Pennsylvania Department of Environmental Protection

Final Remedial Alternatives Analysis

GTAC 7-1-342 – Bishop Tube HSCA Site

East Whiteland Township, Chester County, Pennsylvania

August 5, 2020

Version 1.0

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East Whiteland Township
Chester County, Pennsylvania

Prepared for:
Mr. Dustin Armstrong
Pennsylvania Department of Environmental Protection
Hazardous Sites Cleanup
Southeast Regional Office
2 North Main Street
Norristown, PA 19401

Prepared by:
Groundwater & Environmental Services, Inc.
440 Creamery Way, Suite 500
Exton, Pennsylvania 19341
TEL: 800-220-3068
www.gesonline.com

GES Project:
0070416

Date:
August 5, 2020

Prepared By:

Tonya M. Boyer

Tonya Boyer
Senior Environmental Scientist

Brian Hecker, P.E.
Senior Engineer

Reviewed By:

Timothy Uhler
Senior Project Manager

Denise Good, P.E.
Principal Engineer

COMMONWEALTH OF PENNSYLVANIA
REGISTERED PROFESSIONAL
DENISE N. GOOD
ENGINEER
No. PE082669

By affixing my seal to this document, I am certifying that to the best of my knowledge the information is true and correct. I further certify that I am licensed to practice in the Commonwealth of Pennsylvania and that it is within my professional expertise to verify the correctness of the information.

EXECUTIVE SUMMARY

Groundwater & Environmental Services, Inc. (GES) has prepared this Remedial Alternatives Analysis on behalf of the Commonwealth of Pennsylvania Department of Environmental Protection (PADEP) for the Former Bishop Tube Property (the Property), located at 1 South Malin Road in East Whiteland Township, Chester County, Pennsylvania. The purpose and primary focus of this report is to identify applicable remedial alternatives to mitigate the potential risks to human health and the environment caused by the presence of adsorbed-phase contaminants in the unsaturated zone.

The Property is approximately 13.7 acres in size. Current features include two large vacant structures identified as Building 5 and Building 8 that cover approximately 3.7 acres of the Property. The area immediately surrounding the two buildings predominantly consists of concrete covered surfaces formerly used for facility driveways, parking and loading areas. The remainder of the Property, primarily in the southern and eastern portions, is overgrown with vegetation and trees. The Property was historically zoned industrial; however, the Property was rezoned by East Whiteland Township for residential use in 2014.

The results of the historical remedial investigations summarized in the Remedial Investigation Report prepared by Roux Associates, Inc. (Roux), identified seven (7) volatile organic compounds (VOCs) and nine (9) metals as the primary constituents-of-concern (COCs) in soil at the Property. These COCs include: trichloroethene (TCE), tetrachloroethylene (PCE), cis-1,2-dichloroethylene (cDCE), 1,1,2-trichloroethane (1,1,2-TCA), 1,1,1-trichloroethane (TCA), vinyl chloride (VC), 1,1-dichloroethylene (1,1-DCE), chromium, vanadium, arsenic, nickel, cobalt, lead, antimony, manganese, and thallium. These adsorbed-phase COCs have been detected at concentrations above the PADEP Soil to Groundwater Medium-Specific Concentrations (MSCs) for a Residential, Used Aquifer and/or the PADEP Direct Contact Numeric Values for a Residential Area (0-15 feet) in soil samples collected at the Property. Furthermore, adsorbed-phase VOCs have been detected at concentrations above the PADEP Site-Specific Standard (SSS) Residential Vapor Intrusion (VI) Screening Values (SVs) for Soil in surface (0 – 2 feet below ground surface [bgs]) and subsurface (>2 feet bgs) soil samples collected at the Property. Further, fluoride is considered a potential COC for soil. Additional soil sampling will need to be conducted during pre-design activities to confirm concentration and distribution of fluoride on the Property.

An evaluation of potential exposure pathways for soil at the Property deemed the following pathways potentially complete:

- Inhalation of vapors volatilized from surface and subsurface soils to the ambient air;
- Leaching of constituents from surface and subsurface soil to groundwater;
- Dermal contact, direct ingestion, and inhalation of particulates from contaminated soil; and
- Contact with surface water contaminated by runoff from contaminated surface soil.

An evaluation of additional potential exposure pathways for soil at the Property deemed that the following pathways are currently incomplete as the Property is currently unoccupied, fenced, and posted “No Trespassing”; however, these potential exposure pathways could become complete based on future land use or failure to maintain certain controls (e.g., fencing and signage):

- Inhalation of vapors volatilized from surface and subsurface soil into an enclosed space;
- Incidental soil ingestion, dermal contact with soil, and inhalation of particulates and volatiles from soil for a construction/trench worker; and
- Incidental soil ingestion, dermal contact with soil, and inhalation of particulates and volatiles from soil for a trespasser/recreational user.

Based on the results of the remedial investigation, several remedial alternatives were evaluated to determine appropriate alternatives for the mitigation of the potential risks caused by the on-site adsorbed-phase contaminants in the unsaturated zone. This report analyzes the following remedial alternatives: soil excavation with offsite disposal; soil excavation with onsite treatment; in-situ soil stabilization; in-situ chemical oxidation/reduction (soil mixing); surface barrier; and engineering and institutional controls. Each alternative was evaluated against various criteria to determine appropriate remedial strategies.

TABLE OF CONTENTS

SECTION.....PAGE

1.0 INTRODUCTION 1

2.0 SITE DESCRIPTION AND BACKGROUND 2

2.1 Location and Description 2
2.2 General Physiographic Setting 2
2.2.1 Topography and Drainage 2
2.2.2 Geology and Hydrogeology 3
2.3 Potential Sensitive Receptors 5
2.4 Site Background and History 5
2.4.1 Historical Operations at the Property 5
2.4.2 Remedial Investigation 5
2.4.3 Source Areas 6
2.4.4 DNAPL 7
2.5 Nature and Extent of COCs in Soil 8
2.5.1 CVOCs 8
2.5.2 Metals/Inorganics 9
2.6 Exposure Pathway Assessment 10
2.6.1 Potential Migration Routes 10
2.6.2 Potential Exposure Pathways 10
2.6.3 Construction/Trench Worker Exposure Pathway 11
2.6.4 Trespasser/Recreational User Exposure Pathways 12

3.0 REMEDIAL TECHNOLOGY SCREENING EVALUATION 13

3.1 Current Site Characteristics 13
3.2 Applicable or Relevant and Appropriate Requirements (ARARs) 13
3.3 Potentially Applicable Technologies 14

4.0 REMEDIAL ALTERNATIVE ASSESSMENT 16

4.1 Remedial Alternative Assessment Criteria 16
4.2 Remedial Alternative Assessment 16
4.2.1 Soil Excavation with Offsite Disposal 17
4.2.2 Soil Excavation with Onsite Treatment 17
4.2.3 In-situ Soil Stabilization 19
4.2.4 In-situ Chemical Oxidation/Reduction via Soil Mixing 20
4.2.5 Surface Barrier 21
4.2.6 Engineering and Institutional Controls 22

