPBA and South Plume Area (SPA).

2.2 Nature and Extent of Contamination

Soil RI at the Site have indicated that COCs in soil include metals (antimony, arsenic, cadmium, copper, hexavalent chromium, lead, mercury, nickel, selenium, silver, thallium, and zinc); VOCs; polycyclic aromatic hydrocarbons (PAHs); polychlorinated biphenyls (PCBs); and total and free cyanide. These regulated substances appear to be restricted to specific source locations, several of which have already been subjected to remedial actions.

Groundwater RI and activities at the Site have indicated that the primary COCs due to concentration, detection frequency, and potential for off-Site migration are chlorinated solvents, including tetrachloroethene (PCE), trichloroethene (TCE), and 1,1,1-trichloroethane (TCA), and degradation products of these VOCs. Less frequent detections of hexavalent chromium, lead,

benzene, ethylbenzene, methyl tertiary-butyl ether (MTBE), 1,4-dioxane, and cyanide have also been detected in groundwater samples from Site monitoring wells. The distribution of these constituents in groundwater suggests that they have originated from multiple sources.

2.3 Contaminant Fate and Transport

The aquifers underlying the Site are composed of fractured quartzitic sandstone and karstified carbonate rock. The karstified carbonate rock, which underlies the CPA, North Plant Area (NPA), and WPL portions of the Site, is well connected as a result of high fracture permeability, and well distributed and interconnected solution channels. Chlorinated volatile organic compounds (CVOCs) were introduced to the ground surface in the form of dense non-aqueous phase liquid (DNAPL) through spills, leaks, and on-Site disposal. CVOCs are pervasive throughout the Site at concentrations that exceed PADEP groundwater and soil-to-groundwater MSCs.

At the Site, the factors affecting the transport of a DNAPL release are highly dependent on the geologic characteristics at the location of the release. In the non-carbonate aquifer (**Figure 2.3-1**), DNAPL migrates vertically downward through a thin mantle of soil to the weathered bedrock, where it migrates through tight joints and fractures in the bedrock. In the karst aquifer (**Figure 2.3-2**), DNAPL migrates vertically downward through soil/regolith to pinnacled bedrock, where it is directed along the soil-bedrock interface. It then migrates through solution channels, fractures and bedding planes in the bedrock.

In the subsurface, some of the DNAPL slowly dissolved in the groundwater or percolating water from precipitation, undergoing a number of processes. Dissolved (aqueous) phase chlorinated solvents migrated through the aquifer transported by groundwater flow and generated plumes of dissolved CVOCs extending from each source area to a point of discharge to surface water or, currently, to an extraction well. Prior to operation of the pump and treat system, groundwater in the CPA/NPA/WPL migrated generally westward toward the Codorus Creek through residuum and solution-enhanced pathways in the carbonate bedrock.

The aqueous phase chemicals diffused into the rock matrix, and adsorbed onto organic carbon or mineral surfaces. In the aqueous phase, anaerobic bacteria break down PCE and TCE to cis-1,2-

dichloroethene (cis12DCE) and vinyl chloride (VC) and the TCA to 1,1-dichloroethane (11DCA) and chloroethane. TCA also abiotically transforms to 1,1-dichloroethene (11DCE).

In addition to the CVOCs, 1,4-dioxane, benzene, MTBE, chromium and cyanide occur above PADEP MSCs, but have limited distribution in the groundwater on the Site.

DNAPL has likely been present in the fYNOP groundwater for 70 or more years, since vapor degreasing operations began prior to 1948 (Key Reporters, 1991). During that time, the various processes described above, enhanced by interim remedial actions (IRAs), have resulted in the reduction of the DNAPL mass (**Figure 2.3-3**). Even so, a number of areas remain as probable DNAPL sources. In addition, diffusion and sorption processes have stored CVOC mass in the aquifer, which is released slowly, resulting in a tailing effect for CVOC concentrations in groundwater. Primary source areas are the North Building 4 (NBldg4) Area, the northwest corner of the WPL, and the southwest corner of the WPL. In these areas, concentrations of CVOCs extend to depths of hundreds of feet.

2.4 Interim Remediation Progress

Performance evaluation results of the interim groundwater extraction system, operational since the 1990s, are included in the Part 2 SRI report. The system effectively prevents off-Site migration of groundwater from the fYNOP to the west. Between 1989 and 2015, over 45,000 pounds of CVOCs have been removed by the groundwater extraction system (Leidos, 2017). The rate of removal over the last five years ranged from approximately 1,000 to 1,500 pounds per year. An interim groundwater extraction system was recently installed (operational during the fourth quarter 2018) in the SPBA to control the off-Site migration of groundwater in the SPBA.

The Part 1 SRI report demonstrates that, over the last 20 years, large reductions in COC concentrations have occurred in groundwater, with TCE, the most widely distributed CVOC, reducing in concentration by 90 to 99% in most wells. The reduction is primarily a result of removal by dissolution into the groundwater that migrates from the source or is captured and removed by the pump and treat system, natural degradation of the chlorinated solvents by bacteria and abiotically, and by sorption onto and diffusion of the dissolved phase into the matrix of aquifer solids. Although greatly reduced, concentrations of chlorinated solvents nonetheless exceed

PADEP groundwater MSCs across most of the Site. Several facts (i.e., chlorinated solvents have not been used on Site since 1994, there has been no known release of chlorinated solvents in 30 years, and the groundwater pump and treat systems have been operating for over 25 years) provide an indication of the persistence of the COCs in groundwater at the Site.

Estimates of the mass remaining in the aquifers using trend analysis exceed 60,000 pounds, and may be underestimated because DNAPL residual and accumulation zones may be present. Approximately 2,000 pounds of this mass is dissolved in groundwater in storage in the aquifer at any given time. The remaining mass is adsorbed onto and diffused into the matrix of the aquifer or is in the form of suspected residual or DNAPL accumulation zones. These undissolved sources of mass are very slowly released to the groundwater passing through the Site.

2.5 Soil Risk Assessment Findings

A human health risk assessment (HHRA) for direct exposure of human receptors to soil from ground surface to a depth of fifteen feet below ground surface (bgs) was completed for the Site. This HHRA was developed in accordance with the SSS option under Act 2 and associated PADEP Land Recycling Program 25 Pa. Code Chapter 250 regulations. Results of the soil risk assessment were submitted to the PADEP and USEPA in a report entitled "Soils Risk Assessment – Former York Naval Ordnance Plant" (Soils RA), dated March 2012, (GSC, 2012) and approved by USEPA and PADEP in letters dated July 9, 2012 and July 10, 2012, respectively.

The risk assessment of soil exposures determined that noncarcinogenic hazard indices for each receptor were below the statutory limit of 1.0. This risk assessment also yielded potential carcinogenic risks that were within or below the acceptable Act 2 carcinogenic risk range of 10E-06 to 10E-04 for all receptors. Additionally, modeled exposures to lead in soils were determined to be within USEPA's acceptable levels. These results indicate that potential exposures to soil under current and hypothetical future land use conditions, as described in the report, are within acceptable limits under Act 2. Accordingly, the SSS has been attained for those COCs in soils identified in the Soils RA.

In selecting the soil sampling results on which the Soils RA was based, the exposure pathway to contaminated soils beneath existing building slabs and existing paved areas was considered to be

eliminated by the presence of these capping features, which are considered engineering controls as defined under Act 2. An Environmental Covenant has been recorded for the West Campus portion of the Site limiting the use to nonresidential, requiring that the capping features be maintained and a Soil Management Plan (SMP), approved by PADEP, be implemented for any earth disturbance activity. Should future land use change from the currently assumed commercial/industrial use or if additional impacts to soil are discovered, a revised risk assessment and/or remediation may be necessary for the protection of human health.

2.6 Groundwater Risk Assessment Findings

A HHRA for groundwater was completed for the Site, which was submitted to PADEP and USEPA in a report entitled "Revised Groundwater Human Health Risk Assessment" (GWHHRA), dated March 2018 (NewFields, 2018). The GWHHRA was completed in a manner compliant with PADEP Act 2, USEPA guidance, and Virginia Department of Environmental Quality (VDEQ) guidance. The Site and adjacent areas were divided into seven geographic areas or Land Use Areas (LUAs). These LUAs, which are illustrated on **Figure 2.6-1**, were organized based on current and anticipated future land use, and were used to identify potential receptors and exposure pathways in the GWHHRA. The LUAs listed below were also used to describe and illustrate the areas covered by the CAOs and the proposed remedy for fYNOP.

- LUA 1 consists of the developed portion of the East Campus (Harley-Davidson Property), which includes parking lots, production buildings, and roads, along with adjacent lawn/landscaped areas and storm water facilities.

- LUA 2 includes the mostly undeveloped and wooded portion of the East Campus (Harley-Davidson Property), and is located adjacent to the east side of LUA 1.

- LUA 3 consists of the West Campus that is developed and currently occupied by the ERLC warehouse building, the WPL, and a portion of Eden Road.

- LUA 4 includes residential areas that are located adjacent to the north side of LUA 1 and along the north, east and south sides of LUA 2.

- LUA 5 consists predominately of developed off-Site industrial areas and US Route 30, and includes the quarry northwest of the Site. This broad area is located to the northwest, west and south of the fYNOP.

- LUA 6 includes mostly undeveloped areas located between the WPL (LUA 3) and Codorus Creek (LUA 7). Most of LUA 6 is zoned industrial and is within a flood plain.

- LUA 7 consists of the segment of Codorus Creek surface water impacted by Site groundwater.

The GWHHRA examined the potential long-term exposure and health risk (both cancer and non-cancer) potentially resulting from exposure to chemicals of potential concern (COPCs) in groundwater and associated media (soil vapor and surface water in Codorus Creek) for three current and potential future worker scenarios and a recreational wader who could directly and/or indirectly contact COPCs associated with groundwater in one or more of seven LUAs.

The results of the GWHHRA indicate no exceedances of target incremental lifetime cancer risk (ILCR) or hazard quotient (HQ) for off-Site commercial/industrial workers, construction and utility workers exposed to vapors from groundwater deeper than 15 feet bgs, and recreational waders. The GWHHRA concluded that these receptors are not at risk from Site COPCs under the conditions assumed in the GWHHRA. The only exceedance of the target ILCR was for the on-Site utility worker in areas where groundwater is less than or equal to 15 feet bgs in LUA 1 and LUA 3, due to the reasonable maximum exposure (RME) benzene concentration. Otherwise, potential cancer risk is not of concern at fYNOP.

Exceedances of the target hazard index (HI) (primarily attributable to TCE) were observed for all on-Site worker scenarios, and for utility workers off Site where groundwater is within 15 feet bgs. The highest HIs were associated with the Utility Worker scenario in areas where groundwater is less than or equal to 15 feet bgs, with exceedances in all areas under RME and all but LUA 5 under central tendency exposure (CTE). Although modeled exposures to utility workers has an inherent margin of error that may be overstating the actual potential exposures to utility workers, these results suggest the need for reasonable caution in planning and conducting intrusive activities in these areas.

RME TCE HQs are less than 10 for the commercial/industrial worker and utility worker in LUA 2, and for the utility worker in LUA 5 and LUA 6. Considering the uncertainty in the oral reference dose (RfD) and inhalation reference concentration (RfC) for TCE, adverse health effects are not expected in these LUAs. In LUA 3, CTE HQs for TCE are less than 10 for commercial/industrial workers and construction workers, but greater than 10 at the higher RME concentration. These results suggest that VI may be an issue in buildings in certain parts of LUA 3. Thus, building construction of inhabited buildings in such areas should be preceded by appropriate evaluation, and buildings may require engineering controls.

In the evaluation of a hypothetical future residential development scenario, maximum concentrations of COPCs exceeded putative cleanup goals in all LUAs. These screening-level results indicate that residential development (including potable use of groundwater) on the Site and immediately off the Site in LUAs 5 and 6 is not appropriate.

3 CORRECTIVE ACTION OBJECTIVES AND PROPOSED CORRECTIVE ACTIONS

The CAOs and the proposed corrective actions for the proposed remedy for the Site were developed by the fYNOP Remediation Team, their consultants, and the regulators, USEPA and PADEP. After completion of the Part 1 RAA document generated discussion regarding the CAOs and technologies that may be effective as potential components of the final remedy, USEPA recommended the use of the remedy selection process meeting agenda template, specified in the RCRA FIRST Toolbox (USEPA, 2016). A series of meetings were held between the parties to refine the CAOs. The result of those discussions is presented herein as **Table 3.0-1** and was distributed by email to the fYNOP Remediation Team and the regulators on June 7, 2017. Note that the priority/time frame under Groundwater, Cross Media Transfer A,v (Page 1, Column 7) Air, Human Health, Residential Off Site (Page 4, Column 4) for the SPBA on **Table 3.0-1** has been changed from a ranking of 2 (implement prior to final remedy/cleanup) to 3 (part of long-term final remedy/cleanup or action currently in place, but final remedy required). This is due to a groundwater extraction system being installed after the table was developed. There were also minor changes to the headings regarding on-Site and off-Site areas.

Table 3.0-1 is titled fYNOP Corrective Action Objectives. It is organized by environmental media (groundwater, soil, surface water, etc.) and considers objectives through a series of columns: human health, ecological receptors, cross media transfer and resource restoration. Human health is divided into four columns to address residential and nonresidential conditions on Site and off Site. These divisions are consistent with the LUA divisions used to evaluate potential risks in the GWHHRA (Newfields, 2018). LUAs used in the GWHHRA are shown in **Figure 2.6-1**.

Following each CAO in the various columns of **Table 3.0-1** is a Priority/Time Frame for specified areas on Site or off Site. On-Site and off-Site conditions are important to the feasibility of some remedial actions. Each CAO was given a number of 1 through 4 indicating whether further action is necessary to protect potential human or ecological receptors, with 1 indicating a current potential exposure requiring action, and 4 indicating the presumed final remedy is in place. All CAOs were ranked 3 (indicating no urgency, that the action is part of a long-term final remedy, or cleanup or action is currently in place) or 4 (indicating an existing control is in place and is part of the presumed final remedy). Priority/Time Frame rankings of 3 and 4 indicate that no additional

remedial action is necessary prior to the selection of a final remedy to protect human health and the environment.

The following subsections summarize the contents of **Table 3.0-1** by environmental media. Under each media the CAOs are listed. Some divisions used in the table have been consolidated, particularly when the proposed (or presumed) corrective actions are the same. The related proposed corrective actions are listed under each of the CAOs.

3.1 Groundwater

Groundwater is the environmental medium that requires the most attention due to the magnitude and extent of contamination. Further, as a result of cross-media transfer, remedial actions involving groundwater are often the solutions regarding surface water and air media. Five CAOs for groundwater summarized from **Table 3.0-1** are listed below:

Residential and Nonresidential Human Health

1) Prevent drinking water exposure to COCs above PADEP used aquifer MSCs on **Table 3.1-1**, on Site and off Site.

2) Prevent construction/utility worker exposure to groundwater with concentrations above the PADEP used aquifer MSCs where groundwater is less than 15 feet bgs, on Site and off Site.

Cross Media Transfer

3) Prevent exceedance of the PADEP indoor air screening values by VI into current and hypothetical future on-Site and off-Site buildings from cross-media transfer from groundwater to air.

4) Prevent exceedance of PADEP ambient water quality criteria for toxic substances or to develop site-specific surface water goals for substances in Codorus Creek for cross-media transfer from groundwater to surface water. PADEP surface water quality criteria for COCs in surface water (cis12DCE, PCE, and TCE) are provided on **Table 3.1-2**.

Resource Restoration

5) Attain applicable PADEP Statewide Health Standard MSCs for groundwater in Used Aquifers, with TDS ≤2,500 milligrams per liter (mg/l) for the COCs throughout the plume.

The proposed corrective actions are the use of institutional and engineering controls, and groundwater extraction and treatment to meet the CAOs as described below. In addition, the proposed corrective actions include waivers and an evaluation of in-stream treatment technologies to replace groundwater extraction and treatment.

3.1.1 Prevent Drinking Water Exposure to COCs above PADEP MSCs

Because COCs in the groundwater exceed PADEP MSCs on and off the fYNOP property, the following corrective actions are proposed:

3.1.1.1 Groundwater Use Restrictions

Groundwater is currently only used for environmental sampling and remediation on the East Campus (LUA 1 and 2), West Campus (LUA 3), and Former Cole Steel (in LUA 5) properties. The West Campus and former Cole Steel properties have groundwater use restrictions in their existing environmental covenants that prohibit the use of groundwater with the exception of environmental sampling and remediation. An environmental covenant is proposed for the East Campus that will include a groundwater use restriction prohibiting the use of groundwater with the exception of environmental sampling and remediation.

3.1.1.2 Periodic Assessment

Periodic assessment will be performed to verify continued nonuse of groundwater in LUA 4, LUA 5, and LUA 6. With one exception, there is currently no groundwater usage in LUA 4, LUA 5, and LUA 6 identified in the GWHHRA. The properties in the LUA 4 and LUA 5 are fully developed and public drinking water is provided in this area by the York Water Company. The properties in LUA 6 are currently zoned or used as industrial or are unsuitable for residential usage because they are in the floodplain and public drinking water is provided in this area by the York Water Company. Therefore, future use of groundwater in the LUA 6 is not probable.

The one exception occurs in LUA 4, at a property on Paradise Road, north of the northeastern corner of the Site. This residence was connected to public drinking water by the fYNOP project in October 2007. The property owner continues to use the well for lawn irrigation and outdoor non-potable uses. While this well has remained free of COCs, the proximity to the Northeast Property Boundary Area (NPBA) area makes continued use of this well a potential concern. The proposed remedial action is to decommission this well, requiring cooperation with the property owner.

3.1.1.3 Waiver

A waiver from the periodic assessment obligations or the need for groundwater use restrictions will be requested for the US Route 30 right-of-way in LUA 5 as it is more than reasonable to assume that groundwater will not be used in the future for drinking water purposes in the right-of-way.

3.1.2 Prevent Construction/Utility Worker Exposure to Groundwater with COCs above PADEP MSCs

Construction/utility worker exposures to COCs in the groundwater were determined to exceed acceptable risks in portions of LUAs 1 and 2 (East Campus), 3 (West Campus), 5 (former Cole Steel property and Rt. 30), and 6 (west of the WPL) where the depth to groundwater is less than 15 feet.