5.0 EVALUATION OF ALTERNATIVES 25

5.1 Cross-Over Technologies 25
5.1.1 Soil Excavation 26
5.1.2 In-situ Chemical Oxidation/Reduction via Soil Mixing 26
5.1.3 In-Situ Thermal Treatment 26
5.1.4 Multi-Phase Extraction 27
5.2 Unsaturated Soil Alternatives Summary 27

6.0 CONCLUSIONS 29

7.0 REFERENCES 30

TABLES

Table 1	Remedial Alternative Technology Screening
Table 2	Alternative 1 - Soil Excavation with Offsite Disposal
Table 3	Alternative 2 - Soil Excavation with Onsite Treatment
Table 4	Alternative 3 - In-situ Soil Stabilization
Table 5	Alternative 4 - In-situ Chemical Oxidation/Reduction (Soil Mixing)
Table 6	Alternative 5 - Surface Barrier
Table 7	Alternative 6 - Engineering Controls and Institutional Controls

APPENDICES

Appendix A	Site Figures (Roux, 2019)
Appendix B	Soil Treatment Areas

1.0 INTRODUCTION

GES has prepared this Remedial Alternatives Analysis on behalf of the PADEP for the Property, located at 1 South Malin Road in East Whiteland Township, Chester County, Pennsylvania.

The remedial alternatives presented in this report are based on information presented in the following Bishop Tube Hazardous Site Cleanup Act Site (Site) documents:

- Remedial Investigation Report (RIR), prepared by Roux Associates, Inc. (Roux), dated June 10, 2019[1];
- Feasibility Study Report, prepared by Roux, dated June 17 2019[2];
- PADEP 2019 Remedial Investigation Report Comments Letter, dated October 11, 2019;
- PADEP 2019 Feasibility Study Report Comments Letter, dated October 28, 2019; and
- April 25, 2017 Remediation Scope-of-Work for Targeted Soil Excavation, prepared by Environmental Standards, Inc. (Environmental Standards) dated April 25, 2017.

The Site background/characterization information summarized in this report were obtained from the RIR referenced above.

The purpose and primary focus of this report is to identify applicable remedial alternatives to mitigate the potential risks to human health and the environment, caused by the adsorbed-phase contaminants present in the unsaturated zone at the Site.

[1] The June 2019 RIR, referenced in this document, will likely be revised in 2020. The updated version of the RIR will be a part of the Administrative Record.
[2] The June Feasibility Study Report, referenced in this document, will likely be revised in 2020. The updated version of the Feasibility Study Report will be a part of the Administrative Record.

2.0 SITE DESCRIPTION AND BACKGROUND

2.1 Location and Description

The Property located at 1 South Malin Road in East Whiteland Township, Chester County, Pennsylvania, is approximately 13.7 acres in size. The approximate geographical coordinates of the center of the property site are 40 degrees, 02 minutes, 23 seconds north (latitude) by 75 degrees, 32 minutes, 12 seconds west (longitude). The Property Location Map prepared by Roux is provided in **Appendix A**. The area defined as the Site includes the area within the Property and the extent of groundwater contamination.

Current features at the Property include two large vacant structures identified as Building 5 and Building 8 that cover approximately 3.7 acres of the Property. The area immediately surrounding the two buildings predominantly consists of concrete covered surfaces formerly used for facility driveways, parking and loading areas. The remainder of the Property, primarily in the southern and eastern portions, is overgrown with vegetation and trees. The Property features are depicted on the Reported And/Or Alleged Area of Concern Map prepared by Roux, provided in **Appendix A**.

Surrounding land use consists of commercial, residential, and industrial properties. A Norfolk Southern rail line is located immediately north of the Property, with commercial properties bordering Lancaster Avenue (Route 30) located beyond the rail line. A tributary of Little Valley Creek is located along the eastern property boundary with a residential development (General Warren Village) located beyond the stream. South Malin Road is located immediately west of the Property with a bulk petroleum storage terminal owned and operated by Buckeye Partners, L.P., located beyond the road. A wooded area is located south of the Property, beyond which is an Amtrak rail line. The Local Area Map prepared by Roux is provided in **Appendix A**.

The Property was historically zoned industrial; however, East Whiteland Township rezoned the Property at the request of the current property owner for residential use in 2014.

2.2 General Physiographic Setting

2.2.1 Topography and Drainage

The topography of the Property is moderately sloped, ranging from a topographic high of 450 feet above mean seal level (amsl) in the southwestern corner to a topographic low of 375 feet amsl in the northeast corner. Portions of the Property (e.g., the former southern parking area and Building 8 area) reportedly were topographically altered through cut-and-fill activities to produce a “benched” condition more suitable for construction and use.

The tributary of Little Valley Creek runs south to north just within the eastern property boundary. Beyond the Property, the stream travels north and runs through a culvert beneath the Norfolk Southern rail line and Lancaster Avenue. Approximately 500 feet after exiting the culvert to the north of Lancaster Avenue, the stream begins a northeasterly trend, joins Little Valley Creek, and travels approximately 5,000 feet crossing Conestoga Road and Route 29. Little Valley Creek then begins a more easterly trend.

2.2.2 Geology and Hydrogeology

The Property and surrounding area are located within the Piedmont Physiographic Province and are underlain by rocks that are folded, faulted and metamorphosed. The Site is located primarily within the northeast trending Chester Valley. Chester Valley is predominantly underlain by less resistant carbonate rocks and is bounded by more resistant upland areas to the north and south. These upland areas are also northeast trending, bounding the valley itself, and are referred to as the North Valley Hills and South Valley Hills, respectively.

The rocks that comprise the Chester Valley sedimentary sequence were deposited by continental margin sedimentation during the Upper Precambrian, Cambrian and Ordovician periods (Sloto 1997). The carbonate rocks in the vicinity of the Site are the Ordovician Conestoga Formation. According to Sloto (1987, 1990) and Senior and others (1997), the upper portion of the Conestoga Formation in the Chester Valley area consists of blue-gray to light gray, thin-bedded, argillaceous limestone with intervals of purer, granular limestone. In addition, the carbonate rock of the upper portion of the Conestoga Formation has a finely laminated appearance with shaley partings along bedding planes. The South Valley Hills are underlain by non-carbonate metamorphic phyllite and schist rocks that, in the vicinity of the Site, make up the Octoraro Formation. According to Sloto, the Octoraro Formation in the vicinity of the Site consists of green to silver-gray, fine to medium grained phyllite.

The rocks that underlie the Chester Valley have been deformed and metamorphosed to variable degrees. According to published literature and field observations, the Octoraro phyllites and schists were produced by higher grade metamorphic conditions than the phyllitic limestones of the Conestoga Formation. During the early Paleozoic, a tectonic collision occurred at the eastern edge of the North American continent thrusting the Octoraro Phyllite over and onto the Conestoga Limestone (Sloto 1997). The contact between the carbonate rocks that make up Chester Valley (Conestoga Formation) and the non-carbonate rocks that make up the South Valley Hills (Octoraro Formation) has been mapped as a northeast striking and south dipping thrust fault identified as the Martic Thrust Fault (Blackmer and Brown 2006). As depicted on the Geologic Map provided in **Appendix A**, this thrust fault contact between the Conestoga and Octoraro Formations runs roughly east-west through the southern third of the Property where the South Valley Hills rise up to the south.

The general structure of the carbonate rocks that underlie Chester Valley in the vicinity of the Site is a south dipping anticline (Sloto 1997). The rocks that underlie the Chester Valley area are part of the southern limb of this anticline, strike northeast and dip steeply to the south (Crawford and Crawford 1980, Sloto 1997).

Groundwater transport in Chester Valley is primarily through fractures, joints, faults, foliation parting planes and bedding planes, some of which have been enlarged by solution. According to Sloto, the primary porosity in the carbonate rocks of Chester Valley is virtually non-existent (Sloto 1990). In the Chester Valley, groundwater reportedly flows through a network of fractures that more closely resembles a fractured rock groundwater system than a karst terrain flow system (Sloto 1990). On a regional scale, groundwater flow in eastern Chester Valley converges from the North Valley Hills and South Valley Hills toward the center of Chester Valley and then flows to the east-northeast with discharge to the Schuylkill River (Sloto 1990). However, Sloto also reports that most groundwater flow

in Valley Creek Basin, the portion of Chester Valley where the Site is located, is local with discharge to local streams (Sloto 1990).

Hydrogeologic conditions beneath and downgradient from the Property are generally characterized by two hydrostratigraphic units:

1) partially saturated unconsolidated soil; and
2) fractured bedrock.

Remedial investigation data for the Site have demonstrated that the fracture density, fracture connectivity and hydraulic permeability of the bedrock hydrostratigraphic unit decrease with increasing depth. Accordingly, the shallowest interval of the fractured bedrock exhibits the greatest permeability and therefore the greatest potential for groundwater mobility. Given the predominantly high-angle bedding and fracture plane orientation, the fractured bedrock functions as a single unconfined hydrostratigraphic unit. As noted by Sloto, “the geologic units in Chester Valley are assumed to approximate porous media” and “act together as a single heterogeneous water-table aquifer.”

Site-specific drilling and geophysical investigations produced geologic observations consistent with published literature for the area. Rock encountered beneath the Property was described by Baker as calcareous schist. Roux has described the rock as a phyllitic limestone. These descriptions are similar in that they both recognize a) the substantial presence of carbonate in the rock, b) the argillaceous (or clay containing) nature of the sedimentary source rock and c) the metamorphosed nature of the rock. Also consistent with published literature, the rock encountered had a finely laminated appearance with alternating layers of argillaceous and carbonate material and partings primarily along argillaceous bedding planes. Intervals of purer granular limestone were also encountered.

Similar to Sloto’s observations, the carbonate rock encountered was more typical of a fractured rock system, rather than a karst terrain. There was some limited evidence of zones with relic solution activity, but these zones were commonly completely in-filled with a clay matrix. Occasionally open voids were encountered, but downhole geophysics, packer testing, well yields during sampling and slug test results did not suggest hydraulic conditions consistent with karst terrain. The predominant structural orientation of the bedding planes was consistent with published literature: with strike to the east-northeast and a steep dip (near vertical) to the south. To the extent foliation planes are present, they appear to have an orientation parallel to observed bedding planes. This northeast striking, steeply south dipping structural fabric of the bedrock exerts predominant control over groundwater transport in the area of Site. Where cross-cutting zones of structural weakness exist (e.g., cross-cutting fractures), these features provide a secondary pathway for groundwater transport.

Field observations, water level elevation data and precipitation data indicate that the overburden aquifer within the Site exhibits characteristics of a hydraulically unconfined system (i.e., water table conditions exist). The bedrock aquifer within the Site also largely exhibits characteristics of a hydraulically unconfined system. However, in some locations the bedrock aquifer exhibits hydraulically confined or semi-confined characteristics and likely becomes increasingly confined with depth as a result of decreasing fracture density and connectivity. Water levels from some of the deeper bedrock monitoring wells indicate that the bedrock fractures encountered by those wells are hydraulically isolated or are in poor communication with the shallower portions of the bedrock aquifer.

The references included in this section are detailed in the RIR, prepared by Roux.

2.3 Potential Sensitive Receptors

Potentially sensitive receptors identified for the Property include the following:

- Future residents on the Property;
- Future residential land uses on the Property;
- Residential properties located beyond the eastern property boundary;
- Commercial properties located beyond the northern property boundary;
- The tributary of Little Valley Creek located on the eastern portion of the Property;
- Construction and utility workers; and
- Recreational users and trespassers.

Public water is available and utilized by many properties located in the vicinity of the Property. However, groundwater is also used as a primary drinking water source for one property located within the contaminant plume sourced from the Property. East Whiteland Township does not have an ordinance that prohibits the installation of drinking water wells.

It should be noted that under a Prospective Purchaser Agreement (PPA), executed in 2005, between PADEP and the current property owner, commercial redevelopment of the Property was anticipated, which was consistent with zoning at the time of entry into the PPA, which changed from commercial to residential, based on an application by the current property owner. The Property is currently unoccupied, fenced and posted “No Trespassing.”

2.4 Site Background and History

2.4.1 Historical Operations at the Property

In 1951, J. Bishop & Co. Platinum Works was the first entity known to begin manufacturing operations at the Property. The plant was used among other things for the manufacturing of tubing from stainless steel. The facility that was built in 1951 (referred to as “Plant 5”) is the more southerly of the two current buildings. In 1958, a second building was constructed, referred to as “Plant 8.” The facility continued to operate under various owners and operators as a metal alloy tube manufacturing facility until 1999. Metal alloy tube production concentrated on seamless stainless-steel products for much of the period of operation. During certain periods of time, chlorinated solvents were used for degreasing at the Property. From 1951 to 1999, various entities owned and operated manufacturing operations at the Property. The Property is currently owned by Constitution Drive Partners, L.P. (CDP), who purchased it from the Central and Western Chester County Industrial Development Authority in 2005. The Property has been vacant from 1999 to present.

2.4.2 Remedial Investigation

Investigative activities were conducted at the Site from the early 1970s through 2019. Multiple parties, including Roux, Baker Environmental, Inc. (Baker), PADEP, and others including Environmental Standards, on behalf of CDP, performed site characterization

activities to assess soils, groundwater, sediment, surface water, and/or indoor air quality at the Site. The remedial investigation is detailed in the RIR prepared by Roux. The results of the soil sampling completed by Environmental Standards is detailed under separate cover.

2.4.3 Source Areas

Organic (i.e., chlorinated volatile organic compounds or CVOCs) and inorganic (i.e., metals and fluoride) source areas on the Property are discussed below. The distribution of the COCs in soil are depicted on the figures included in **Appendix A**.