3.1.2.1 Health and Safety Plans

The existing environmental covenant on the West Campus requires compliance with a Post-remediation Care Plan (PRCP) or SMP. The existing environmental covenant also requires that all building and demolition plans be reviewed by Harley-Davidson. A requirement that earth disturbance activity on the East Campus must be performed pursuant to a health and safety plan (HASP) will be included in the proposed CP and FR.

An environmental covenant proposed for the East Campus will require that a HASP be implemented for earth disturbance activity on the property to protect from direct and indirect outdoor exposure to groundwater by utility and construction workers. An evaluation of the excavation location, the scope of the work for the excavation activities, and the implementation of

safety and health measures that are appropriate for the conditions, as necessary will also be required.

The former Cole Steel property (identified on **Figure 2.6-1**) currently has an environmental covenant prohibiting all earth moving activity in the identified "EC" area of the property related to the plating area sump unless it is demonstrated to the PADEP and USEPA that such activity is acceptable. According to the GWHHRA, this property and US Route 30 are the only off-Site properties in the LUA 5 with potentially complete exposure pathways to groundwater for utility and construction workers (groundwater concentrations greater than the MSCs and the depth to water shallower than 15 feet bgs). If the activity and use limitations in the environmental covenant are not sufficient or are lifted at some later date, the former Cole Steel property will be added to the area for periodic notifications described below in Section 3.1.2.2. The US Route 30 portion of LUA 5 is discussed below in Section 3.1.2.3 Waiver.

3.1.2.2 Periodic Notifications

To eliminate the potential utility worker exposure pathway, periodic notification of the property owners in the LUA 6 will be conducted as part of the periodic assessment of groundwater usage. This notification will also be provided to the local municipality and municipal water and/or sewer authorities and providers operating in the municipality. These parties will be notified of the potentially complete exposure pathway to groundwater by utility workers and will be provided contact information in the event that intrusive utility work is necessary on a property in LUA 6.

3.1.2.3 Waiver

A waiver from the HASP or periodic notification obligations related to the prevention of utility/construction worker exposure to groundwater will be requested for the US Route 30 right-of-way as it is more than reasonable to assume that utility/construction worker exposure will be infrequent and relatively short in duration due to the primary function of this property to act as an active highway.

3.1.3 Prevent Exceedance of the Applicable PADEP Indoor Air Screening Values by Vapor Intrusion into Current and Hypothetical Future On-Site and Off-Site Buildings

The GWHHRA identified or acknowledged the potential for groundwater concentrations to exceed VI screening values under portions of the East Campus (LUAs 1 and 2), all areas of the West Campus (LUA 3), a small area south of the SPBA in LUA 4, and west of the WPL (LUA 6). The following corrective actions are proposed to meet this CAO.

3.1.3.1 Institutional/Engineering Controls for On-Site Buildings

The GWHHRA made the assumption that residential use of the fYNOP property will be prohibited. Therefore the risks of VI on the residential use of the East and West Campuses were not evaluated. As a result, the environmental covenant proposed for the East Campus will include such a restriction, and the West Campus is already subject to such a restriction.

An evaluation conducted in the GWHHRA determined that COC concentrations in groundwater at existing buildings 3 and 70 on the East Campus do not exceed the PADEP nonresidential VI screening values (SV_{GW-NR}) and do not represent a potential VI source for current or future commercial/industrial workers in the buildings. The environmental covenant proposed for the East Campus will include an activity and use limitation requiring an evaluation and, if necessary, mitigation be conducted to address the potential for VI into existing and future inhabited buildings on the property.

The West Campus has a 775,000 square foot distribution center called the ERLC. A vapor barrier, approved by the PADEP, was installed beneath this building during its construction, thus suitable mitigation was performed. No other occupied buildings exist on the West Campus at this time. The existing environmental covenant on the West Campus will be modified to require that an evaluation and, if necessary mitigation, be conducted to address the potential for VI into existing and future inhabited buildings on the West Campus property.

3.1.3.2 Institutional Controls for Former Cole Steel Property

The GWHHRA did not evaluate the use of the Former Cole Steel Property under residential use. There is an existing environmental covenant that restricts the use of this property to nonresidential only. The recent groundwater quality data from the wells representative of shallow groundwater on

this property show no current VI source as defined by the PADEP Land Recycling Program Technical Guidance Manual for Vapor Intrusion into Buildings from Groundwater under Act 2 (effective January 18, 2017) and therefore, no unacceptable risk is associated with potential VI into buildings on this property.

3.1.3.3 Groundwater Extraction System in the Southern Property Boundary Area (SPBA)

A groundwater extraction system was installed and deployed in the fourth quarter 2018 to capture and control shallow groundwater containing PCE and TCE from fine-grained residual soil and bedrock along the fYNOP SPBA, where on-Site groundwater concentrations exceed VI screening criteria. This system is considered a component of the final remedy.

3.1.3.4 Waiver

A waiver from the obligations related to potential VI will be requested for the US Route 30 right-of-way as it is more than reasonable to assume that no occupied buildings will be constructed in the right-of-way.

3.1.3.5 Periodic Assessment

The GWHHRA determined that future residential development to the west of the WPL in LUA 6 without consideration of potential VI would not be appropriate. The properties in LUA 6 are currently zoned or used as industrial or are unsuitable for residential usage because they are in the floodplain. However, due to the potential for zoning change or future residential construction, periodic assessment will be performed to verify continued non-residential use in LUA 6 concurrent with the periodic assessment in Section 3.1.1.2.

3.1.4 Prevent Exceedance of PADEP Ambient Water Quality Criteria or Develop Site-Specific Standard Surface Water Goals for Toxic Substances in Codorus Creek

The GWHHRA determined that no unacceptable risks exist to humans in Codorus Creek (LUA 7) as a result of discharges of Site-impacted groundwater to the creek. Additionally, the Part 2 SRI for groundwater concluded that average surface water concentrations are less than the current PADEP ambient water quality criteria (Chapter 93) for PCE, TCE, and cis12DCE at all seven of the

monitoring stations. However, without the operation of the existing interim groundwater extraction system, current PADEP ambient water quality criteria may be exceeded for TCE and PCE. Corrective actions are proposed to meet the CAO for the final remedy.

3.1.4.1 Operation of Groundwater Extraction System

The current active groundwater extraction system in the WPL will continue to be operated as corrective actions to address the potential for exceedances of ambient water quality criteria in Codorus Creek; unless and until shutdown is allowed pursuant to regulatory approval of an alternative to the groundwater extraction system (Section 4.2.4).

The effectiveness of the groundwater extraction system in the WPL was tested under a number of pumping scenarios and seasonal conditions during studies summarized in the Part 2 SRI Report. The current configuration involves the pumping of five (5) collection wells: CW-9, CW-13, CW-15A, CW-17 and CW-20 at a combined groundwater extraction rate of approximately 220 gallons per minute (gpm). However, the SRI studies provided sufficient data on the surface water quality to demonstrate that the objective of preventing exceedances of ambient water quality criteria in Codorus Creek may be met by pumping only CW-20 at 80 gpm. The proposed plan is to continue pumping of the WPL extraction wells at withdrawal rates and pumping configurations that are supported by the SRI studies.

3.1.4.2 Consideration of Other Remedial Alternatives

Due to the potential long-term operational requirement of the GWTS and their related cost, a number of other remedial alternatives to reduce VOC mass in groundwater that discharges to surface water may be considered in the future. The intent to further evaluate and explore those alternatives is recorded in this subsection. The following alternatives or a combination of them for protecting surface water quality have been discussed by the fYNOP Remediation Team:

- Interception of spring-fed groundwater discharge: The majority of Site-impacted groundwater discharges to Codorus Creek through three springs. The fYNOP Team has preliminarily considered possible treatment at the spring discharge points, or intercepting the discharges and providing treatment, which includes evaluating technical items and permitting requirements.

- In stream treatment of spring-fed groundwater discharge: Preliminary discussions have considered treating the groundwater discharges in Codorus Creek by aeration using compressed air and/or a cascade structure at the location of the spring discharges to volatilize the TCE and PCE from the water.

- Assessment and development of a mixing zone in Codorus Creek: After selection and implementation of the final remedy, the fYNOP Remediation team will explore with the regulators the development and application of a mixing zone located downstream of the spring-fed groundwater discharges. The assessment would include additional monitoring of Codorus Creek and comparison of the monitoring results with USEPA stream water quality criteria.

3.1.5 Attain Applicable PADEP Statewide Health Standard MSCs for Groundwater for COCs Throughout the Plume

Concentrations in groundwater underlying the East Campus, West Campus, and the area west of the West Campus exceed applicable PADEP MSCs for groundwater (Used Aquifer with TDS ≤ 2500 mg/l in a non-residential setting). This widespread dissolved-phase presence of CVOCs is due to apparent DNAPL source zones in fine-grained soil residuum, quartzitic sandstone bedrock, and karstified carbonate bedrock at numerous locations within the Site. Results of extensive investigations completed over the past four decades indicate the Site is located in a complex hydrogeologic setting with much of the East Campus characterized by groundwater flow in low permeability residuum and fractured sandstone bedrock. The western portions of the East Campus, the West Campus, and the area west of the West Campus are characterized by groundwater flow in low permeability soil residuum and in high permeability karstified carbonate bedrock. After more than four decades since solvent releases occurred, the overall nature and extent of the DNAPL presence is difficult to discern. Groundwater concentration data suggests DNAPL penetration in the carbonate bedrock extends to depths on the order of 400 to 450 feet bgs.

Given that five to seven decades have elapsed since solvent releases occurred, the majority of the remaining CVOC mass at the Site is present as discrete, localized DNAPL source/accumulation zones or as CVOC mass that is diffused within the fine-grained soil and sedimentary bedrock. Sorption of CVOC mass onto organic carbon particles in the soil and bedrock is anticipated to be

another mass storage mechanism. The combined effects of dissolution of residual DNAPL, "back" diffusion of CVOC mass from aquifer solids, and desorption of CVOC mass from organic carbon particles are expected to extend groundwater restoration timeframes from decades to centuries.

In light of these findings, a Technical Impracticability (TI) Area is proposed for two areas of the Site. As shown on **Figure 3.1-1**, the two TI Areas include: first, a large, broad area that covers portions of the West Campus and areas to the west and east of the West Campus (TI Area 1); and second, a small, narrow area near the eastern property boundary that extends into the SPBA (TI Area 2). The proposed TI Areas were developed to encompass apparent DNAPL source areas and adjacent areas determined to be downgradient of apparent DNAPL source areas.

TI Area 1 includes the undeveloped industrial and floodplain area between the Site and Codorus Creek, and extends to the west side of Codorus Creek and northward along Codorus Creek to the extent of the carbonate aquifer. The CSM presented in the Part 2 SRI describes Codorus Creek as a discharge boundary for Site-impacted groundwater passing beneath the WPL under natural conditions (GSC, 2016, revised 2018, pp. 175-177). Components of the CSM are illustrated on **Figure 3.1-2**, Notes #7, 8 and 9, which are taken from the Part 2 SRI and restated here:

7. Under natural flow conditions (without operation of the groundwater extraction system), all impacted groundwater flowing through the CPA and WPL discharges into Codorus Creek.
8. Due to discrete conduits, site-impacted groundwater can pass beneath (west of) the creek through solution channels before discharging to the creek.
9. Noncarbonate Kinzers Shale eliminates the potential for development of solution channels connecting the site to carbonate rocks further west, and is a barrier that forces the discharge of site-impacted groundwater to the creek

Two groundwater discharge locations, SW-15 and SW-26, impacted by the Site, discharge to the west side of Codorus Creek. The locations of these springs are shown on Figure 3.5-26 of the Part 2 SRI. The occurrence of these springs supports the basis for the CSM components stated above, and the extension of the TI Area 1 boundary to the west side of the creek.

As shown on **Figure 3.1-1**, TI Area 1 extends to the north of groundwater monitoring wells MW-95 and the MW-98 well cluster to the northern extent of the carbonate aquifer. **Figure 3.1-1** illustrates that the northern extent of the carbonate is the result of a fault contact between the Vintage Formation (limestone/dolostone) and the Harpers Formation (phyllite). The Harpers Formation is not susceptible to the development of solution cavities and is much less permeable than the Vintage, resulting in Site-impacted groundwater being directed to the creek, rather than passing into the Harpers. This is illustrated by the travel directions of tracer dyes injected into the Vintage at various depths, and further supported by the trace to undetected concentrations of Site-related COCs in the Harpers in MW-98D. This condition is the basis for the northward extension of the TI Area 1 boundary.

TI Area 2, in the southeastern corner of the fYNOP Site, bounds TCE and PCE concentrations in groundwater that result from one or more apparent releases of DNAPL in the vicinity of monitoring well MW-15 and the SPBA area. The northern, eastern, and western boundaries surround four monitoring wells in the northern portion of the TI area where concentrations exceeding PADEP used aquifer MSCs show no concentration trend. The southern boundary of TI Area 2 corresponds with the southern property boundary of the fYNOP.

For portions of the Site outside of the two proposed TI Areas, the proposed remedy is to attain a Site-Specific Standard (SSS) under Act 2 for groundwater using the GWHHRA and institutional/engineering controls, with used aquifer MSCs for groundwater eventually met through monitored natural attenuation (MNA). For the purposes of this report, MNA refers to monitoring groundwater for the presence of VOCs to confirm declining trends in concentrations due to the natural attenuation processes of dilution, dispersion, aqueous diffusion, sorption, and abiotic degradation. **Table 3.1-1** includes a listing of the PADEP used aquifer MSCs for groundwater.

A plume of TCE and PCE migrated off Site from the SPBA defined by TI Area 2. The existing groundwater extraction system described above in Subsection 3.1.3.3 is part of the final remedy for the remediation of this plume.

A work scope for PRCP groundwater monitoring within and outside TI Area 1 and TI Area 2 will be presented in the CP.

3.2 Soil

The Soils RA (GSC, 2012) established no risk to human health and was conducted in accordance with PADEP Act 2 guidance to include the results of presumptive remedies. The presumptive remedy incorporated into the Soils RA included the assumption that existing impermeable areas (pavement and building slabs, protective liners) will remain in place (or, if disturbed, be replaced) and become part of the final remedy. In addition, the assumption was made that property use in the future will be limited to non-residential. Secondly, a HASP will be required for earth disturbance activity on the property to protect from direct and indirect outdoor exposure to soil by utility and construction workers that includes an evaluation of the excavation location, the scope of the work for the excavation activities, and the implementation of safety and health measures that are appropriate for the conditions, as necessary.

During the development of **Table 3.0-1**, the fYNOP Remediation Team acknowledged the following:

- Because of the extensive mass of recalcitrant COCs diffused and adsorbed in the aquifer matrix the extensive volume of aquifer impacted will act as a source for groundwater contamination many years into the future. Remediating small known areas of concentrations in the soil that exceed PADEP soil to groundwater MSCs is believed to be of inconsequential value.

- Source investigations conducted to locate soil contamination above the water table that would remove a source of groundwater contamination have been extensive and have not been successful. Past interim removal actions, while removing mass, did little to improve the quality of groundwater.

- The soil investigation has been quite extensive, and areas of known previous activities that may have resulted in releases of COCs have been investigated. A potential exists that future excavations may encounter COCs that may expose untrained construction workers.

Two CAOs for soil summarized from **Table 3.0-1** are listed below:

Residential and Nonresidential Human Health

1) Prevent direct contact exposure to chemicals where concentrations exceed PADEP direct contact MSCs in soil.

Cross Media Transfer

2) Prevent chlorinated VOCs, semi-volatile organic compounds (SVOCs) and metals from leaching and impacting groundwater above PADEP used aquifer MSCs for groundwater.

The proposed corrective actions are the use of institutional and engineering controls to meet the CAOs as described below.

3.2.1 Prevent Direct Contact Exposure to Chemicals Where Concentrations Exceed PADEP MSCs

There are no exceedances of PADEP direct contact MSCs in soil samples in off-Site samples. Therefore this CAO applies only to on-Site areas, the East Campus (LUAs 1 and 2) and the West Campus (LUA 3). The Soils RA assumed no residential property use, and excluded from the risk assessment soil samples beneath all pavement, building slabs and protective liners. Those presumptive corrective actions will be used to address the CAO.

3.2.1.1 Land Use Restrictions

Land use on the East Campus (LUA 1 and 2) and West Campus (LUA 3) is currently non-residential. The West Campus has a land use restriction in the existing environmental covenant that prohibits future residential land use. A planned environmental covenant for the East Campus will include a land use restriction prohibiting future residential land use on the property.

3.2.1.2 Caps to Limit Direct Contact Exposure

The existing environmental covenant on the West Campus requires the maintenance of caps and building slabs to limit potential direct contact exposure to soil. An environmental covenant proposed for the East Campus will require the maintenance of caps and building slabs to limit potential direct contact exposure to soil. **Figure 3.2-1** from the Soils RA (GSC, 2012) identifies the general locations of the caps (buildings, foundations, slabs, and pavement areas) that were used during the soil risk assessment and will be maintained as engineering controls to limit potential

direct contact exposure to soil. These areas will be surveyed, appropriately documented, and maintenance will be made a part of the long-term maintenance plan for the Site.

3.2.1.3 Health and Safety Plan/Soil Management Plan

The existing environmental covenant on the West Campus requires compliance with a PRCP or SMP. The existing environmental covenant also requires that all building and demolition plans be reviewed by Harley-Davidson. PADEP requires that a HASP be implemented for earth disturbance activity on the property to protect from direct contact exposure to soil by utility and construction workers. The HASP and SMP will be included in the proposed CP and FR.

An environmental covenant proposed for the East Campus will require that a HASP and a SMP, be implemented for earth disturbance activity on the property to protect from direct contact outdoor exposure to soil by utility and construction workers. An evaluation of the excavation location, the scope of the work for the excavation activities, and the implementation of safety and health measures that are appropriate for the conditions, as necessary will also be required.