2.4.3.1. CVOC Source Areas

Former operations at the Property included the handling and/or use of CVOCs in several areas. Based on the prior use of the Property, combined with the nature and extent of COCs, three main CVOC source areas were identified in the RIR prepared by Roux:

- **Former Building 8 VDA** – This is the general area within and adjacent to the north side of Building 8, including the following features: a vapor degreaser and solvent distillery indoors, subsurface piping, and a solvent above-ground storage tank (AST) outside. This source area represents the most significant source of CVOCs at the Property. This source area is characterized by the presence of TCE, TCA, and related CVOC daughter products in soil and groundwater. The suspected presence of dense non-aqueous phase liquid (DNAPL), observed proximate to bedrock monitoring wells, is attributed to this source area. A depiction of monitoring wells, located proximate to where DNAPL is suspected to exist in bedrock, based on an evaluation of analytical data and physical observations by Baker and/or Roux, is provided on the Suspected DNAPL in Bedrock Monitoring Wells figure, included in **Appendix A**.

- **Former Drum Storage Area 3** – This is the drum storage area that was located outside the southeast corner of Building 8. This source area is characterized by the presence of TCE (but no TCA exceedances) and related daughter products in soil and groundwater. With one possible exception, suspected DNAPL observed proximate to bedrock monitoring wells is not attributed to this source area. An evaluation of groundwater results for MW-22 in this area indicates a high degree of variability in concentration over time. For this reason, it is unclear whether DNAPL is present within the aquifer matrix proximal to the location of MW-22.

- **Former Building 5 VDA** – This refers to a small vapor degreaser reportedly located in Building 5. It was also alleged by former employees that a second, larger degreaser was located in Building 5, positioned west of the small vapor degreaser. This possible second discreet source area is characterized by the presence of TCE (but no TCA exceedances) and related daughter products in soil and groundwater. A second discreet area of soil contamination, associated with the relocated large vapor degreaser, may also be present west of the small vapor degreaser area characterized by Baker, Roux, and Environmental Standards. No DNAPL is attributed to this source area.

2.4.3.2. Metals/Fluoride Source Areas

Former operations at the Property included the handling and/or treatment of pickle rinse water in several areas which may have contained select metals and/or fluoride. Based on available documentation regarding the prior use of the Property, combined with the nature and extent of select COCs, metals and/or fluoride were identified in one or more additional source areas. Based on the distribution and concentrations (relative to the Medium-Specific Concentrations [MSCs]/Statewide Health Standards [SHSs] as benchmarks), these inorganic source areas (metals and/or fluoride source areas) are of lesser impact relative to the CVOC source areas. These metals and/or fluoride source areas identified in the RIR prepared by Roux, are described below. The distribution of the COCs in soil are depicted on the figures included in **Appendix A**.

- **Area East of Building 8** – As defined by soil and shallow groundwater data, there is an area east of Building 8 that is considered a metals and/or fluoride source area. This is considered an inorganic source area for groundwater. This area exhibits soil exceedances for nickel and total chromium (compared to hexavalent chromium MSCs due to the absence of speciation data and no MSC for total chromium). This area also exhibits groundwater exceedances for manganese and fluoride (there are no exceedances of chromium and nickel). In addition, there are sporadic exceedances of several other metals (i.e., arsenic, thallium, and lead) in groundwater in this area.

- **Area South of the Eastern Portion of Building 8** – As defined by soil and shallow groundwater data, there is an area south of the eastern portion of Building 8 that is considered a source area. This is considered an inorganic source area for groundwater. This area exhibits several soil exceedances for total chromium (compared to hexavalent chromium MSCs due to the absence of speciation data and no MSC for total chromium). This area exhibits groundwater exceedances for nickel, total chromium, hexavalent chromium, and fluoride. There are also isolated soil exceedances of cobalt and lead in this metals and/or fluoride source area.

- **Area South of the Central Portion of Building 5** – As defined by soil and shallow groundwater data, there is an area south of the central portion of Building 5 that is considered a metals and/or fluoride source area. This is considered an inorganic source area for groundwater. This area exhibits soil exceedances for total chromium (compared to hexavalent chromium MSCs due to the absence of speciation data and no MSC for total chromium). This area exhibits shallow groundwater exceedances for nickel, hexavalent chromium, manganese, and fluoride. There is also an isolated exceedance of thallium in one groundwater sample.

Additionally, arsenic, total chromium, and vanadium were detected at concentrations above the PADEP Direct Contact Numeric Values for a Residential Area (0-15 feet) in soils samples collected across the Property.

2.4.4 DNAPL

A soil investigation performed by Baker indicated that DNAPL was not conclusively observed in soil; however, some evidence of potential residual DNAPL was observed on

NAPL liners within Former Drum Storage Area 3 (Baker sample DSA-FLUTE01, 3-4 feet below ground surface [bgs]) and Former Building 8 VDA (Baker sample VDP-FLUTE02, 4-5 feet bgs). Baker inferred from these results that DNAPL had migrated through these areas into fractured bedrock. No DNAPL was observed in the NAPL liners installed in the VD5 Area. Baker testing of monitoring wells MW-25 and MW-27 using FLUTe® NAPL liners reportedly showed a trace amount of staining, potentially indicating the presence of DNAPL in MW-25.

Roux observed DNAPL in the drilling "mud" tub during drilling of the 406 to 426 feet bgs interval in MW-75. Subsequent efforts by Roux to identify and physically recover DNAPL were conducted in MW-26C and MW-75B without success. Methods employed included a bottom-loading bailer, deployment of a bottom-loading, pressurized discrete interval sampler and an agitation method with bulk fluid/sediment pumping and separation at the surface.

The dissolved phase concentrations and the MW-75 drilling observations support the conclusion that some DNAPL is present in deep bedrock beneath the Site. Due to a specific gravity higher than water, DNAPL has migrated down the near vertical structural fabric of the bedrock.

2.5 Nature and Extent of COCs in Soil

The nature and extent of COCs in soil at the Property are described below.

2.5.1 CVOCs

Roux identified seven (7) CVOCs that were detected at concentrations above the PADEP Soil to Groundwater MSC for a Residential, Used Aquifer. These CVOCs include:

- TCE
- PCE
- cDCE
- 1,1,2-TCA
- TCA
- VC
- 1,1-DCE

Of these CVOCs, TCE, 1,1,2-TCA, and VC were also detected at concentrations above the PADEP Direct Contact Numeric Value for a Residential Area (0-15 feet). The distribution of the COCs in soil are depicted on the figures included in **Appendix A**.

In addition, TCE, PCE, 1,1,2-TCA, TCA, VC, and 1,1-DCE were detected at concentrations above the PADEP Site-Specific Standard (SSS) Residential Vapor Intrusion (VI) Screening Values (SVs) for Soil (SV_{SOIL}) (PADEP Technical Guidance Manual [TGM], 2019 Table IV-2) in subsurface (>2 feet bgs) soil samples collected at the Property. VI SVs have not been developed for cDCE; however, cDCE concentrations have been detected at concentrations above the PADEP SSS Residential SV_{SOIL} for the isomer trans-1,2-dichloroethylene (tDCE) in subsurface soil samples collected at the Property. Furthermore, TCE, 1,1,2-TCA, VC, and 1,1-DCE have been detected at

concentrations above the PADEP SSS Residential SV_{SOIL} in surface (0 – 2 feet bgs) samples collected at the Property.

Based on review of the CVOC data in the RIR, Roux determined the following conclusions:

- An assessment of the areal extent and concentrations of CVOCs in soil, as defined largely by Baker data, indicates that the highest concentrations of CVOCs in soil are in the Former Building 8 VDA. Lower concentrations are observed in Former Drum Storage Area 3; the lowest levels were found in the Former Building 5 VDA.

- The data for both TCA and TCE adequately define the nature and extent of the source areas contributing to groundwater conditions beneath the Property.

- The extent of CVOC-impacted soil above standards, as represented by the TCE distribution, is similar in the shallow and deep overburden soil intervals.

2.5.2 Metals/Inorganics

Roux identified nine (9) metals that were either detected at concentrations above the PADEP Soil to Groundwater MSC for a Residential, Used Aquifer and/or the PADEP Direct Contact Numeric Value for a Residential Area (0-15 feet). These metals include:

- Chromium
- Vanadium
- Arsenic
- Nickel
- Cobalt
- Lead
- Antimony
- Manganese
- Thallium

The metals detected at concentrations above the PADEP Soil to Groundwater MSC for a Residential, Used Aquifer include:

- Chromium
- Arsenic
- Nickel
- Cobalt
- Lead
- Antimony
- Manganese

The metals detected at concentrations above the PADEP Direct Contact Numeric Value for a Residential Area (0-15 feet) include:

- Chromium
- Vanadium
- Arsenic

- Cobalt
- Lead
- Antimony
- Thallium

In addition, fluoride is considered a potential COC for soil. Additional soil sampling will need to be conducted during pre-design activities to confirm concentration and distribution of fluoride on the Property.

2.6 Exposure Pathway Assessment

Using PADEP-approved EPA and American Society for Testing and Materials (ASTM) Risk-Based Corrective Action guidance, this assessment identified potential current and future exposure pathways for human receptors, as per Pennsylvania Code, Title 25 § 250.402. The future use of the Property is assumed residential based on the current land use zoning.

2.6.1 Potential Migration Routes

COC migration routes were evaluated for soil based on the detection of COCs in the media and the potential for those detected COCs to migrate within the media or to another media. This would include, but is not limited to, the identified COCs in surface and subsurface soils leaching to groundwater which contributes to diffuse discharge of contaminants to the nearby Little Valley Creek.

<u>Surface Soil</u>

- Volatilization of constituents from surface soil to outdoor air;
- Volatilization of constituents from subsurface soil to indoor air;
- Particulate emission of entrained constituents from surface soil to outdoor air;
- Leaching of constituents from surface soil to subsurface soil; and
- Runoff from contaminated surface soil entering surface water.

<u>Subsurface Soil</u>

- Volatilization of constituents from subsurface soil to outdoor air;
- Volatilization of constituents from subsurface soil to indoor air;
- Particulate emission of entrained constituents from subsurface soil to outdoor air with intrusive activities; and
- Leaching of constituents from subsurface soil to groundwater.

2.6.2 Potential Exposure Pathways

Potential exposure routes were evaluated for soil based on the detection of COCs in the media. Only the exposure pathways associated with the COCs in soil at the Property were evaluated.

2.6.2.1. Air Exposure Pathways

- *Inhalation of vapors volatilized from surface and subsurface soils to the ambient air*: Act 2 does not provide ambient air standards; therefore, soil VI screening values (SV_{SOIL}) are used to evaluate this pathway as these data provide conservative values due to the diffusion associated with ambient air concentrations. Adsorbed-phase COCs have been detected at concentrations above the PADEP SSS Residential SV_{SOIL} in surface (0 – 2 feet bgs) and subsurface (>2 feet bgs) soil samples collected at the Property. Therefore, this pathway was deemed relevant for this Site.

- *Inhalation of vapors volatilized from surface and subsurface soil into an enclosed space:* Adsorbed-phase COCs have been detected at concentrations above the PADEP Soil to Groundwater MSCs for a Residential, Used Aquifer and/or the PADEP Direct Contact Numeric Values for a Residential Area (0-15 feet) in soil samples collected at the Property. Furthermore, adsorbed-phase COCs have been detected at concentrations above the PADEP SSS Residential SV_{SOIL} in surface (0 – 2 feet bgs) and subsurface (>2 feet bgs) soil samples collected at the Property. Therefore, this pathway was deemed relevant for this Site.

2.6.2.2. Groundwater Exposure Pathways

- *Leaching of constituents from surface and subsurface soil to groundwater*: Adsorbed-phase COCs have been detected at concentrations above the PADEP Soil to Groundwater MSCs for a Residential, Used Aquifer. Therefore, this pathway was deemed relevant for this Site.

2.6.2.3. Soil Exposure Pathways

- *Dermal contact, direct ingestion, and inhalation of particulates from contaminated soil:* Adsorbed-phase COCs have been detected at concentrations above the PADEP Direct Contact Numeric Values for a Residential Area (0-15 feet) in soil samples collected at the Property. Therefore, this pathway was deemed relevant for this Site.

2.6.2.4. Surface Water Exposure Pathways

- *Contact with surface water contaminated by runoff from contaminated surface soil:* The nearest surface water body to the Property is the tributary of Little Valley Creek, which is located on the eastern portion of the Property. COCs have been detected in historical surface water and sediment samples collected from the stream. Therefore, this pathway was deemed relevant for this Site.

2.6.3 Construction/Trench Worker Exposure Pathway

- *Incidental soil ingestion, dermal contact with soil, and inhalation of particulates and volatiles from soil for a construction/trench worker:* Adsorbed-phase COCs have been detected at concentrations above the PADEP Soil to Groundwater MSCs for a Residential, Used Aquifer and/or the PADEP Direct Contact Numeric Values for a Residential Area (0-15 feet) in soil samples collected at the Property. Furthermore, adsorbed-phase COCs have been detected at concentrations above the PADEP Residential SSS SV_{SOIL} in surface (0 – 2 feet bgs) and subsurface (>2

feet bgs) soil samples collected at the Property. Therefore, this pathway was deemed relevant for this Site.