3.2.2 Prevent Chlorinated VOCs, SVOCs and Metals from Leaching and Impacting Groundwater

Because of the extensive mass of recalcitrant COCs diffused and adsorbed in the aquifer matrix and the extensive volume of aquifer impacted that will act as a source for groundwater contamination many years into the future, there is inconsequential value to remediating small known areas of concentrations in the soil that exceed PADEP soil to groundwater MSCs. However, there are areas of soil and buried waste under existing pavement, building slabs and protective liners for which there would be relative improvement if the surface remained impermeable. These impermeable surface areas will be recorded and maintained as part of the final remedy.

3.2.2.1 Caps to Limit Potential Leaching to Groundwater

The caps described above will also limit infiltration of precipitation and runoff. This will limit leaching from soil to groundwater and the potential for groundwater to be impacted above the groundwater MSCs from COPCs in the vadose zone (above the water table). The impermeable surface will be extended over the unpaved grass swale in the WPL. **Figure 3.2-1** identifies the

general locations of the caps (e.g., foundations, slabs, and pavement capping areas) that will be maintained as engineering controls to meet the corrective action objectives. These areas will be surveyed, appropriately documented, and maintenance will be made a part of the long term maintenance plan for the Site.

Areas on the East Campus with the potential for substances to leach from soil to groundwater and to impact the groundwater above the MSCs have been characterized and are limited in extent. No caps are proposed as part of the final remedy in the East Campus for the purpose of limiting potential leaching from soil to groundwater.

3.3 Surface Water

The only corrective action objective for surface water occurs under the Resource Restoration column because the GWHHRA identified no residential or non-residential human health risks associated to surface water. Additionally, the Part 2 SRI concluded that average surface water concentrations are less than the current PADEP ambient water quality criteria (Chapter 93) for PCE, TCE, and cis12DCE at all seven of the monitoring stations. Without the operation of the existing interim groundwater extraction system, current PADEP ambient water quality criteria may be exceeded for TCE and PCE. Corrective actions are proposed to meet the CAO. The source of the impact on surface water is due to cross-media transfer from groundwater. The CAO stated for surface water was covered in Section 3.1. The proposed corrective action is discussed in Subsection 3.1.4.

3.4 Air

Page 4 of **Table 3.0-1** examines the environmental medium of air. In all cases at the Site, air is only impacted by cross-media transfer from groundwater or soil. All CAOs related to air have previously been addressed in the previous sections on groundwater or soil.

3.5 Waste

Management of waste parallels the management of soil, discussed in Section 3.2, with the same risk assessment assumptions as with soil. Page 5 of **Table 3.0-1** examines the CAOs for waste.

Four CAOs for waste summarized from **Table 3.0-1** are listed below:

Residential and Nonresidential Human Health

3) Prevent direct contact exposure to waste.

4) Prevent inappropriate relocation of waste.

Cross Media Transfer

5) Prevent potential for leaching of COCs to groundwater from the Eastern Landfill and impacting groundwater above respective groundwater MSCs.

6) Prevent potential for leaching of COCs to groundwater from fill under Eden Road and the western portion of the WPL impacting GW above respective groundwater MSCs.

No waste is deposited off the fYNOP property. These CAOs apply only to on-Site areas, the East Campus (LUAs 1 and 2) and the West Campus (LUA 3).

3.5.1 **Prevent Direct Contact Exposure to Waste**

The Soils RA assumed no residential property use, and excluded from the risk assessment soil samples beneath pavement, building slabs and protective liners. Those presumptive corrective actions will be used to address this CAO.

The corrective actions proposed for limiting the potential direct contact exposure to soil (Section 3.2.1), namely land use restrictions, caps to prevent direct contact, and HASP/SMP for intrusive work in the East and West campuses also address potential direct contact to waste.

3.5.2 **Prevent Inappropriate Relocation of Waste**

The existing environmental covenant on the West Campus will be modified, and the environmental covenant proposed for the East Campus will require that, if waste is encountered during construction or excavation, it will be managed in accordance with appropriate local, state, and federal regulations.

3.5.3 **Minimize Leaching of COCs to Groundwater from the Eastern Landfill**

The Soils RI (SAIC, 2009) reported a few detections of COCs that exceed nonresidential soil to groundwater MSCs in the Eastern Landfill. As previously stated, due to large mass of recalcitrant COCs adsorbed in the aquifer matrix and the extensive volume of aquifer impacted that will act as a source for groundwater contamination many years into the future, no inconsequential value exists to remediating small known areas of concentrations in the soil that exceed PADEP soil to groundwater MSCs. Due to the nature of landfills in general and position of the Eastern Landfill above the CPA where the higher concentrations of COCs occur, recent samples of groundwater were taken upgradient and downgradient of this area. **Figure 3.5-1** shows the results of the most recent groundwater analyses from groundwater samples taken in 2016. The results indicate that the landfill is not a source of additional COCs to the groundwater. No action is proposed to address the MSC exceedances in the waste material in the landfill above the water table.

3.5.4 **Minimize Leaching of COCs to Groundwater from Fill under Eden Road and the Western Portion of the WPL**

The corrective action proposed for limiting potential leaching of COCs from soil to groundwater (Section 3.2.2), namely caps to prevent leaching of COCs to the groundwater in the WPL, also address this CAO.

4 SUMMARY OF THE PROPOSED REMEDY

The proposed remedy includes a combination of remedial technologies and process options assembled into a presumptive remedial alternative to meet the CAOs. The overall remedy consists of a combination of institutional controls, engineering controls, and remedial actions. The specific elements of the proposed remedy apply to on-Site and off-Site areas subdivided in accordance with the LUAs defined in the GWHHRA (**Figure 2.6-1**). A summary of the specific elements of the proposed remedy are listed by LUA in the following subsections. **Table 4.0-1** is a summary of the proposed final remedy. Obligations for off-Site engineering and institutional controls (i.e., controls to address potential complete exposure pathways in off-Site LUAs) will be included in the proposed environmental covenant for the East Campus Property.

4.1 On-Site Areas

On-Site LUAs are subdivided into the East Campus (Harley-Davidson Property) composed of a developed area (LUA 1) and undeveloped and wooded area (LUA 2), and the West Campus (LUA 3) composed of a warehouse building, the WPL, and a portion of Eden Road.

4.1.1 East Campus (LUAs 1 and 2)

- Institutional Controls
    - Environmental Covenant (to be implemented) – Restricting groundwater use; prohibiting residential land use; including HASP and SMP requirements in the CP and FR for intrusive activities causing soil disturbance; and requiring evaluation of the potential VI pathway into future proposed buildings. The proposed covenant would be applied to both LUAs 1 and 2.
    - Environmental Covenant (to be implemented) - Requiring that relocation of waste be managed in accordance with appropriate PADEP regulations.
    - Environmental Covenant (to be implemented) – The MMRP and the BSRA portions of the East Campus Area will be subject to additional activity and use limitations related to the unique historical activities in those areas, as documented in the separate PP-FR report.

- Environmental Covenant (to be implemented) - Requiring maintenance of existing caps (e.g., foundations, slabs, and pavement capping areas) to prevent potential direct contact exposure to soil.

- TI Area (to be implemented) – Designation of TI Areas around portions of the East Campus where attainment of PADEP Statewide Health Standard in groundwater is believed to be impracticable due to the widespread presence of multiple, discrete DNAPL source areas in residual soil and bedrock.

- Engineering Controls

  - VI Mitigation (to be implemented) – Passive vapor barriers or active sub-slab depressurization systems to eliminate the potential VI pathway into future proposed buildings. This engineering control would be applied based on results of an evaluation of the VI pathway or as a presumptive mitigation alternative.

  - Groundwater Extraction System in the WPL (existing) – Control of groundwater to reduce VOC mass flux in groundwater that eventually discharges to Codorus Creek. This remedial action consists of groundwater extraction using one or more vertical wells with air stripping treatment of the groundwater withdrawals at the groundwater treatment building (Building 41A) prior to discharge to Codorus Creek (currently active as an interim remedial measure).

  - Groundwater Extraction System in the SPBA (existing) – Capture and control shallow groundwater along the fYNOP property boundary to mitigate off-Site migration of shallow groundwater demonstrated by a hydraulic gradient reversal, where groundwater concentrations exceed VI screening criteria. This engineering control includes extraction of groundwater using vertical wells with air stripping treatment of the groundwater withdrawals in the Site Groundwater Treatment Plant (currently active as an interim remedial measure and undergoing performance evaluation).

- Remedial Actions

    - Groundwater Monitoring (to be implemented) – Monitoring of groundwater with the multiple objectives: 1) document temporal trends in the nature and lateral extent of VOC plumes in groundwater associated with suspected DNAPL source areas; 2) verify that contaminated groundwater remains within TI Area 1 and TI Area 2; 3) assess declining trends in VOC concentrations in groundwater in portions of the East Campus outside the proposed TI Areas where MNA is proposed as part of the remedy to ultimately demonstrate attainment of groundwater cleanup levels; and 4) confirm the groundwater extraction system maintains hydraulic control of shallow groundwater in the SPBA (currently active as an interim remedial measure).

4.1.2 **West Campus (LUA 3)**

- Institutional Controls

    - Environmental Covenant (existing) – Restricting groundwater use; prohibiting residential land use; referencing the HASP and SMP requirements in the CP and FR for intrusive activities causing soil disturbance; and requiring maintenance of existing caps to prevent potential direct contact to soil, soil fill, and/or waste, and potential leaching from soil, soil fill, and/or waste to groundwater.

    - Environmental Covenant (proposed modification) – Requiring evaluation of the potential VI pathway into future proposed buildings and maintenance of the vapor barrier in the existing building.

    - Environmental Covenant (proposed modification) – Requiring that relocation of waste be managed in accordance with appropriate PADEP regulations.

    - Environmental Covenant (to be implemented) – The MMRP portion of the West Campus will be subject to additional activity and use limitations related to the unique historical activities in those areas, as documented in the separate PP-FR.

- TI Area (to be implemented) – Designation of TI Area covering the West Campus due to the widespread presence of multiple, large DNAPL source areas in residual soil and carbonate karstic bedrock.

- Engineering Controls

  - VI Mitigation (existing) – Passive vapor barriers or active sub-slab depressurization systems to eliminate the potential VI pathway into existing and future proposed buildings. This engineering control would be applied based on results of an evaluation of the VI pathway or as a presumptive mitigation alternative.

  - Groundwater Extraction System in the WPL (existing) – Control of groundwater to reduce VOC mass flux in groundwater that eventually discharges to Codorus Creek. This remedial action includes extraction of groundwater using one or more vertical wells with air stripping treatment of the groundwater withdrawals in the Site Groundwater Treatment Plant (currently active as an interim remedial measure).

  - Mapping and maintenance of existing caps (to be implemented) – Survey (mapping) of existing caps and long-term maintenance of the caps to protect against direct contact with soils with concentrations exceeding MSCs under nonresidential land use and to reduce infiltration of groundwater and leaching of COCs to groundwater.

- Remedial Actions

  - Groundwater Monitoring (to be implemented) – Monitoring of groundwater with the multiple objectives: 1) document temporal trends in the nature and lateral extent of VOC plumes in groundwater associated with suspected DNAPL source areas; 2) verify that contaminated groundwater remains within TI Area 1; 3) assess declining trends in VOC concentrations in groundwater in portions of the West Campus outside the proposed TI Area where MNA is proposed as part of the remedy to ultimately demonstrate attainment of groundwater cleanup levels; and 4) confirm the groundwater extraction system reduces VOC mass flux in groundwater that discharges to Codorus Creek (currently active as an interim remedial measure).

4.2 Off-Site Areas

Off-Site areas in proximity to the fYNOP are subdivided into four distinct LUAs, including: residential areas, north, east, and south of the East Campus (LUA 4); developed industrial areas and U.S. Route 30, south of the Site, west of the Site on the west side of Codorus Creek, and the quarry northwest of the Site (LUA 5); undeveloped industrial and floodplain areas between the West Campus and Codorus Creek (LUA 6); and the portion of Codorus Creek southwest, west, and northwest of the Site (LUA 7).

4.2.1 Residential Areas (LUA 4)

- Institutional Controls
    - Periodic Assessment (to be implemented) – Periodic verification of continued nonuse of groundwater as part of a PRCP. The requirement for periodic assessment will be included in the East Campus Environmental Covenant.
- Remedial Actions
    - Groundwater Monitoring (to be implemented) – Monitoring of groundwater with the multiple objectives: 1) assess declining trends in VOC concentrations in groundwater, where present in LUA 4 to ultimately demonstrate attainment of groundwater cleanup levels; and 2) confirm the groundwater extraction system in the SPBA portion of the East Campus maintains hydraulic control of shallow groundwater.
    - Groundwater Extraction System in the SPBA (existing) – Capture and control shallow groundwater along the fYNOP property boundary to mitigate off-Site migration of shallow groundwater demonstrated by a hydraulic gradient reversal, where groundwater concentrations exceed VI screening criteria. This engineering control includes extraction of groundwater using vertical wells with air stripping treatment of the groundwater withdrawals in the Site Groundwater Treatment Plant (currently active as an interim remedial measure).

- Residential Well Decommissioning (to be implemented) – Decommission this off-Site well located in the NPBA, and used for lawn irrigation and outdoor non-potable uses. Decommissioning will require property owner cooperation.

4.2.2 **Industrial Areas (LUA 5)**

- Institutional Controls
  - Periodic Assessment (to be implemented) – Periodic verification of continued nonuse of groundwater as part of a PRCP (includes a waiver from periodic assessment for U.S. Route 30 right-of-way).
  - Environmental Covenant for Former Cole Steel property (existing) – Restricts groundwater use; prohibits residential land use.
  - Periodic Notifications (to be implemented) – Periodic notification to property owners of potentially complete exposure pathway to groundwater by utility construction workers as part of a PRCP.
- Remedial Actions
  - Groundwater Monitoring (to be implemented) – Monitoring of groundwater to assess declining trends in VOC concentrations in groundwater, where present in LUA 5 to ultimately demonstrate attainment of groundwater cleanup levels (currently active as an interim remedial measure).
  - Groundwater Extraction System in the SPBA (existing) – Control of groundwater to prevent off-Site migration of VOCs that may extend into LUA 5 (currently active as an interim remedial measure).

4.2.3 **West of West Parking Lot (LUA 6)**

- Institutional Controls

- Periodic Assessment (to be implemented) – Periodic verification of continued nonuse of groundwater as part of a PRCP.

- Periodic Notifications (to be implemented) – Periodic notification to property owners of potentially complete exposure pathway to groundwater by utility construction workers as part of a PRCP.

- TI Area (to be implemented) – Designation of TI Area around the portion of LUA 6 that is west (downgradient) of the West Campus with the presence of VOC mass in carbonate karstic bedrock.

- Remedial Actions

  - Groundwater Monitoring (to be implemented) – Monitoring of groundwater with the multiple objectives: 1) document temporal trends in the nature and lateral extent of VOC plumes in groundwater associated with suspected DNAPL source areas; 2) verify that contaminated groundwater remains with TI Area 1; 3) assess declining trends in VOC concentrations in groundwater in portions of the LUA 6 downgradient of the West Campus where DNAPL source areas are less pronounced; 4) assess declining trends in VOC concentrations in groundwater outside the proposed TI Area where MNA is proposed as part of the remedy to ultimately demonstrate attainment of groundwater cleanup levels; and 5) confirm the groundwater extraction system (currently active as an interim remedial measure and part of the PP-FR in the WPL reduces VOC mass flux in groundwater that discharges to Codorus Creek.

4.2.4 **Codorus Creek (LUA 7)**

- Remedial Actions

  - Surface Water Monitoring (to be implemented) – Monitoring of surface water quality to confirm the effectiveness of the groundwater extraction system (currently active as an interim remedial measure and part of the PP-FR) in the WPL portion of the West Campus at controlling/reducing the VOC mass flux in groundwater that discharges to

Codorus Creek. The monitoring data would also be used to develop site-specific surface water goals for PCE, TCE, and cis12DCE.

- Groundwater Extraction System in the WPL (existing) – Control of groundwater to reduce VOC mass flux in groundwater that migrates from LUA 1,2 and 3 through LUA 6 and eventually discharges to Codorus Creek (LUA 7). This remedial action includes extraction of groundwater using one or more vertical wells with air stripping treatment of the groundwater withdrawals in the Site Groundwater Treatment Plant (currently active as an interim remedial measure).

- Evaluation of Alternative to Groundwater Extraction System in the WPL (to be implemented) – Evaluate remedial action alternatives to groundwater extraction in the WPL to reduce VOC mass in Codorus Creek. Alternatives to be considered include: intercept and treat spring-fed groundwater discharge at certain spring locations; *in-situ* treat spring-fed discharge at certain spring locations; and develop a mixing zone strategy in Codorus Creek located downstream of certain spring-fed groundwater discharge points.

5 JUSTIFICATION FOR THE PROPOSED REMEDY

The proposed remedy has been developed based on the results of soil and groundwater RI, soil and groundwater risk assessments, and the successful implementation of IRAs at the Site. This section provides a justification for the proposed remedy based on a review of the remedy against the evaluation criteria specified in Section 300.430(e) of the NCP and the evaluation criteria (standards) for RCRA Corrective Action (USEPA, 1994b).

The first three evaluation criteria are termed "threshold criteria" and must be satisfied for an alternative to be considered for selection. Threshold criteria descriptions are provided below.

1. ***Overall Protection of Human Health and the Environment:*** This criterion is an evaluation of the alternative's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure are eliminated, reduced, or controlled through removal, treatment, engineering controls, or institutional controls. The alternative's ability to achieve each of the CAOs is evaluated.

2. ***Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) and Ability to Achieve Cleanup Objectives:*** This criterion evaluates how the alternative complies with the ARARs or, if a waiver is required, how it is justified. ARARs are defined as those promulgated Federal or State requirements (e.g., cleanup standards, standards of control) that specifically address a hazardous substance, pollutant, or contaminant. ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs provide guidance on acceptable or permissible concentrations of regulated substances in different environmental media. These chemical-specific ARARs can provide guidance on cleanup levels for various media, points of compliance for achievement of those cleanup levels, and possible goals for cleanup timeframes. Location-specific ARARs govern activities in critical environments such as floodplains, wetlands, endangered species habitats, or historically significant areas. Action-specific ARARs are technology- or activity-based requirements. The ARARs identified for the Site in the RAA Part 1 report are listed in **Table 5.0-1**.

3. ***Control the Sources of Releases:*** This criterion evaluates the alternatives ability to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health or the environment. When evaluating this criterion, further releases of contamination are to be controlled to the maximum extent practicable.

The next five evaluation criteria "primary balancing criteria" are typically used to compare the positive and negative aspects of each of the remedial strategies. For the fYNOP, these primary balancing criteria are reviewed solely to provide some guidance as to whether or not the proposed remedy is reasonable with respect to each criterion.

1. ***Long-term Effectiveness and Permanence:*** This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on Site after the selected remedy is implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the engineering and/or institutional controls intended to limit the risk, and 3) the reliability of these controls.

2. ***Reduction of Toxicity, Mobility or Volume through Treatment:*** Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the Site.

3. ***Short-term Effectiveness:*** The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

4. ***Implementability:*** The technical and administrative feasibility of implementing each alternative are evaluated. Technical feasibility includes the difficulties associated with the construction of the remedy and the ability to monitor its effectiveness. For administrative feasibility, the availability of the necessary personnel and materials is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, institutional controls, and so forth.

5. ***Cost:*** Capital costs and annual operation, maintenance, and monitoring costs are estimated for each alternative and compared on a present worth basis. Although cost-effectiveness is

the last balancing criterion evaluated, where two or more alternatives have met the requirements of the other criteria, it can be used as the basis for the final decision.

The final two criteria, State Acceptance and Community Acceptance, are considered to be "modifying criteria" and they are taken into account after evaluating the proposed remedy against the other seven criteria.

5.1 Threshold Criteria

The proposed remedy satisfies the threshold criteria as follows:

- ***Overall Protection of Human Health and the Environment*** – The application of institutional and engineering controls will eliminate, reduce, or control risks to human health and the environment so that there are no unacceptable risks associated with the remaining presence of hazardous substances in on-Site and off-Site media. The elements of the proposed remedy include institutional and engineering controls will: 1) eliminate the potential for on-Site use of groundwater; 2) reduce the potential for off-Site groundwater use; 3) eliminate, reduce, or control exposures to hazardous substances in on-Site and off-Site groundwater; 4) eliminate, reduce or control exposures to hazardous substances in on-Site soils and wastes; 5) eliminate the potential for VI into existing or future buildings; and 6) reduce the chemical mass flux in Site groundwater that discharges to Codorus Creek.

- ***Compliance with ARARs and Ability to Achieve Media Cleanup Objectives*** – The chemical–specific ARARs identified in **Table 5.0-1** will be met with the exception of PA drinking water standards for portions of the East Campus and West Campus where Site investigations have indicated the apparent presence of DNAPL source areas and areas that are in a position downgradient of those apparent DNAPL source areas. This exception will be addressed by the designation of TI Areas, including a large, broad area that covers portions of the West Campus and the areas east and west of the West Campus; and a small, narrow area near the eastern property boundary that extends into the SPBA. The large TI Area would include the undeveloped industrial and floodplain area between the Site and Codorus Creek, and will extend to the west side of Codorus Creek. Outside of the TI areas the remedy will allow achievement of media cleanup objectives at designated points of

compliance within reasonable timeframes. The location-specific and action-specific ARARs in **Table 5.0-1** that apply to the proposed remedy will also be met. The remedies will accomplish the Overall Protection of Human Health and the Environment by implementing a plan to provide notices and inspections of land use and water supply development off Site and environmental covenants to prevent groundwater consumption on Site.

- ***Control the Sources of Releases*** –To the extent practicable, the proposed remedy includes elements that will control the remaining sources to eliminate further releases that could pose a threat to human health and the environment. The proposed remedy includes capping of former suspected DNAPL source areas that eliminates the potential for direct-contact with soil and eliminates or reduces infiltration of water that would otherwise have the potential to generate groundwater plumes. The remedy also includes environmental covenants that prohibit site activities that could have the potential to reduce the effectiveness of the current source control measures. These covenants include the restriction of the use of groundwater and the prohibition of site activities that would disturb, remove, or otherwise interfere with the installation, use, operation, and maintenance of the engineering controls required for the remedy, such as caps in former suspected DNAPL source areas.

5.2 Balancing Criteria

The proposed remedy is reasonable with respect to the balancing criteria as follows:

- ***Long-term Effectiveness and Permanence*** – The elements of the proposed remedy have a proven track record of success. The use of environmental covenants, periodic reviews, and periodic notifications as institutional controls has an excellent history of long-term effectiveness in eliminating, reducing, or controlling pathways and protecting human health and the environment. The proposed engineering controls of groundwater extraction using vertical wells has demonstrated decades of effectiveness at the Site in reversing hydraulic gradients, controlling VOC mass flux from apparent DNAPL source areas, and reducing and controlling groundwater VOC plumes. The treatment of VOC-containing groundwater by air stripping also has decades of demonstrated effectiveness at the Site. Monitoring of groundwater and surface water are remedial actions that are proven to be effective at

tracking remedial progress and verifying the selected remedy is successful in achieving CAOs.

- ***Reduction of Toxicity, Mobility, or Volume through Treatment*** – The proposed remedy does not involve active remedial actions that would substantially reduce the toxicity or mobility of contaminants. Groundwater extraction has removed a large VOC mass but results of investigations indicate a significant VOC mass still remains at the Site. Efforts to reduce the toxicity of the contaminants by degradation, the mobility of the contaminants by stabilization or grouting, and further reduce the volume of the contaminants by active *in-situ* remedial actions, such as thermal treatment, have been determined to be technically impracticable or not feasible due to hydrogeologic conditions and the nature and extent of the contaminants (GSC, 2014).

- ***Short-term Effectiveness*** – The short-term effectiveness of the proposed remedy is reasonable as it does not pose unacceptable risks to Site workers, the community, or the environment.

- ***Implementability*** – The proposed remedy is readily implementable. Many of the elements of the remedy are already in place or being actively implemented as IRA. Elements of the remedy that are proposed are both technically and administratively feasible. The proposed elements of the remedy are reasonable and have a long history in Pennsylvania of acceptance by Federal, State, and local regulatory agencies.

- ***Cost*** – The proposed remedy is a presumptive remedy, and any potential alternatives are orders of magnitude more expensive and a full cost comparison is not practicable. Act 2 and the One Cleanup Program (under the Memorandum of Agreement between EPA and PADEP) do not require cost estimates for remedy construction and implementation or long-term O&M and monitoring, and do not require posting financial assurance for post-remedial care.

5.3 Modifying Criteria

The modifying criteria will be addressed for the proposed remedy as follows:

- ***State Acceptance*** – As part of the One Cleanup Program process, the proposed remedy described in this report will be reviewed concurrently by both the USEPA and the PADEP.

- ***Community Acceptance*** – This criterion will be addressed by implementing the specific requirements of the PA Act 2 public notification process and by communication of the proposed remedy to the community via periodic newsletters and project-specific website prepared and maintained by the fYNOP team.

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Tables

	Table 3.0-1 - fYNOP 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 Media	**Human Health Residential Onsite**	**Human Health Non-Residential Onsite**	**Human Health Residential Offsite**	**Human Health Non-Residential Offsite**	**Ecological Receptors**	**Cross-media Transfer**	**Resource Restoration**
Ground-water	**A**. Prevent drinking water exposure to constituents of concern (COCs) (wide spread chlorinated compounds, localized benzene, chromium, 1,4-dioxane) above respective PADEP used aquifer medium-specific concentrations (MSCs) for groundwater (GW). i. Priority/Timing (East Campus): 3 (GW not currently used on Site, current owner restricts GW use except for sampling and remediation. Current property use is non-residential.) Presumed Remedy: Restrict future land use to non-residential and GW use to sampling and remediation with an environmental covenant. ii. Priority/Timing (West Campus): 4 (recorded environmental covenant restricts property use to commercial or	**A**. Prevent drinking water exposure to COCs (wide spread chlorinated compounds, localized benzene, chromium, 1,4-dioxane) above GW MSCs. i. Priority/Timing (East Campus): 3 (GW not currently used on Site, current owner restricts GW use except for sampling and remediation. Presumed Remedy: Restrict future groundwater use to sampling and remediation with an environmental covenant). ii. Priority/Timing (West Campus): 4 (environmental covenant restricts GW use except for sampling and remediation). **B**. Prevent exposure above respective GW MSCs to TCE, PCE, 124TMB, Bz, Nap, 11DCE, c1,2DCE, and VC for utility workers and construction workers for TCE and c1,2DCE where depth to GW is less than 15' below ground surface (bgs). i. Priority/Timing (East Campus): 3 (Current owner has a procedure in place to require health and safety (H&S) plan and soil management plan for activities involving excavations. No restrictions exist for future owners.) Presumed Remedy: develop an environmental covenant that requires H&S plan and soil management plan for activities involving excavations. ii. Priority/Timing (West Campus): 4 (recorded environmental covenant requires H&S plan and soil management plan for activities involving excavations)	**A.** Prevent drinking water exposure to TCE, PCE, DCE and VC above respective GW MSCs. i. Priority/Timing: 3 (GW not currently used for drinking water off-Site [GSC, 2017]. Presumed Remedy: Implement Post Remediation Care Plan [PRCP] for periodic monitoring of GW use and reporting to verify continued nonuse of GW). ii. Priority/Timing (former Cole Steel): 4 (environmental covenant restricting residential and GW use exists on former Cole Steel property).	**A.** Prevent drinking water exposure to TCE, PCE, DCE and VC above respective GW MSCs. i. Priority/Timing: 3 (GW not currently used off-Site [GSC, 2017]. Presumed Remedy: Implement PRCP for periodic monitoring of GW use and reporting to verify continued nonuse of GW, except as noted below in ii. and iii.). ii. Priority/Timing (former Cole Steel): 4 (environmental covenant restricting use of groundwater exists on former Cole Steel property). iii. Priority/Timing: (US Route 30 [Arsenal Road] South of Site): 3 (Request waiver for the need of an environmental covenant restricting the use of groundwater beneath the Arsenal Road). **B.** Prevent exposure to TCE above the GW MSC in groundwater for construction and utility workers in areas where depth to groundwater is less than 15' bgs. i. Priority/Timing: 3 (no current control over off-Site properties). ii. Priority/Timing (former Cole Steel): 4 (environmental covenant exists requiring a health and safety plan and soil management plan for activities involving excavations).	Not Applicable (NA) (Ecological screening assessment in GW risk assessment identified no ecological COPCs).	**A.** Prevent exceedance of PADEP indoor air screening values for numerous volatile organic compounds (VOCs) by vapor intrusion (VI) into current and hypothetical future on-Site and off-Site residential buildings. i. Priority/Timing (East Campus): 3 (Current property use is non-residential. Presumed Remedy: Restrict future land use to non-residential with an environmental covenant). ii. Priority/ Timing (West Campus): 4 (environmental covenant limits property use to commercial or industrial). iii. Priority/Timing (West of Site): 3 (areas are currently zoned or used as industrial, or unsuitable for residential construction [flood plain]). iv. Priority/Timing (former Cole Steel): 4 (environmental covenant exists on former Cole Steel property restricting residential development). v. Priority/Timing (Southern Property Boundary Area [SPBA]): 3 (Interim groundwater extraction system is operating to address the potential risk of VI off-site within a lateral distance of 100 feet of the shallow groundwater contamination in the monitoring wells located in the southeast corner of the SPBA). **B.** Prevent exceedance of PADEP indoor air screening values for TCE by VI into current and hypothetical future non-residential buildings by on-Site commercial/industrial workers i. Priority/Timing (East Campus): 3 (current buildings have industrial ventilation systems). ii. Priority/Timing (West Campus): 3	**A.** Attain GW MSCs for COCs throughout the plume. Priority/Timing: 3 (Technically impracticable in some areas at the Site due to the widespread nature of the source areas and contaminants in the groundwater and the technical inability to address continuing sources. COCs are sorbed to the aquifer matrix or in the form of DNAPL. Concentration trends are downward in most representative wells due to natural attenuation.) **B.** Establish a Technical Impracticability (TI) Boundary where conditions in A. above exist. Outside of the TI Boundary, restore the aquifer below PADEP MSCs for Used aquifers with TDS </= 2500 mg/l.

	Table 3.0-1 - fYNOP 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 Media	**Human Health Residential Onsite**	**Human Health Non-Residential Onsite**	**Human Health Residential Offsite**	**Human Health Non-Residential Offsite**	**Ecological Receptors**	**Cross-media Transfer**	**Resource Restoration**
	industrial, and GW use except for sampling and remediation).					(Current building has a vapor barrier; agreement with owners/environmental covenant may need to be modified to require consideration of VI for future buildings). **C.** (Environmental Receptors) Prevent exceedance of PADEP ambient water quality criteria for toxic substances (WQCTS) or develop site specific surface water goals for PCE, TCE, and cis1,2DCE in Codorus Creek. i. Timing: 3 (interim groundwater extraction system in place).	
Soil	**A.** Prevent direct contact exposures to chemicals where concentrations exceed PADEP direct contact MSCs in soil. i. Priority/Timing (East Campus, excluding the Military Munitions Response Program [MMRP] Areas): 3 (current industrial owner usage excludes residential use of property.) Presumed Remedy: Restrict future land use to non-residential use with an environmental covenant. ii. Priority/Timing (West Campus): 4 (environmental covenant in place to exclude residential	**A.** Prevent direct contact exposures to PCE, PAHs, PCBs and Pb, where concentrations exceed PADEP direct contact MSCs in soil. i. Priority/Timing (East Campus, excluding MMRP/B&SR): NA(No exceedances of the PADEP direct contact MSCs in soil). ii. Priority/Timing (West Campus): 3 (Environmental covenant requires maintenance of interim caps in place and requires health and safety plan and soil management plan for activities involving intrusive work). Caps may need to be modified or extended, and will need to be mapped and recorded.	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 chlorinated VOCs, SVOCs and metals from leaching and impacting groundwater above respective GW MSCs. i. Priority/Timing (East Campus): 3 (areas have been characterized and are limited in extent). ii. Priority/Timing (West Campus): 3 (Caps and agreements in place to maintain the caps. Caps may need to be modified or extended, and will need to be mapped and recorded.)	NA (No sensitive soil resource identified.)

	Table 3.0-1 - fYNOP 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 Media	**Human Health Residential Onsite**	**Human Health Non-Residential Onsite**	**Human Health Residential Offsite**	**Human Health Non-Residential Offsite**	**Ecological Receptors**	**Cross-media Transfer**	**Resource Restoration**
	use of property).						
Surface Water	NA (GW Risk Assessment identified no human health risks related to surface water).	NA (GW Risk Assessment identified no human health risks related to surface water).	NA (GW Risk Assessment identified no human health risks related to surface water in Johnsons Run, Codorus Creek or Mill Creek, with or without operation of the interim groundwater extraction system. Codorus Creek is not a current drinking water supply and future potable use is improbable).	NA (GW Risk Assessment identified no human health risks related to surface water in Johnsons Run, Codorus Creek or Mill Creek, with or without operation of the interim groundwater extraction system. Codorus Creek is not a current drinking water supply and future potable use is improbable.)	NA (Ecological screening assessment in GW risk assessment identified no ecological COPCs.)	NA (No threat to other media.)	A. Prevent exceedance of PADEP ambient water quality criteria for toxic substances (WQCTS) or develop site specific surface water goals for PCE, TCE, and cis1,2DCE in Codorus Creek. i. Timing: 3 (interim groundwater extraction system in place).

	Table 3.0-1 - fYNOP 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 Media	**Human Health Residential Onsite**	**Human Health Non-Residential Onsite**	**Human Health Residential Offsite**	**Human Health Non-Residential Offsite**	**Ecological Receptors**	**Cross-media Transfer**	**Resource Restoration**
Air	**A**. Prevent exceedances of PADEP indoor air screening values of VOCs in future residential buildings. i. Priority/Timing (East Campus): 3 (current industrial owner usage excludes residential use of property. Presumed Remedy: Restrict future use to non-residential with an environmental covenant.) ii. Priority/Timing (West Campus): 4 (Environmental covenant in place restricting residential use).	**A**. Prevent exposures to TCE from VI into occupied buildings by commercial/industrial workers. i. Priority/Timing (East Campus): 3 (Current buildings have engineering controls such as industrial ventilation systems). ii. Priority/Timing (West Campus):3 (Current building has a vapor barrier; agreement with owners/environmental covenant may need to be modified to require consideration of VI for future buildings).	**A**. Prevent exposures to chlorinated VOCs from VI into existing and future residential buildings. i. Priority/Timing: 3 (West of fYNOP - areas zoned or used as industrial, or unsuitable for residential construction [flood plain]) ii. Priority/Timing: 4 (South of fYNOP - environmental covenant exists on former Cole Steel property that restricts residential development). iii. Priority/Timing: 3 (SPBA - Interim groundwater extraction system is operating to address the potential risk of VI off-site within a lateral distance of 100 feet of the shallow groundwater contamination in the monitoring wells located in the southeast corner of the SPBA).	**A.** GW Risk Assessment identified no unacceptable human health risks to commercial/industrial workers. **B.** Prevent exposures to TCE from VI into future utility trenches where groundwater is less than 15' bgs. i. Priority /Timing: 3 (West of fYNOP – no control over off-Site properties. ii. Priority/Timing: 4 (South of fYNOP – environmental covenant exists on former Cole Steel property that prohibits excavation activities unless it is demonstrated to not pose a threat to human health or the environment).	NA (no threat to ecological receptors).	NA (no threat to other media).	NA

	Table 3.0-1 - fYNOP 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 Media	**Human Health Residential Onsite**	**Human Health Non-Residential Onsite**	**Human Health Residential Offsite**	**Human Health Non-Residential Offsite**	**Ecological Receptors**	**Cross-media Transfer**	**Resource Restoration**
Waste	**A.** Prevent direct contact exposures to waste. i. Priority/Timing (East Campus – Eastern Landfill): 3 (Current operations are industrial; current owner excludes residential use of property. Presumed Remedy: Restrict future use to non-residential with an environmental covenant.) ii. Priority/Timing (West Campus – Fill located beneath the western portion of the West Parking lot [WPL] and Eden Road): 4 (Environmental covenant in place to exclude residential use of property)	**A.** Prevent direct contact exposures to waste, and inappropriate relocation of waste. i. Priority/Timing (East Campus – Eastern Landfill): 3 (Procedure in place to require appropriate protection and management to workers for all intrusive work). ii. Priority/Timing (West Campus – Fill located beneath the western portion of the WPL and Eden Road): 4 (Environmental covenant requires maintenance of caps in place and requires health and safety plan for activities involving intrusive work. Environmental covenant requires proper management of disturbed material in compliance with post remediation care plan or a soil management plan approved by PADEP).	NA (No off-Site waste)	NA (No off-Site waste)	NA	**A**. Prevent potential for leaching of COCs to groundwater from the Eastern Landfill and impacting GW above respective GW MSCs. i. Priority/Timing 3 (Eastern Landfill is uncapped. Groundwater chemistry data does not suggest meaningful leaching to groundwater). **B**. Prevent potential for leaching of COCs to groundwater from fill under Eden Road and the western portion of the WPL impacting GW above respective GW MSCs. i. Priority/Timing: 3 (West Campus - Area is capped and the environmental covenant requires maintenance and preservation of existing impermeable surfaces [cap]. Small portions of the area are not capped and may require final capping).	NA
Other	None	None	None	None	None	None	None

Note: The priority/time frame on under Groundwater, Cross Media Transfer A,v (Page 1, Column 7) and Air, Human Health, Residential Offsite (Page 4, Column 4) for the SPBA has been changed from a ranking of 2 (implement prior to final remedy/cleanup) to 3 (part of long-term final remedy/cleanup or action currently in place, but final remedy required) because a groundwater extraction system was installed since the table was developed, and is now operating in this area.