2.6.4 Trespasser/Recreational User Exposure Pathways

- *Incidental soil ingestion, dermal contact with soil, and inhalation of particulates and volatiles from soil for a trespasser/recreational user:* A trespasser is a person that gains access to the site without permission, while a recreational user accesses the site with permission. Adsorbed-phase COCs have been detected at concentrations above the PADEP Soil to Groundwater MSCs for a Residential, Used Aquifer and/or the PADEP Direct Contact Numeric Values for a Residential Area (0-15 feet) in soil samples collected at the Property. Furthermore, adsorbed-phase COCs have been detected at concentrations above the PADEP Residential SSS VI SV_{SOIL} in surface (0 – 2 feet bgs) and subsurface (>2 feet bgs) soil samples collected at the Property. Therefore, this pathway was deemed relevant for this Site.

3.0 REMEDIAL TECHNOLOGY SCREENING EVALUATION

3.1 Current Site Characteristics

Review of available site characterization information indicates that there are four (4) potential pathways for exposure to the unsaturated soil COCs at the Site:

- Inhalation of volatilized vapors soil;
- Leaching of constituents from surface and subsurface soil to groundwater;
- Dermal contact, ingestion, and inhalation of particulates from contaminated soil; and
- Contact with surface water contaminated by runoff from contaminated surface soil.

Based on the above listed potential exposure pathways, various remedial alternatives were screened in order to determine appropriate methods for mitigation of on-site COCs and the associated risks. In order to evaluate the appropriate remedial technologies, the following characteristics were considered:

- The Property is occupied by two adjoining industrial buildings and surrounding various paved areas related to the former manufacturing activities. The remainder of the Property consists of both paved and unpaved areas.
- The Property is bordered to the east by tributary of Little Valley Creek and residential properties (General Warren Village), to the west by South Malin Road, to the north by a Norfolk Southern rail line, and to the south by an undeveloped wooded parcel.
- The depth to water at the Site typically ranges from six (6) to 14 feet bgs.
- Review of soil analytical results collected during soil boring and monitoring well installation events at the Property indicate that adsorbed impact of COCs is present in the saturated and unsaturated zones. However, it appears that the majority of available soil data was collected in the unsaturated zone (i.e., <14 feet bgs). With this, the screening evaluation considered unsaturated soils only. Outlines of the targeted treatment areas by analyzed COC are included in **Appendix B**.

3.2 Applicable or Relevant and Appropriate Requirements (ARARs)

As part of the technology screening evaluation, the list of PADEP standards and/or requirements for clean-up related to waste sites in Pennsylvania was reviewed to determine Applicable or Relevant and Appropriate Requirements (ARARs) that are potentially pertinent to this cleanup project. The following ARARs were identified as applicable requirements for the site:

- The Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. §9601 et seq.;
- The Hazardous Sites Cleanup Act ,35 P.S. § 6020.101 et seq.;
- The Land Recycling and Environmental Remediation Standards Act 2, 35 P.S. § 6026.101 et seq.;
- The Solid Waste Management Act, 35 P.S. §§ 6018.101-6018.1003;
- The Clean Streams Law, 35 P.S. §§ 691.1 – 691.1001;
- The Dam Safety and Encroachments Act, 32 P.S. § 693.1 et seq.;

- The Flood Plain Management Act, 32 P.S. § 679.101 et seq.;
- The Storm Water Management Act, 32 P.S. § 680.1 et seq.;
- The Pennsylvania Safe Drinking Water Act, 35 P.S. § 721.1 et seq.;
- The Air Pollution Control Act, 35 P.S. §§ 4001-4015;
- The Water Well Drillers License Act, 32 P.S. § 645.1 et seq.;
- The Pennsylvania Uniform Environmental Covenants Act, 27 Pa. C.S. §§ 6501 – 6517; and
- Implementing regulations for all above-identified statutes.

The above-listed ARARs were utilized as part of the Remedial Alternatives Assessment detailed in **Section 4.0** of this report.

3.3 Potentially Applicable Technologies

Considering the above-referenced characteristics, the following remedial alternatives were evaluated to determine if they would be an effective remedial strategy for the COCs and associated risks at the Property:

- Soil excavation with offsite disposal;
- Soil excavation with onsite treatment;
- In-situ soil stabilization;
- Soil vapor extraction;
- Multi-phase extraction;
- In-situ chemical oxidation/reduction (fluid delivery);
- In-situ chemical oxidation/reduction (soil mixing);
- Enhanced in-situ bioremediation;
- Surface Barrier;
- Phytoremediation;
- Monitored natural attenuation;
- Engineering controls;
- Institutional controls; and
- No action.

The listed remedial technologies may address all or only part of the identified COC impacted soils at the Property. Additionally, the above list of remedial technologies may be limited in their application scope with respect to saturated versus unsaturated soil treatment. For the purposes of this RAA, remedial technologies deemed effective for use in unsaturated soils or technologies that may be part of a broader multi-technology approach were assessed, which include the following:

- Soil excavation with offsite disposal;
- Soil excavation with onsite treatment;
- In-situ soil stabilization;
- In-situ chemical oxidation/reduction (soil mixing);
- Surface Barrier;
- Engineering controls; and
- Institutional controls.

A summary of the remedial alternative technology screening is provided in **Table 1**. Each of the retained remedial alternatives are described and subsequently evaluated in **Section 4.0** of this report.

4.0 REMEDIAL ALTERNATIVE ASSESSMENT

4.1 Remedial Alternative Assessment Criteria

Based on the remedial technology screening evaluation, each suitable technology was further evaluated to determine:

- Threshold Criteria:
  - The protection of human health and the environment; and
  - Compliance with ARARs.
- Balancing Criteria:
  - Feasibility of the remedial alternative;
  - Effectiveness of the remedial alternative;
  - Implementability of the remedial alternative;
  - Remedial alternative implementation timeframe;
  - Permanence of the remedial alternative;
  - The cost of implementation of the remedial alternative; and
  - Community acceptance of the remedial alternative.

Based on review of soil analytical data against the applicable PADEP standards, outlines of approximate targeted treatment areas by analyzed COC were developed and are included in **Appendix B**. Note that **Appendix B** does not include treatment area figures for vanadium or chromium, as the aerial extent is not delineated sufficiently to bound the extent of treatment required. The cost estimate for the implementation of each remedial alternative was generated based on target treatment areas, recent information from similar sites, and/or current accepted industry construction cost information. Public reaction to remedial alternatives will be considered during the Hazardous Sites Cleanup Act's (HSCA's) Administrative Record process.

4.2 Remedial Alternative Assessment

Based on the remedial alternative technology screening, each suitable technology was further evaluated to determine a cost-benefit, comparative analysis to support the selection of a recommended remedial approach protective of human health and the environment. This evaluation was performed for the following remedial alternatives:

- Soil excavation with offsite disposal;
- Soil excavation with onsite treatment;
- In-situ soil stabilization;
- In-situ chemical oxidation/reduction (soil mixing);
- Surface Barrier;
- Engineering controls; and
- Institutional controls.

The cost estimate for the implementation of each remedial alternative was generated based on target treatment areas, recent information from similar sites and/or current accepted industry construction cost information. Additionally, certain Property-specific attributes were considered, including the low bridge clearance at the South Malin Road railroad underpass, which may restrict access to the Property by large vehicles/equipment.