Table 3.1-1
PADEP Used Aquifer Medium Specific Concentrations (MSCs) for Groundwater
Former York Naval Ordnance Plant - York, PA

Parameter	CAS Number	PA MSC UA R (µg/L)	PA MSC UA NR (µg/L)
Volatile Organic Compound			
1,1,1,2-Tetrachloroethane	630-20-6	70	70
1,1,1-Trichloroethane	71-55-6	200	200
1,1,2,2-Tetrachloroethane	79-34-5	0.84	4.3
1,1,2-Trichloroethane	79-00-5	5	5
1,1-Dichloroethane	75-34-3	31	160
1,1-Dichloroethene	75-35-4	7	7
1,2-Dibromoethane	106-93-4	0.05	0.05
1,2-Dichloroethane	107-06-2	5	5
1,2-Dichloropropane	78-87-5	5	5
1,4-Dioxane	123-91-1	6.4	32
2-Butanone	78-93-3	4000	4000
2-Hexanone	591-78-6	63	260
4-Methyl-2-Pentanone	108-10-1	3300	9300
Acetone	67-64-1	38000	110000
Acrylonitrile	107-13-1	0.72	3.7
Benzene	71-43-2	5	5
Bromochloromethane	74-97-5	90	90
Bromodichloromethane	75-27-4	80	80
Bromoform	75-25-2	80	80
Bromomethane	74-83-9	10	10
Carbon Disulfide	75-15-0	1500	6200
Carbon Tetrachloride	56-23-5	5	5
Chlorobenzene	108-90-7	100	100
Chlorodibromomethane	124-48-1	80	80
Chloroethane	75-00-3	250	1200
Chloroform	67-66-3	80	80
Chloromethane	74-87-3	30	30
cis-1,2-Dichloroethene	156-59-2	70	70
cis-1,3-Dichloropropene	10061-01-5	7.3	34
Ethylbenzene	100-41-4	700	700
Methyl tert-butyl ethe	1634-04-4	20	20
Methylene chloride	75-09-2	5	5
Styrene	100-42-5	100	100
Tetrachloroethene	127-18-4	5	5
Toluene	108-88-3	1000	1000
trans-1,2-Dichloroethene	156-60-5	100	100
trans-1,3-Dichloropropene	10061-02-6	7.3	34
Trichloroethene	79-01-6	5	5
Vinyl Chloride	75-01-4	2	2
Xylenes (Total)	1330-20-7	10000	10000

Parameter	CAS Number	PA MSC UA R (µg/L)	PA MSC UA NR (µg/L)
METAL			
Antimony	7440-36-0	6	6
Arsenic	7440-38-2	10	10
Barium	7440-39-3	2000	2000
Beryllium	7440-41-7	4	4
Cadmium	7440-43-9	5	5
Chromium	7440-47-3	100	100
Copper	7440-50-8	NS	1000
Hexavalent Chromium	18540-29-9	100	100
Lead	7439-92-1	5	5
Mercury	7439-97-6	2	2
Nickel	7440-02-0	100	100
Selenium	7782-49-2	50	50
Silver	7440-22-4	100	100
Thallium	7440-28-0	2	2
Vanadium	7440-62-2	2.9	8.2
Zinc	7440-66-6	2000	2000

Parameter	CAS Number	PA MSC UA R (µg/L)	PA MSC UA NR (µg/L)
Semi Volatile Organic Compound			
1,2,4-Trichlorobenzene	120-82-1	70	70
1,2-Dichlorobenzene	95-50-1	600	600
1,3-Dichlorobenzene	541-73-1	600	600
1,4-Dichlorobenzene	106-46-7	75	75
2,4,5-Trichlorophenol	95-95-4	4200	12000
2,4,6-Trichlorophenol	88-06-2	42	120
2,4-Dichlorophenol	120-83-2	20	20
2,4-Dimethylphenol	105-67-9	830	2300
2,4-Dinitrophenol	51-28-5	83	230
2,4-Dinitrotoluene	121-14-2	2.4	11
2,6-Dinitrotoluene	606-20-2	0.49	2
2-Chloronaphthalene	91-58-7	3300	9300
2-Chlorophenol	95-57-8	40	40
2-Methylnaphthalene	91-57-6	170	470
2-Methylphenol	95-48-7	2100	5800
2-Nitroaniline	88-74-4	420	1200
2-Nitrophenol	88-75-5	330	930
3-& 4-Methylphenol	106-44-5	NS	NS
3,3'-Dichlorobenzidine	91-94-1	1.6	7.6
3-Nitroaniline	99-09-2	NS	NS
4,6-Dinitro-2-Methylphenol	534-52-1	3.3	9.3
4-Bromophenyl phenyl ether	101-55-3	NS	NS
4-Chloro-3-Methyl-Phenol	59-50-7	4200	12000
4-Chloroaniline	106-47-8	3.7	17
4-Chlorodiphenyl Ether	7005-72-3	NS	NS
4-Nitroaniline	100-01-6	37	170
4-Nitrophenol	100-02-7	60	60
Acenaphthene	83-32-9	2500	3800
Acenaphthylene	208-96-8	2500	7000
Anthracene	120-12-7	66	66
Benzo (A) Anthracene	56-55-3	0.32	4.9
Benzo (a) Pyrene	50-32-8	0.2	0.2
Benzo (b) Fluoranthene	205-99-2	0.19	1.2
Benzo (g,h,i) Perylene	191-24-2	0.26	0.26
Benzo (k) Fluoranthene	207-08-9	0.19	0.55
Bis(2-Chloroethoxy) Methane	111-91-1	130	350
Bis(2-Chloroethyl) Ether	111-44-4	0.15	0.76
Bis(2-Chloroisopropyl) Ether	108-60-1	300	300
Bis(2-Ethylhexyl) Phthalate	117-81-7	6	6
Butylbenzylphthalate	85-68-7	380	1800
Carbazole	86-74-8	37	170
Chrysene	218-01-9	1.9	1.9
Dibenzo (a,h) Anthracene	53-70-3	0.055	0.6
Dibenzofuran	132-64-9	42	120
Diethylphthalate	84-66-2	33000	93000
Dimethylphthalate	131-11-3	NS	NS
Di-n-Butylphthalate	84-74-2	4200	12000
Di-n-octylphthalate	117-84-0	420	1200
Fluoranthene	206-44-0	260	260
Fluorene	86-73-7	1700	1900
Hexachlorobenzene	118-74-1	1	1
Hexachlorobutadiene	87-68-3	9.4	44
Hexachlorocyclopentadiene	77-47-4	50	50
Hexachloroethane	67-72-1	1	1
Indeno (1,2,3-cd) Pyrene	193-39-5	0.19	2.8
Isophorone	78-59-1	100	100
Naphthalene	91-20-3	100	100
Nitrobenzene	98-95-3	83	230
N-Nitrosodi-N-Propylamine	621-64-7	0.1	0.49
N-Nitrosodiphenylamine	86-30-6	150	690
Pentachlorophenol	87-86-5	1	1
Phenanthrene	85-01-8	1100	1100
Phenol	108-95-2	2000	2000
Pyrene	129-00-0	130	130

Notes:
Medium Specific Concentrations (MSCs) from 25 Pa. Code § Chapter 250 (Appendix A, Tables 1 and 2)
MSCs are reviewed periodically and are subject to change
NS - MSC not developed
PA MSC UA R - PADEP Medium Specific Concentration Used Aquifer, Residential
PA MSC UA NR - PADEP Medium Specific Concentration Used Aquifer, Non-Residential
µg/L - micrograms per liter

Table 3.1-2
PADEP Surface Water Quality Criteria
Former York Naval Ordnance Plant - York, Pennsylvania

	Fish and Aquatic Life		Human Health
	CFC	AFC	CRL
Chemical Name	**(µg/L)**	**(µg/L)**	**(µg/L)**
cis-1,2-Dichloroethene (cis12DCE)	N/A	N/A	12
Tetrachlorethene (PCE)	140	700	0.69
Trichloroethene (TCE)	450	2,300	2.5

Notes:
Surface water quality criteria from 25 Pa. Code § Chapter 93 - Water Quality Standards (Table 5 - Water Quality Criteria for Toxic Substances)
CFC - Chronic Fish Criteria or Criteria Continuous Concentration from Chapter 93
AFC - Acute Fish Criteria or Criteria Maximum Concentration from Chapter 93
CRL - Cancer Risk Level or Human Health Criteria from Chapter 93
Criteria are reviewed periodically and are subject to change
N/A - Criterion not developed
µg/L - micrograms per liter

Table 4.0-1
Summary of Proposed Remedy Components

Remedy Location		Institutional Controls		Engineering Controls		Remedy Monitoring	Remedial Action
		In Place	To Be Added	In Place	To Be Added		
On-Site Areas	**East Campus (LUAs 1&2)**		Groundwater Use Restriction Health and Safety Plan for Earth Disturbance Activities Prohibition on Residential Use Evaluation of VI Potential for Future Buildings Technical Impracticability Area Waste Management Plan	Operation of SPBA GW Extraction System Maintenance of Caps and Building Slabs Operation of WPL GW Extraction System	VI Mitigation if Necessary	Groundwater Monitoring per Plan	Monitored Natural Attenuation Outside TI Boundary
	West Campus (LUA 3)	Groundwater Use Restriction Soil Management Plan Health and Safety Plan for Earth Disturbance Activities Prohibition on Residential Use	Evaluation of VI Potential for Future Buildings Technical Impracticability Area Waste Management Plan	Operation of WPL GW Extraction System Vapor Barrier on Warehouse Building	VI Mitigation if Necessary Maintenance of Caps and Building Slabs	Groundwater Monitoring per Plan	
Off- Site Areas	**Residential Areas (LUA 4)**		Periodic Assessment of Groundwater Use			Groundwater Monitoring per Plan	Operation of SPBA GW Extraction System Decommission Existing Water Supply Well Monitored Natural Attenuation
	Industrial Areas (LUA 5)	Groundwater Use Restriction[1] Prohibition on Residential Use[1] Prohibition on Earth Moving Activity in Identified Area[1]	Periodic Assessment of Groundwater Use Periodic Notification for Potential Worker Exposure			Groundwater Monitoring per Plan	Operation of SPBA GW Extraction System Monitored Natural Attenuation
	West of West Parking Lot (LUA 6)		Periodic Assessment of Groundwater Use Periodic Notification for Potential Worker Exposure Technical Impracticability Area			Groundwater Monitoring per Plan	
	Codorus Creek (LUA 7)					Surface Water Monitoring per Plan	Operation of WPL GW Extraction System Evaluate Feasibility of Other Remedial Alternatives

Notes:

LUA - Land Use Area
MMRP - Military Munitions Response Program
SPBA - Southern Property Boundary Area
GW - Groundwater
WPL - West Parking Lot
TI - Technical Impracticability
VI - Vapor Intrusion
[1] - on former Cole Steel Property

Table 5.0-1
Applicable or Relevant and Appropriate Requirements for fYNOP Proposed Remedy

Chemical-Specific ARARs

- ***Safe Drinking Water Act (SDWA) Maximum Contaminant Levels (MCLs) (40 CFR 141)*** – MCLs have been promulgated for a number of organic and inorganic contaminants to regulate the concentration of these compounds in public drinking water.

- ***Clean Air Act of 1970 (42 CFR 85)*** – Promulgated national primary and secondary ambient air quality standards for air pollutants for protection of public health.

- ***PA Safe Drinking Water (25 PA Code, Chapter 109) –*** Standards for groundwater used as a drinking water source.

- ***PA Water Quality Standards (25 PA Code, Chapter 93)*** – Surface water quality standards promulgated for protection of human health and aquatic life.

- ***PA Water Quality Toxics Management Strategy (25 PA Code, Chapter 16)*** – Water quality criteria for various toxic substances promulgated for protection of human health and aquatic life.

- ***PA Land Recycling and Environmental Remediation Standards Act (Act 2)(25 PA Code, Chapter 250)*** – 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.

- ***PA Air Pollution Control Act of 1971 (25 PA Code, Chapter 131)*** – Ambient air quality standards for discharges of air pollutants.

- ***Resource Conservation and Recovery Act (RCRA) Hazardous Waste Generator and Transporter Requirements (40 CFR 264)*** – Establishes responsibilities of generators and transporters of hazardous waste in the handling, transportation, and management of waste, SWMU closure and other RCRA closure activities.

Location-Specific ARARs

- ***Protection of Wetlands and Floodplains (Executive Orders 11990 and 11988)*** – Potentially applicable to remedial actions conducted within wetlands and/or floodplains.

- ***Fish and Wildlife Improvement Act of 1978 (16 USC 742)*** – Protects fish and wildlife against impacts that may affect their protective habitats.

- ***Endangered Species Act of 1973 (50 CFR 200)*** – Potentially applicable if any endangered or threatened species or habitats are present where remediation activities may occur.

Table 5.0-1
Applicable or Relevant and Appropriate Requirements for fYNOP Proposed Remedy

- ***National Historic Preservation Act of 1966 (16 USC 470 et. Seq.)*** – Requires action be taken to recover and to preserve historic artifacts that may be threatened as the result of land alteration.

- ***National Archeological and Historic Preservation Act of 1974 (132 CFR 229)*** – Requires action to be taken to recover and to preserve scientific, prehistoric, historic, or archaeological artifacts that may be threatened as the result of land alteration.

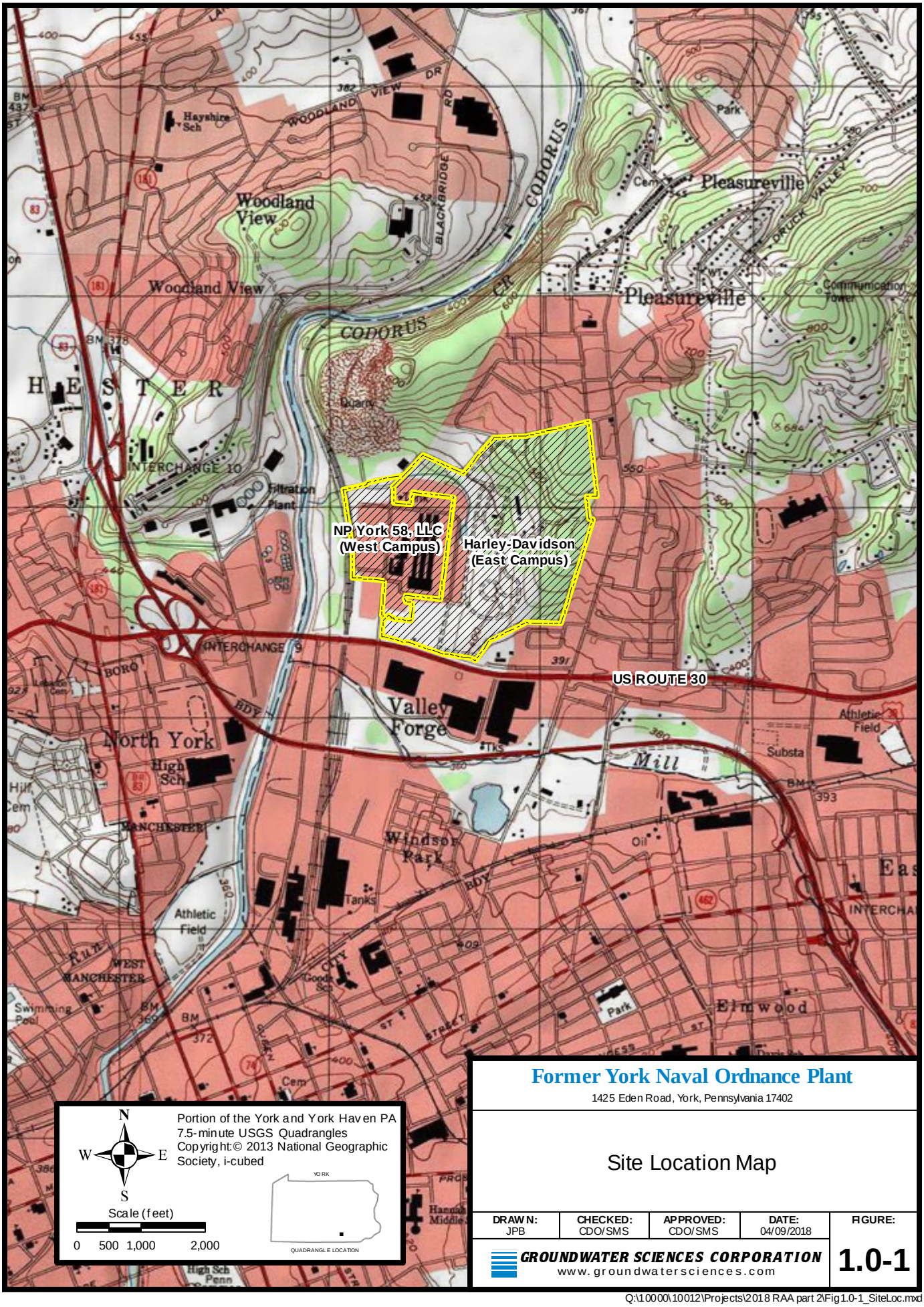
- ***PA SWMA, Act 97, Chapters 269a and 288*** – carbonate bedrock underlays Site. Formations must be >5 ft think and be the topmost geologic unit

Action-Specific ARARs

- ***PA National Pollutant Discharge Elimination System (25 PA Code, Chapter 92)*** – Requirements applicable for alternatives that include a water discharge.

- ***PA Solid Waste Management Program, Management of Fill Policy*** – PA established policy for “clean fill” and “regulated fill” that may be used during remedial activities.

Figures



Portion of the York and York Haven PA 7.5-minute USGS Quadrangles

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

Site Location Map

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/09/2018	1.0-1

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Northeast Property Boundary Area (NPBA)
Liquid waste disposed on Perimeter Road and fence for dust & weed control; liquid waste disposed in groundhog holes

Old Waste Containment Area
Liquid wastes (acids, bases, oils, CVOCs) stored in tanks, treated in wastewater treatment plant or burned in boilers; leaks and spills were documented.

North Plant Area (NPA)

Building 67 Container Storage Area

Former Drum Storage Area (Buildings 51&67)
Drums of waste stored; former Part B RCRA area

Metal Chip Bin Area
Cutting oil leakage

Industrial Waste Treatment Plant (IWTP)
Confirmed source of CVOCs

Waste Solvent Boilers Bldg 10
(Power House)

North Building 4, Plating/Sludge
Vapor Degreaser Area
CVOC leakage and spillage during degreasing operations

North End Test Track (NETT)
Open pit disposal of bombline grease and other wastes; cyanide disposal; storage of thousands of drums of liquid waste

Area B
CVOC disposal area

Burn Pile Area (BPA)

Eastern Perimeter Road
Liquid waste disposed on Perimeter Road and fence for dust & weed control; liquid waste disposed in groundhog holes

Eastern Landfill Area

Building 4 Wastewater Sumps

Underground Storage
Tank T-4
Leakage of gasoline from piping

Building 54

Reforested Area
Suspected liquid waste disposed in groundhog holes

Building 4 Sumps, Zinc Plater Area
Chrome/zinc plater area - leaks and spills during operations

Building 2 Settling Tanks (Bomb Line-Heat Treatment)
SWMU-61&62

West Parking Lot (WPL)
Western half was land-filled with construction debris and used as a disposal area for manufacturing wastes, including CVOCs, paint wastes and plating waste

Building 2 Drum Staging Area
Drums staged during cleanup of NETT area

Cyanide Spill Area MW-2
Cyanide waste disposed in metal cannisters

Building 2 (East Corridor) Former Waste Water Sumps SWMU 47-52

Southwest Parking Lot
Suspected disposal of liquid CVOC wastes

CVOC leakage and spillage during storage, transfer and usage; TCA spill of hundreds of gallons

TCA Tank Area SWMU-1

Chrome/Zinc Plater Area
Leaks and spills during operation

Southeast Property Boundary Area (SPBA)
Liquid waste disposed on Perimeter Road and fence for dust & weed control; liquid waste disposed in groundhog holes

Building 2 Degreaser
Potential for leakage of CVOCs during metal cleaning operation

SPBA Sanitary Sewer Investigation
PCE found in soil excavated during sewer installation

SAND BANK HILL QUARRY

CODORUS CREEK

MAPLE CREST BLVD

CHRONISTER STREET

RIDGE ROAD

PLEASANT VIEW DRIVE

PARADISE ROAD

EDEN ROAD

CITY VIEW ROAD

MT. HERMAN BLVD

TOPPER ST

CANTERBURY LANE

NORTH SHERMAN STREET

OLD ARSENAL ROAD

U.S. ROUTE 30 / ARSENAL ROAD

ELEVENTH AVENUE

N

W E

S

LEGEND

- Solid Waste Management Units
- fYNOP Property Boundary
- NP York 58, LLC Property Boundary (West Campus)
- Buildings
- Railroad (2006)
- Road, Curb or Walkway
- Areas of Concern

Source: Figure 1.2-1. Remedial Alternatives Analysis Report (Part 1), December 2014.

ABBREVIATIONS:
BPA - Burn Pile Area
CPA - Central Plant Area
CVOC - Chlorinated Volatile Organic Compounds
IWTP - Industrial Waste Treatment Plant
NETT - North End Test Track
NPA - North Plant Area
NPBA - Northeast Property Boundary Area
SPBA - Southeast Property Boundary Area
TCA - 1,1,1-Trichloroethane
WPL - West Parking Lot

Scale (feet)
0 125 250 500

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

Solid Waste Management Units and Areas of Concern

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/09/2018	1.1-1

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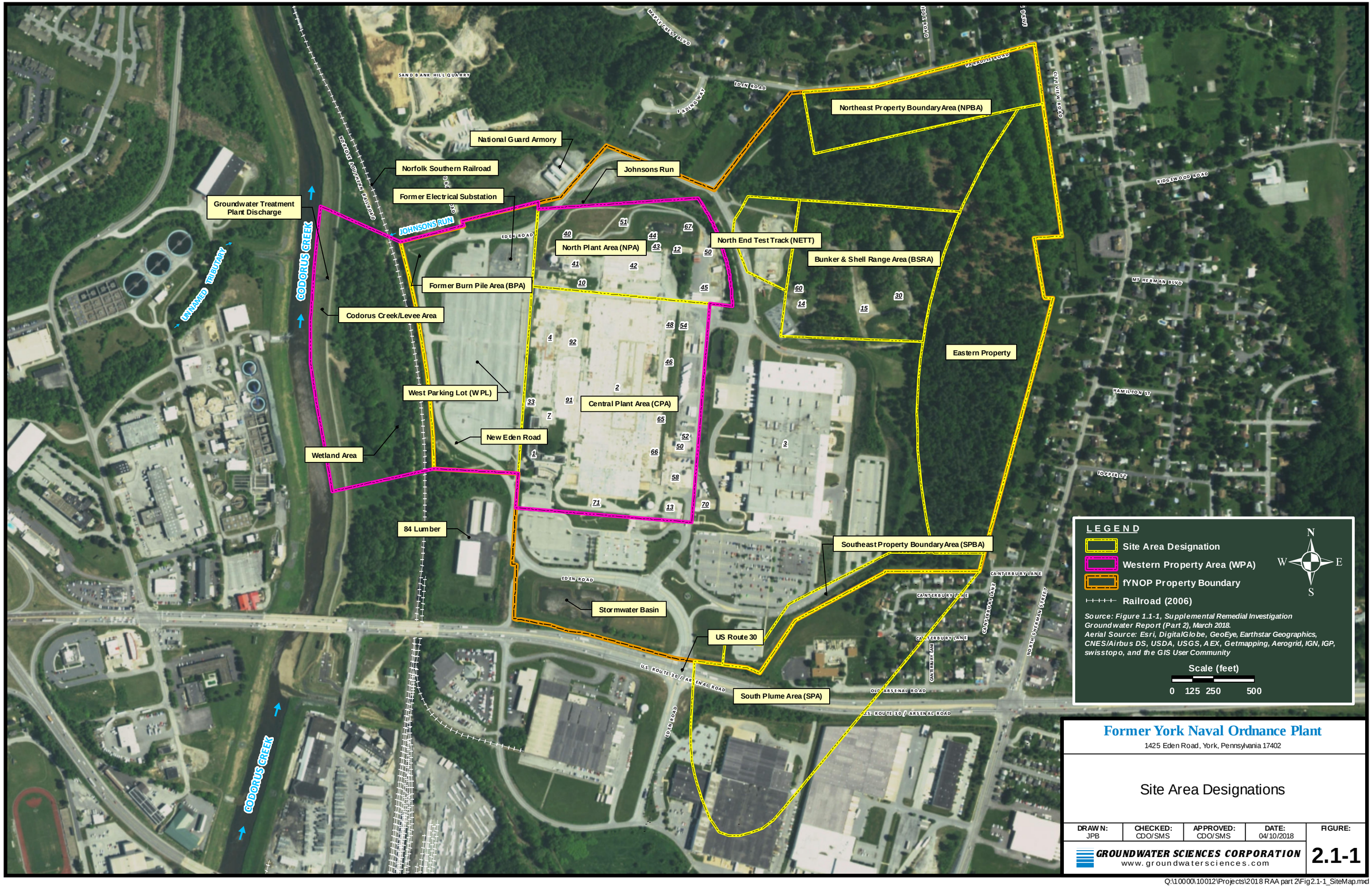

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

Site Area Designations

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/10/2018	2.1-1

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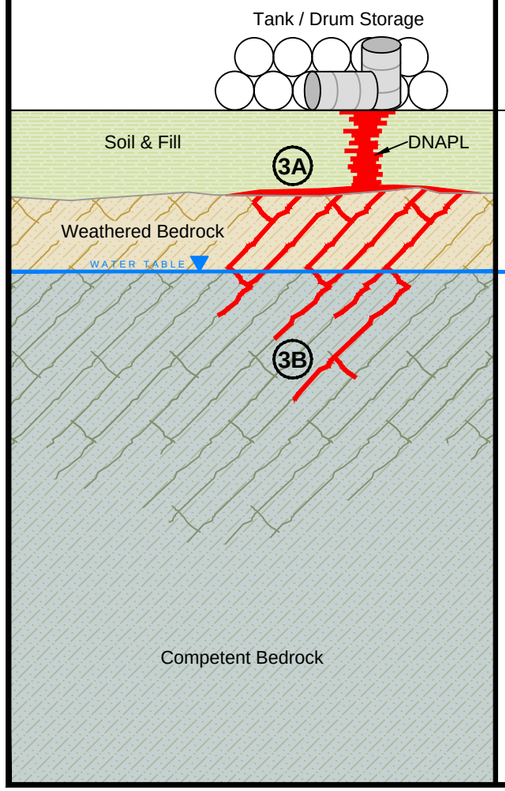
1. GEOLOGY	2. HYDROGEOLOGIC ZONES	3. NAPL TRANSPORT PROCESSES	4. AQUEOUS TRANSPORT PROCESSES	5. VAPOR TRANSPORT PROCESSES	6. FATE PROCESSES
	VADOSE ZONE SATURATED ZONE FRACTURED AQUIFER	3A DNAPL ACCUMULATION AND LATERAL SPREAD ALONG THE RESIDUUM/BEDROCK INTERFACE 3B DNAPL SEEPAGE INTO FRACTURES AND BEDDING PLANES	INFILTRATION UNSATURATED FLOW OF GRAVITATIONAL WATER DISSOLUTION FROM DNAPL RECHARGE AT WATER TABLE LATERAL ADVECTION (FLOW) VERTICAL ADVECTION	DIFFUSIVE LOSS OF VAPOR TO ATMOSPHERIC & INDOOR AIR VAPOR DIFFUSION EVAPORATION FROM DNAPL VOLATILIZATION FROM THE WATER TABLE	AEROBIC DEGRADATION PARTITIONING FROM SOIL VAPOR TO PORE WATER (REVERSIBLE) SORPTION ONTO ORGANIC CARBON FRACTION OF FORMATION SOLIDS (REVERSIBLE) SORPTION RETARDED INTRAGRANULAR AQUEOUS DIFFUSION (REVERSIBLE) SORPTION ONTO ORGANIC CARBON FRACTION OF FORMATION SOLIDS (REVERSIBLE) SORPTION RETARDED AQUEOUS DIFFUSION INTO RESIDUUM AND ROCK MATRIX (REVERSIBLE) TRANSFORMATION OF PARENT COMPOUNDS TO DAUGHTER PRODUCTS SORPTION RETARDED INTRAGRANULAR AQUEOUS DIFFUSION (REVERSIBLE)

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

Overview of
Fate and Transport Mechanisms
(Non-Carbonate Bedrock Setting)

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/10/2018	2.3-1

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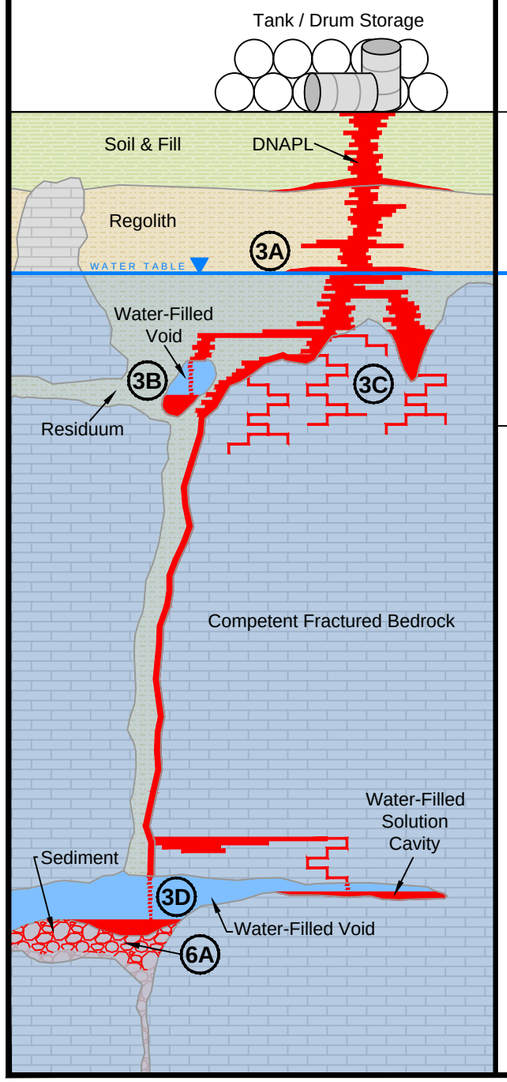
1. GEOLOGY	2. HYDROGEOLOGIC ZONES	3. NAPL TRANSPORT PROCESSES	4. AQUEOUS TRANSPORT PROCESSES	5. VAPOR TRANSPORT PROCESSES	6. FATE PROCESSES
	VADOSE ZONE EPIKARST SATURATED ZONE KARST AQUIFER	3A DNAPL ACCUMULATION AND LATERAL SPREAD ALONG THE RESIDUUM/BEDROCK INTERFACE DIRECTED TO ZONES OF VERTICAL PERM. OR SINKING POINTS, OR POOLED IN CLOSED DEPRESSIONS 3B DNAPL ACCUMULATION IN SEDIMENT-FILLED AND OPEN VOIDS (SOLUTION CAVITIES) 3C DNAPL SEEPAGE INTO FRACTURES AND BEDDING PLANES 3D DNAPL TRANSPORT DURING MODERATE TO HIGH TURBULENT FLOW IN SOLUTION-ENHANCED CONDUITS	INFILTRATION UNSATURATED FLOW OF GRAVITATIONAL WATER DISSOLUTION FROM DNAPL RECHARGE AT WATER TABLE LATERAL ADVECTION (FLOW) VERTICAL ADVECTION TRANSPORT WITH SUSPENDED SEDIMENT IN SOLUTION-ENHANCED CONDUITS	DIFFUSIVE LOSS OF VAPOR TO ATMOSPHERIC & INDOOR AIR VAPOR DIFFUSION EVAPORATION FROM DNAPL VOLATILIZATION FROM THE WATER TABLE	AEROBIC DEGRADATION PARTITIONING FROM SOIL VAPOR TO PORE WATER (REVERSIBLE) SORPTION ONTO ORGANIC CARBON FRACTION OF FORMATION SOLIDS (REVERSIBLE) SORPTION RETARDED INTRAGRANULAR AQUEOUS DIFFUSION (REVERSIBLE) SORPTION ONTO ORGANIC CARBON FRACTION OF FORMATION SOLIDS (REVERSIBLE) 6A SORPTION RETARDED AQUEOUS DIFFUSION INTO RESIDUUM AND ROCK MATRIX (REVERSIBLE) TRANSFORMATION OF PARENT COMPOUNDS TO DAUGHTER PRODUCTS SORPTION RETARDED INTRAGRANULAR AQUEOUS DIFFUSION (REVERSIBLE)

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

Overview of Fate and Transport Mechanisms (Carbonate Bedrock Setting)