4.2.1 Soil Excavation with Offsite Disposal

Excavation of contaminated unsaturated soil is a viable remedial alternative for the Property, as it would result in the removal of the identified adsorbed COCs, thereby, mitigating the risk for ingestion or dermal contact with contaminated soils. Additionally, excavation of the impacted soils would mitigate the risks of inhalation of vapors volatilized from the soils, leaching of constituents to groundwater, and contact with surface water, contaminated by runoff from contaminated surface soil. Soil excavation with offsite disposal could be executed in a fashion that results in the elimination of unsaturated soil contaminant mass. Therefore, this alternative is considered to be protective of human health and the environment. The alternative is compliant with the PADEP ARARs, as it addresses the concerns associated with the soil contamination present at the Property. To implement excavation in the identified areas of COC exceedances, it would require the removal of the onsite structures, significantly contributing to the overall alternative cost.

The depth of the excavation proposed is dependent upon the elevation of the contamination that will be observed during the excavation activities. It is assumed that the contamination elevation is consistent with the characterization work recently completed and that the depth of the excavation will extend to the top of the water table unless vertical COC delineation is completed. Additionally, to complete this excavation, it is assumed that the aerial extent of the non-delineated COCs (e.g., chromium, arsenic, vanadium) end at the extent of property development (i.e., impervious surface cover, building foundation perimeter). Following the completion of excavation activities, certified clean fill material would be utilized as backfill to match existing surface grades.

This remedial alternative could be expanded by increasing the excavation depth to also include the treatment of saturated soils (see Section 5.0).

While completing an excavation of this size and complexity with the number of known COCs, does present challenges, including razing the existing facility structures, this alternative is considered to be implementable. In order to access the Property due to the South Malin Road low bridge clearance restriction, smaller equipment may be required. As a result, this may delay the completion of the remedy. The potential negative impact to Little Valley Creek should be limited to runoff and dust. Both can be mitigated by an appropriate plan (i.e., soil and erosion control and fugitive dust control). Additionally, excavation of the soils does not require long term work or continued maintenance. Therefore, this remedial alterative is considered to be permanent. A remedy timeline of up to four (4) years is anticipated, with one (1) year of planning/design, less than one (1) year for remedy implementation, and two (2) years for post construction monitoring and reporting.

The evaluation of this option estimated the removal of approximately 48,000 cubic yards of impacted unsaturated soils at an estimated cost of $7,823,725. A breakdown of estimated costs for this alternative is provided as **Table 2**. The primary contributors for the cost are for the transportation and off-site disposal of the excavated soils, the demolition of the former facility structures, and backfill soil.

4.2.2 Soil Excavation with Onsite Treatment

Excavation of contaminated unsaturated soil is a viable remedial alternative for the Property, as it would result in the removal of the identified adsorbed COCs, thereby

mitigating the risk for ingestion or dermal contact with contaminated soils. Additionally, excavation of the impacted soils would mitigate the risks of inhalation of vapors volatilized from the soils, leaching of constituents to groundwater, and contact with surface water contaminated by runoff from contaminated surface soil. Soil excavation with onsite treatment could be executed in a fashion that results in treatment of unsaturated soil contaminant mass. Therefore, this alternative is considered to be protective of human health and the environment. The alternative is compliant with the PADEP ARARs, as it addresses the concerns associated with the soil contamination present at the Property. To implement excavation in the identified areas of COC exceedances, it would require the removal of the onsite structures, significantly contributing to the overall alternative cost.

The depth of the excavation proposed is dependent upon the elevation of the contamination that will be observed during the excavation activities. It is assumed that the contamination elevation is consistent with the characterization work recently completed and that the depth of the excavation will extend to the top of the water table unless vertical COC delineation is completed. Additionally, to complete this excavation, it is assumed that the aerial extent of non-delineated COCs (e.g., chromium, arsenic, vanadium) end at the extent of property development (i.e., impervious surface cover, building foundation perimeter). For the purposes of this analysis, it is assumed that the soils will be blended with a stabilizing agent, such as Portland cement, fly ash, or other additive, to eliminate the direct contact and leaching exposure pathways for the COCs and to make it suitable for backfill.

Excavation of impacted soil with onsite treatment at the Property would mitigate the risk for ingestion or dermal contact with contaminated soils. Additionally, excavation of the impacted soils should reduce the risks of inhalation of vapors volatilized from the soils, leaching of constituents to groundwater, and contact with surface water contaminated by runoff from contaminated surface soil. Therefore, this alternative is considered to be protective of human health and the environment. The alternative is compliant with the PADEP ARARs, as it addresses the concerns associated with the soil contamination present at the Property.

This remedial alternative could be expanded by increasing the excavation depth to also include the treatment of saturated soils (see Section 5.0).

While completing an excavation of this size and complexity with treatment of the number of known COCs within the unsaturated soils would present numerous challenges, including razing the existing facility structures, this alternative is considered to be implementable. In order to access the Property due to the South Malin Road low bridge clearance restriction, smaller equipment may be required. As a result, this may delay the completion of the remedy. The potential negative impacts to Little Valley Creek are limited to runoff and dust. Both can be mitigated by an appropriate plan (i.e., soil and erosion control and fugitive dust control). Additionally, excavation and onsite treatment of the soils does not require long term work or continued maintenance. Therefore, this remedial alterative is considered to be permanent. A remedy timeline of up to four (4) years is anticipated, with one (1) year of planning/design, less than one (1) year for remedy implementation, and two (2) years for post construction monitoring and reporting.

An evaluation of this option estimated the excavation, onsite treatment, and backfill of approximately 48,000 cubic yards of treated soils at an estimated cost of $5,204,485. A breakdown of estimated costs for this alternative is provided as **Table 3**. The primary

contributors for the cost are for the ex-situ soil treatment and the demolition of the former facility structures.

4.2.3 In-situ Soil Stabilization

Solidification and stabilization of contaminated soils to limit the flux of contaminants from soil to groundwater and soil to air via in-situ application has been shown to be effective at remediating the COCs identified at the Property. Therefore, it is expected that this technology is a viable remedial alternative for the Property.

Site-specific addition rates of cementitious reagent(s) are mixed with impacted soils at the Property through one of several available in-situ mixing methods, resulting in a solidified monolith of increased unconfined compressive strength (e.g., 50 pounds per square inch) and reduced permeability (i.e., $1x10^{-6}$ centimeters per second) in comparison to native soil conditions. This reduction in permeability results in groundwater to be diverted around the solidified treatment zone should there be a temporary increase in the groundwater elevation. This remedial alternative should reduce leaching of unsaturated source zone contaminants to groundwater by limiting the contact between infiltrated surface water and impacted soils.