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/10/2018	2.3-2

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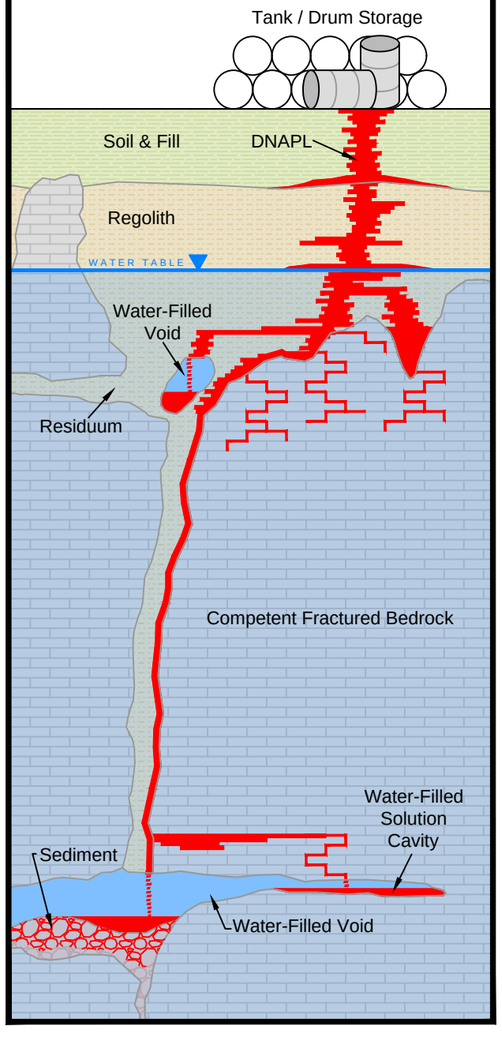
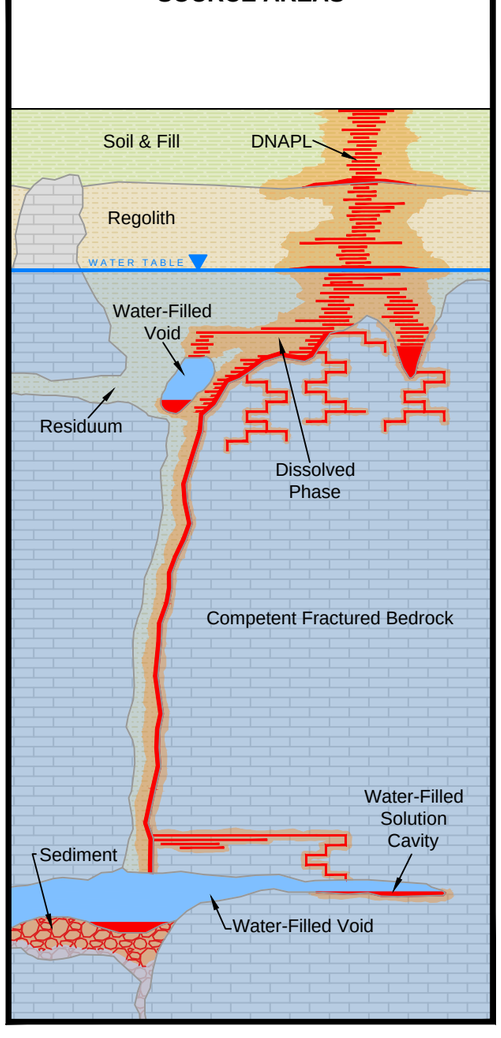
STAGE ONE: SOLVENT RELEASES



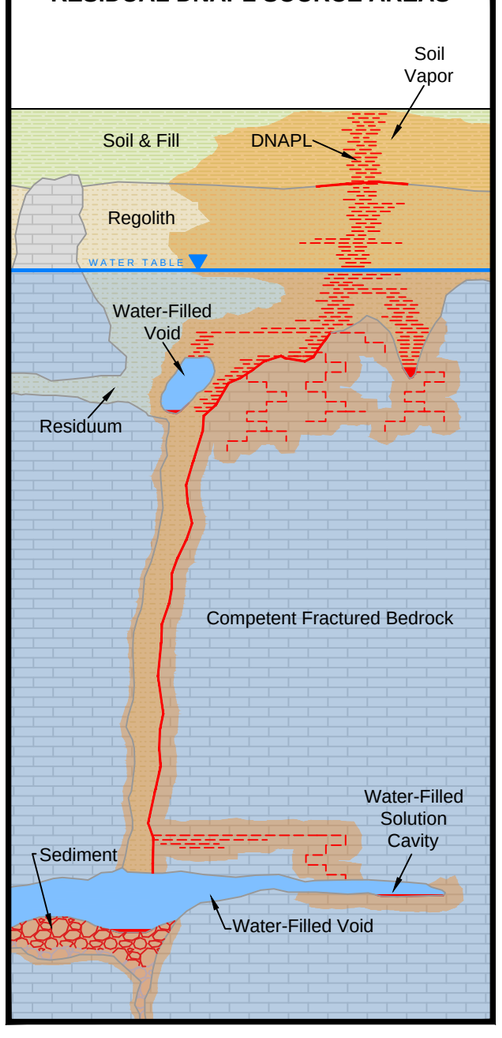
DNAPL penetration through soil fill, residual soil, and infilled voids, caverns, and cutters within epikarst layer in carbonate bedrock. DNAPL accumulation zones form at top of residual soil within the capillary fringe above the historical water table at the top of cutters infilled with fine-grained soils, and near the base of cutters, caverns, and voids within the carbonate bedrock.

STAGE TWO: RESIDUAL DNAPL SOURCE AREAS



DNAPL penetration has ceased. Development of residual DNAPL zones and high soil and bedrock concentrations due to processes of diffusion and sorption of CVOC mass from DNAPL pathways and accumulation zones. DNAPL may be transported from accumulation zones and suspended sediment during medium to high turbulent flow in water-filled solution cavities. DNAPL also dissolves and migrates with groundwater.

STAGE THREE: REDUCTION IN RESIDUAL DNAPL SOURCE AREAS



Majority of CVOC mass has spread into soil and bedrock due to diffusion. Localized DNAPL presence in areas of greatest initial accumulation. Reversed diffusion from the soil and bedrock into groundwater provides a continuing source of CVOCs to the groundwater.

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

Conceptual Model of DNAPL Fate and Transport in a Karst Aquifer

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/10/2018	2.3-3

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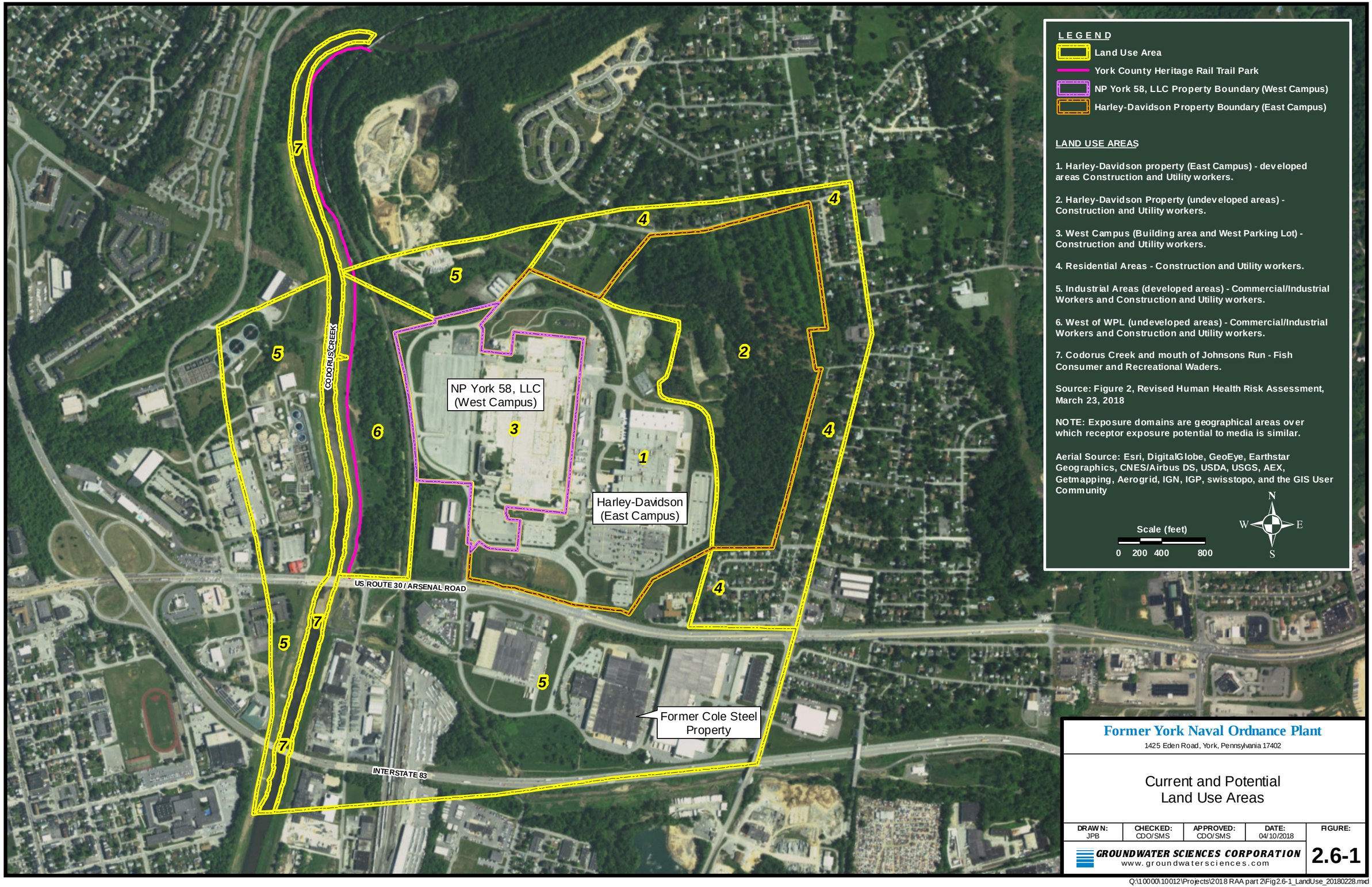

LEGEND

- Land Use Area
- York County Heritage Rail Trail Park
- NP York 58, LLC Property Boundary (West Campus)
- Harley-Davidson Property Boundary (East Campus)

LAND USE AREAS

1. Harley-Davidson property (East Campus) - developed areas Construction and Utility workers.

2. Harley-Davidson Property (undeveloped areas) - Construction and Utility workers.

3. West Campus (Building area and West Parking Lot) - Construction and Utility workers.

4. Residential Areas - Construction and Utility workers.

5. Industrial Areas (developed areas) - Commercial/Industrial Workers and Construction and Utility workers.

6. West of WPL (undeveloped areas) - Commercial/Industrial Workers and Construction and Utility workers.

7. Codorus Creek and mouth of Johnsons Run - Fish Consumer and Recreational Waders.

Source: Figure 2, Revised Human Health Risk Assessment, March 23, 2018

NOTE: Exposure domains are geographical areas over which receptor exposure potential to media is similar.

Aerial Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

N
W E
S

Scale (feet)
0 200 400 800

Former York Naval Ordnance Plant
1425 Eden Road, York, Pennsylvania 17402

Current and Potential Land Use Areas

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/10/2018	2.6-1

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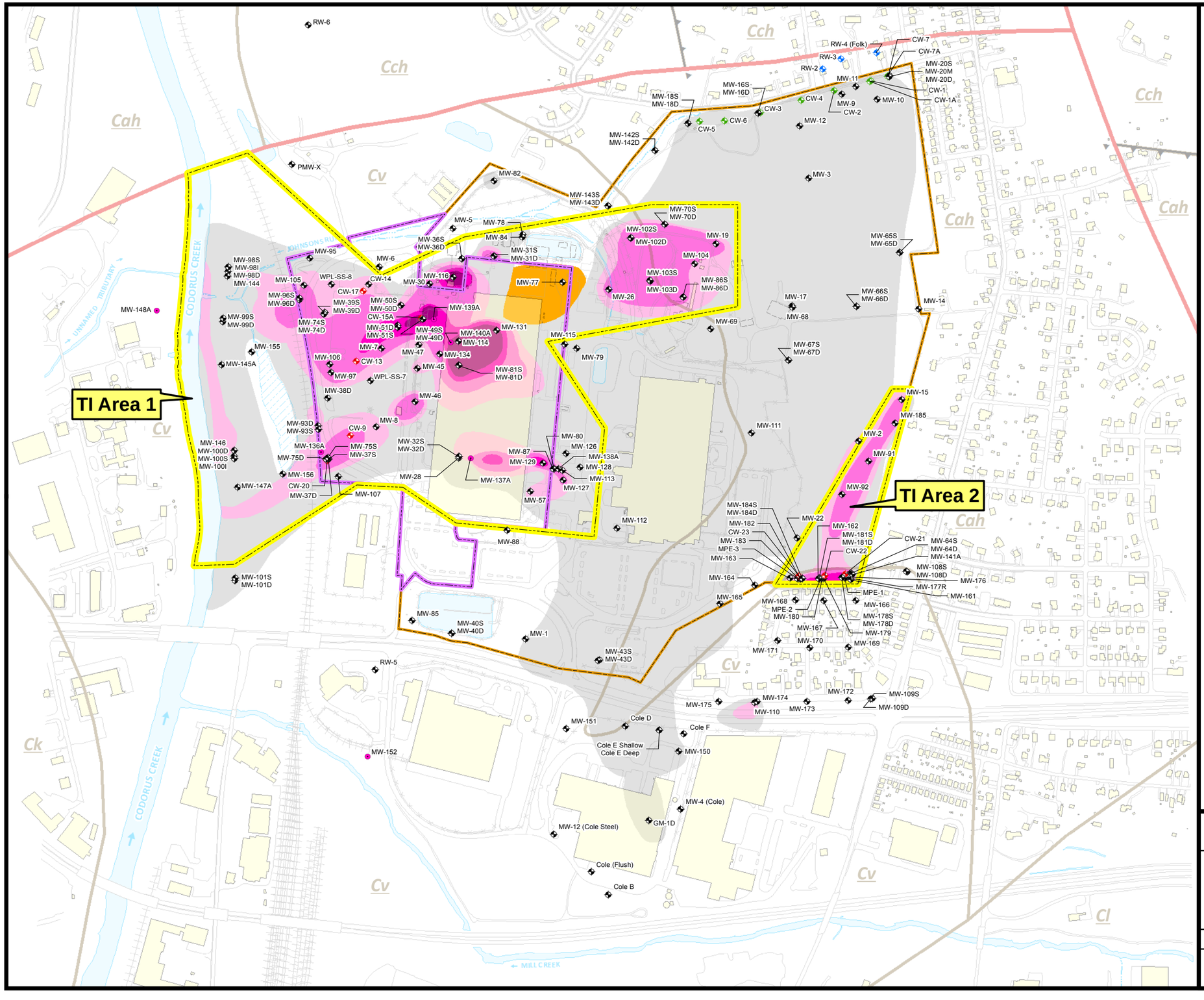

LEGEND

- Active Collection Well
- Inactive Collection Well
- Monitoring Well
- Residential Well
- Waterloo™ Monitoring Well
- Proposed Technical Impracticability (TI) Boundary
- NP York 58, LLC Property Boundary (West Campus)
- Harley-Davidson Property Boundary (East Campus)
- Block Fault
- Thrust Fault
- Ledger Formation (Cl)
- Kinzers Formation (Ck)
- Vintage Formation (Cv)
- Antietam & Harpers Formation, undiv. (Cah)
- Chickies Formation (Cch)
- Existing Building
- Demolished/Slab Remains
- Demolished/Slab Removed
- Railroad
- Road, Curb or Walkway
- Fenceline
- Existing Stream
- Existing Water Feature
- Wetland Boundary (2006)
- TCE/PCE Concentration >5 <50 µg/L
- TCE/PCE Concentration >50 <100 µg/L
- TCE/PCE Concentration >100 <500 µg/L
- TCE/PCE Concentration >500 <1,000 µg/L
- TCE/PCE Concentration >1,000 <10,000 µg/L
- TCE/PCE Concentration >10,000 µg/L
- Petroleum Plume

N
W E
S

NOTES:
1) TCE/PCE plumes are from the Part 2 SRI for groundwater (GSC, 2018). Concentrations are for the shallow portion of the aquifer (defined as any well monitoring groundwater within approximately 75 feet of the ground surface).
2) Proposed monitoring well (PMW-X) is to be installed and the location is approximate (to be determined based on site access and other considerations).

Scale (feet)
0 150 300 600

Former York Naval Ordnance Plant
1425 Eden Road, York, Pennsylvania 17402

Technical Impracticability (TI) Areas

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO	SMS	4/25/2019	3.1-1

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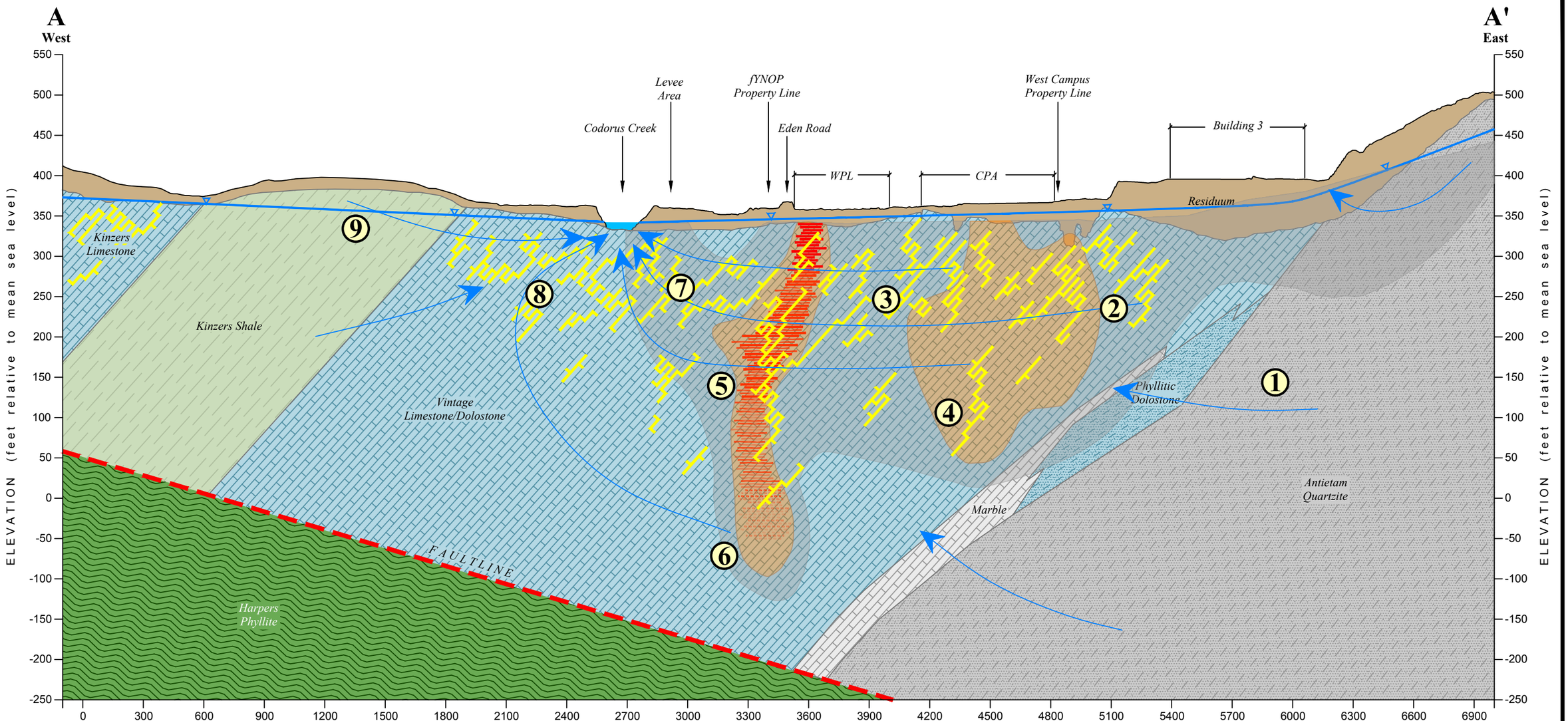


NOTES

1. Groundwater migrates from east to west, from high topographic areas underlain by quartzite sandstone to the carbonate aquifer that underlies the western half of the site.
2. Groundwater flows within the carbonate aquifer through a network of solution channels and fractures. Flow direction is widely variable, but the net direction is westward.
3. The frequency of solution cavities in the carbonate aquifer above 170' - 200' bgs is 15% - 19%. Below this depth, the frequency is 2%, and the hydraulic conductivity is reduced.
4. Deep conduits (> 200' bgs) are connected to the shallow conduit system.
5. DNAPL is suspected to have penetrated downward through the karstified portion of the aquifer and into the underlying fractured portion of the aquifer against an upward vertical piezometric head. DNAPL adsorbs onto and diffuses into the rock matrix and dissolves in groundwater. Natural processes degrade the TCE & PCE into cis12DCE.
6. At depth, anaerobic dechlorination has completely degraded TCE & PCE to cis12DCE.
7. Under natural flow conditions (without operation of the groundwater extraction system), all impacted groundwater flowing through the CPA & WPL discharges into Codorus Creek.
8. Due to discrete conduits, site-impacted groundwater can pass beneath (west of) the creek through solution channels before discharging to the creek.
9. Noncarbonate Kinzers Shale eliminates the potential for development of solution channels connecting the site to carbonate rocks further west, and is a barrier that forces the discharge of site-impacted groundwater to the creek.

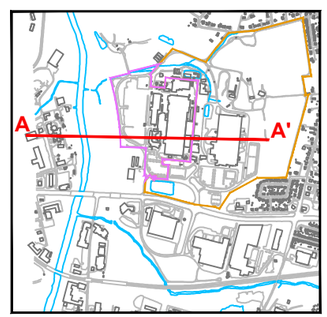
Approximate Horizontal Scale: 0 – 500'

Approximate Vertical Scale: 0 – 125'

Vertical Exaggeration 4x

LEGEND

- Solution Channels (Conceptualized)
- Water Table
- Generalized Net Direction of Groundwater Flow
- Residual DNAPL (Chlorinated Hydrocarbons)
- Dissolved Chlorinated Hydrocarbons Partitioning From DNAPL Sources
- Dissolved Chlorinated Hydrocarbons Migrating with Groundwater (Advection)



CROSS SECTION LOCATION MAP
SCALE: 1"=3000'

Source: Figure 4.0-2 from the Part 2 Supplemental Groundwater Remedial Investigation Report (Revised March 2018).

Former York Naval Ordnance Plant
1425 Eden Road, York, Pennsylvania 17402

Conceptual Site Model
Cross Section A-A'
Non-Pumping Conditions

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO	SMS	4/25/2019	3.1-2

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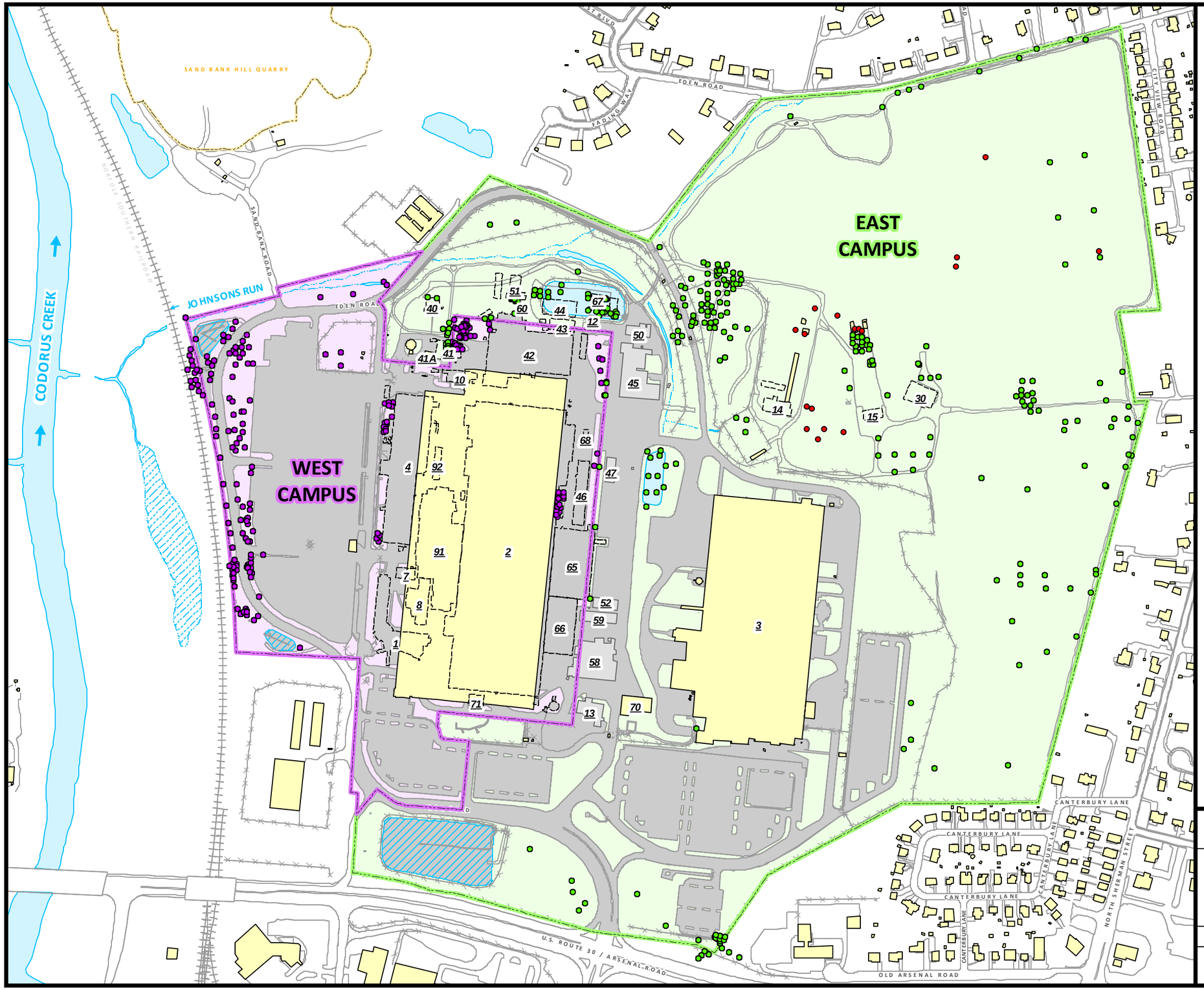

N

W E

S

LEGEND

- Soil Sample (East Campus, Non-Impervious, 0-15' BOS)
- Soil Sample (West Campus, Non-Impervious, 0-15' BOS)
- MMRP Sample Location Points*
- NP York 58, LLC Property Boundary (West Campus)
- Harley-Davidson Property Boundary (East Campus)
- Active Building
- Former Building (Slab-in-Place)
- Former Building (Slab Removed)
- Railroad
- Road, Curb or Walkway
- Fenceline
- Impervious Surface Area (as of 1/24/2012) **
- Impervious Liner (as of 1/24/2012) **
- Existing Water Feature
- Existing Stream
- Wetland Boundary (2006)

** MMRP sample location points were taken from Table 3-1 of the Final Site Inspection Report, York Naval Ordnance Plant (ALION, 2008); locations as plotted are suspect.*

*** Impervious areas were revised using the following sources:*
***FR09-ES-5 Plans.dwg** (NuTec Design Associates, Inc., May 2010)*
***Master Utility.dwg** (Harley-Davidson, October 2011)*
Figure 1, "West Parking Lot and Eden Road Relocation Areas Stormwater Facilities" (SAIC, December 2005)
Figure 3.5-2 of the Supplemental Remediation Investigation Soils Report, York Naval Ordnance Plant (SAIC, December 2009).
Input from Sharon R. Fisher (H-D) and Rodney G. Myers (SAIC) on Jan. 24, 2012.

Scale (feet)

0 100 200 400

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

East and West Campus Divisions Location of Soil Samples

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	CDO/SMS	CDO/SMS	04/10/2018	3.2-1

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LEGEND

- Monitoring Well
- Spring
- 1968 Landfill Outline
- 1974 Landfill Outline
- Pre-RI EM Target Anomalies
- Groundwater Contours on October 16, 2017 (Feet AMSL)
- Harley-Davidson Property Boundary (East Campus)
- Existing Building
- Demolished/Slab Removed
- Road, Curb or Walkway
- Fenceline

N / W / E / S

Scale (feet): 0 20 40 80

Location ID
Top of Open Interval FtBGS - Bottom of Open Interval FtBGS (Open Interval Thickness)
Trichloroethene (TCE) and Tetrachloroethylene (PCE)
2008 RI Round 1 Event
2013 Comprehensive Sampling Event
2014 Comprehensive Sampling Event
2015 Comprehensive Sampling Event
2016 Comprehensive Sampling Event
2017 Comprehensive Sampling Event
NS = Not Sampled
J = The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

MW-65S
71.3'-86' (14.7')
TCE | PCE
99 | 3.1
NS | NS
NS | NS
NS | NS
40 | 3
NS | NS

MW-65D
89'-103' (14')
TCE | PCE
10 | 0.35 J
NS | NS
NS | NS
NS | NS
3.9 | 0.41 J
NS | NS

MW-66S
47.2'-100' (52.8')
TCE | PCE
16 | 0.58 J
NS | NS
NS | NS
NS | NS
3 | 0.61 J
NS | NS

MW-66D
81.4'-100' (18.6')
TCE | PCE
10 | 0.43 J
NS | NS
NS | NS
NS | NS
2.6 | 0.47 J
NS | NS

MW-14
18'-80' (62')
TCE | PCE
1.2 | 3.6
NS | NS
NS | NS
NS | NS
1.8 | 11
NS | NS

MW-17
15'-79' (64')
TCE | PCE
40 | 0.41 J
NS | NS
NS | NS
NS | NS
2.5 | 0.52 J
NS | NS

MW-68
80'-105' (25')
TCE | PCE
47 | 0.52 J
NS | NS
NS | NS
NS | NS
1.7 | 0.47 J
NS | NS

MW-67S
12.8'-31' (18.2')
TCE | PCE
29 | 4.3
NS | NS
NS | NS
NS | NS
NS | NS
NS | NS

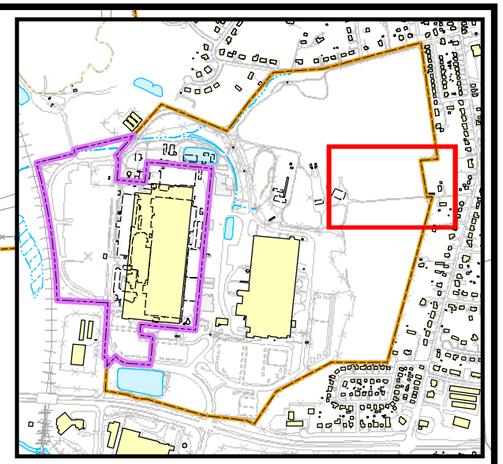
MW-67D
58'-71' (13')
TCE | PCE
40 | 0.44 J
NS | NS
NS | NS
NS | NS
NS | NS
NS | NS

S-10
0'-0' (0')
TCE | PCE
NS | NS
NS | NS
NS | NS
NS | NS
0.6 J | 0.8 J
NS | NS

S-4

30

440 450 460 470 480 490 500 420 430



Location Map (1:1500 Scale)

Former York Naval Ordnance Plant

1425 Eden Road, York, Pennsylvania 17402

Eastern Landfill Area

DRAWN:	CHECKED:	APPROVED:	DATE:	FIGURE:
JPB	SMS	CDO	5/10/2018	3.5-1

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Appendix A

EPA Review of Proposed Plan – Final Remedy for the former York Naval Ordnance Plant (Letter Dated March 19, 2019)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

March 19, 2019

Mr. Christopher O'Neil
Groundwater Sciences Corporation
2601 Market Place Street, Suite 310
Harrisburg, PA 17110

Re: EPA review of Proposed Plan – Final Remedy for the former York Naval Ordnance Plant

Dear Mr. O'Neil:

This letter is in response to the Proposed Plan – Final Remedy for the former York Naval Ordnance Plant, prepared by Groundwater Sciences Corporation and dated December 2018. EPA has reviewed this report and provides the following comments to be addressed:

1. Section 3.1, Groundwater – This section refers to "appropriate" PADEP MSCs. To be clear, instead indicate that the appropriate MSCs are the used aquifer MSCs, and provide a table of specific numeric cleanup levels for groundwater. Likewise, the reference to PADEP ambient water quality criteria for toxic substances should reference a table of surface water concentrations for PCE, TCE, and cis 1,2-DCE to meet in surface water.
2. Section 3.1.3 – The GWHHRA also identified LUA6 as a hypothetical future residential VI area, and the Corrective Action Objectives chart indicates this area is zoned industrial or unsuitable for residential construction. The potential for zoning change or future residential construction can be addressed as part of the proposed periodic use assessment and notification to the property owners in LUA6.
3. Section 3.1.5 – This section proposes a TI boundary for two areas of the site, as shown on Figure 3.1-1. The proposed TI boundary for TI area 1 includes some groundwater monitoring wells which currently meet the proposed groundwater cleanup levels, or appear likely to achieve cleanup levels in a reasonable time period based on current trends, so should be excluded from the TI zone. These wells should be designated as long-term monitoring locations to verify that contaminated groundwater above cleanup levels stays within the TI area. These wells include: MW-98 S,I,D; MW-144; MW-95; MW-6; MW-5; MW-143 S,D; MW-69; MW-79; MW-115; MW-112; and MW-101 S,D.
4. Section 3.1.5 – The text states that TI Area 1 extends to the west side of Codorus Creek but provides no basis. The only well on the west side of the creek, MW-148A, did not detect TCE or PCE. Surface water sampling location COD-SW-15 is on the west side of the creek and was impacted by TCE and PCE.
5. Section 3.1.5 – The next-to-last paragraph in this section should be revised to make it clear that the proposed remedy includes eventually achieving used aquifer Statewide Health Standard (SHS) MSCs outside the TI Areas (e.g., moving the comma would help: "…the proposed remedy is to attain a SSS under Act 2 for groundwater, using the GWHHRA and institutional/engineering controls, with ~~PADEP~~ used aquifer SHS MSCs for groundwater eventually met through monitored natural attenuation (MNA)." Additionally, a table of numeric cleanup levels to be achieved in groundwater outside the TI Areas should be included to avoid confusion as to what the specific cleanup levels to be achieved will be.

6. Section 3.3, Surface Water – Revise the first sentence as follows: "The only corrective action objective for surface water occurs under the Resource ~~Recovery~~ Restoration column of Table 3.0-1 because…"
7. Section 3.5.2, Prevent Inappropriate Relocation of Waste – Revise the end of this sentence as follows: "…if waste is encountered during construction or excavation, it will be managed in accordance with appropriate ~~PADEP~~ local, state, and federal regulations."
8. Section 4.1.1, East Campus (LUAs 1 and 2) – Under the Remedial Actions bullet, Groundwater Monitoring, include additional long-term monitoring objectives to verify that contaminated groundwater remains within TI Areas 1 and 2, and to ultimately demonstrate attainment of groundwater cleanup levels in groundwater outside of the TI Areas.
9. Section 4.1.2, West Campus (LUA 3) – Under the Remedial Actions bullet, Groundwater Monitoring, include additional long-term monitoring objectives to verify that contaminated groundwater remains within the TI Area 1, and to ultimately demonstrate attainment of groundwater cleanup levels in areas outside the TI Area.
10. Section 4.2.1, Residential Areas (LUA 4) – In the bullet for Remedial Actions, Groundwater Monitoring, include an additional objective to ultimately demonstrate attainment of groundwater cleanup levels.
11. Section 4.2.2, Industrial Areas (LUA 5) - In the bullet for Remedial Actions, Groundwater Monitoring, include an additional objective to ultimately demonstrate attainment of groundwater cleanup levels.
12. Section 5, Justification for the Proposed Remedy – This section provides a justification for the proposed remedy based on the two threshold and 5 balancing evaluation criteria of the National Contingency Plan. This section should be modified to also specifically include remedy evaluation criteria for RCRA Corrective Action. Many of the criteria overlap. The RCRA Corrective Action threshold criteria include: (1) Protect human health and the environment, (2) Achieve media cleanup objectives, and (3) Control sources of release. The RCRA Corrective Action balancing criteria include: (1) Long-term reliability and effectiveness, (2) Reduction of toxicity, mobility, and volume through treatment, (3) Short-term effectiveness, (4) Implementability, (5) Cost, (6) Community acceptance, and (7) State acceptance. Section 5 does include headings for Community and State acceptance, but does not include the source control threshold criterion. The Compliance with ARARs heading should be modified to also discuss the threshold criterion "Achieve media cleanup objectives," and more specifically, to discuss cleanup levels, points of compliance, and cleanup timeframe.
13. Section 5.2, Balancing Criteria – The text states that the costs to implement the proposed remedy are reasonable compared to other potentially available alternatives. This document did not evaluate other alternatives and no costs are provided. This section should provide cost estimates for remedy construction and implementation, and for long term operation, maintenance, and monitoring of the proposed remedy. In addition, this section should indicate the financial assurance mechanism that will be used.

Thank you for your cooperation in working with EPA and PADEP in the remediation of this site. If you have any questions, please don't hesitate to call me at (215) 814-3407.

Sincerely,

Griff Miller
CDR, U.S. Public Health Service
Office of Pennsylvania Remediation
EPA Region 3

cc: Sharon Fisher, Harley-Davidson (via email)
Pamela Trowbridge, PADEP (via email)