The in-situ soil stabilization will involve the mechanical mixing of in-situ soils with binding reagents in pre-determined treatment cells. The treatment cells will be used to promote even remedy application, with thorough mixing, and track treatment performance. The binding reagents will be mixed with water to form a slurry prior to mixing. This slurry is added to the in-situ soil, which results in the total volume of the in-situ soil stabilization mixture increasing in volume. Additionally, water is added to the slurry until the in-situ soil and slurry can effectively be homogenized. This volume increase (bulking) resulting from the mixing is required to be transported and disposed offsite after curing for at least 24 hours, as the stabilized soils cannot be placed above the frost line. By the time of disposal, the bulking material will have become solidified.

The depth of the mixing cells is dependent upon the vertical delineation of the identified contamination. It is assumed that the contamination elevation is consistent with the characterization work completed and that the depth of the soil mixing will extend to the top of the water table unless vertical delineation is completed. Additionally, it is assumed that the aerial extent of non-delineated COCs (e.g., chromium, arsenic, vanadium) end at the aerial extent of property development (i.e., impervious surface cover, building foundation perimeter).

In-situ stabilized soils that are exposed to freezing temperatures may be susceptible to degradation due to freeze and thaw cycles; therefore, in-situ stabilized soils must be installed below the frost line. Therefore, prior to in-situ soil stabilization remedy implementation, the surface soils in the designated treatment areas will be excavated to the identified frost depth (assume to be three feet). After in-situ soil stabilization remedy implementation, stabilized soil swell will be removed back to three (3) feet bgs and backfilled to match surrounding grades.

This remedial alternative scope may be expanded by increasing the mixing depth to also include the treatment of saturated soils. Also, depending on remedial action timelines, the in-situ stabilized soils may impede the implementation of potential saturated soil and/or groundwater remedial options.

The in-situ application of the selected binding reagents would need to be evaluated during pre-design for potential negative impact to the tributary of Little Valley Creek adjacent to the treatment area.

While other alternatives presented in this report result in the removal of the majority of contaminant mass, the application of this remedial alternative can be tailored to achieve the desired outcome of sequestering the identified soil contaminants to eliminate the unsaturated soil exposure pathways that exist at the Property.

In-situ soil stabilization is considered to be implementable. The area of contamination would be relatively accessible following demolition of the existing facility structures and can accommodate the installation of temporary equipment during the remedy implementation. The South Malin Road low bridge clearance for large equipment access to the site was also considered in the alternative feasibility and cost. Additionally, in-situ soil stabilization does not require long term work or continued maintenance. Therefore, this remedial alterative is considered to be permanent. A remedy timeline of up to four (4) years is anticipated, with one (1) year of planning/design, less than one (1) year for remedy implementation, and two (2) years for post construction monitoring and reporting.

The estimated total cost to complete the activities outlined above is $5,315,125. A breakdown of estimated costs for this alternative is provided as **Table 4**. The primary contributors for the cost are the soil stabilization treatment, offsite soil disposal, and the demolition of the former facility structures.

4.2.4 In-situ Chemical Oxidation/Reduction via Soil Mixing

The use of chemical oxidation/reduction reagents for the treatment of unsaturated soils via in-situ mechanical soil mixing has been shown to be effective at remediating the COCs identified at the Property. Therefore, it is expected that this technology is a viable remedial alternative for the Property. The use of a reagent such as MetaFix® by Peroxychem of Philadelphia, Pennsylvania, is capable of treating comingled plumes of multiple, heavy metals and chlorinated solvents utilizing a blend of iron, carbon, and calcium-based compounds based on site-specific conditions. Following the blending of the reagent into the treatment zone, metals present in the soil are subjected to reduction, adsorption, precipitation, and conversion to stable sulfide and iron-sulfide precipitates. Additionally, with the creation of reducing conditions, the reagent will also reduce the identified chlorinated ethenes and ethanes present in the unsaturated soils.

It is anticipated that in-situ mixing of the reagent can be utilized at the Property to destroy and/or chemically stabilize the adsorbed-phase COCs that exist in the surface and subsurface soils. Utilizing this technology will result in the reduction in concentrations in soil to below criteria levels to close the identified COC exposure pathways.

The in-situ application of the selected reagent(s) should to be evaluated during pre-design for potential negative effects to the tributary of Little Valley Creek adjacent to the treatment area, which could include detrimental effects from runoff during implementation.

Additionally, while other alternatives presented in this report result in the removal of the majority of contaminant mass, the application of this remedial alternative can be tailored

to achieve the desired outcome associated with eliminating the unsaturated soil exposure pathways that exist at the Property.

To implement, identified treatment areas would be divided into manageable cells to promote even reagent application, adequate dosing for the contaminant mass within the cell, thorough mixing, and track treatment performance. The depth of the mixing cells is dependent upon the vertical delineation of the identified contamination. It is assumed that the contamination elevation is consistent with the characterization work completed and that the depth of the soil mixing will extend to the top of the water table unless vertical delineation is completed. Additionally, it is assumed that the aerial extent of non-delineated COCs (e.g., chromium, arsenic, vanadium) end at the aerial extent of property development (i.e., impervious surface cover, building foundation perimeter). Following the completion of soil mixing activities, the site surface would be finished to match existing unpaved surface grades.

Following the implementation of soil mixing, the surface and subsurface soils would not be suitable for redevelopment due to the reduction in bulk soil density. It is not uncommon following a soil mixing application (demonstrating successful treatment), that the treated soils are then stabilized via an in-situ application of cementitious reagent(s) to achieve a desired unconfined compressive strength. As the plans for the future property use have not been finalized, the costs for in-situ stabilization are not included with this remedial technology.

This remedial alternative scope may be expanded by increasing the mixing depth to also include the treatment of saturated soils (see Section 5.0).

In-situ chemical reduction via soil mixing using a reagent such as MetaFix® is considered to be implementable. The area where contamination is present would be relatively accessible following demolition of the existing facility structures and can accommodate the installation of temporary equipment during the remedy implementation. The South Malin Road low bridge clearance for large equipment access to the Property was also considered into the alternative feasibility and cost. Based on information gathered, the clearance should not be a limiting factor for this approach. Additionally, in-situ chemical reduction via soil mixing does not require long term work or continued maintenance. Therefore, this remedial alterative is considered to be permanent. A remedy timeline of up to four (4) years is anticipated, with one (1) year of planning/design, less than one (1) year for remedy implementation, and two (2) years for post construction monitoring and reporting.

The estimated total cost to complete the activities outlined above is $3,514,048. A breakdown of estimated costs for this alternative is provided as **Table 5**. The primary contributors for the cost are the reagent, reagent application (soil mixing), and the demolition of the former facility structures.

4.2.5 Surface Barrier

Installation of an impervious surface barrier or cap can be completed at the Property to mitigate the potential for dermal contact and/or ingestion of adsorbed COCs. The impervious cap would also eliminate the direct contact exposure pathway, leaching of constituents from subsurface soil to groundwater, and the inhalation of vapors volatilized from subsurface (unsaturated) contaminated soils.

The impervious cap would be focused in the areas with concentrations of contamination exceeding the PADEP residential direct contact numeric values that were identified in surface soils during soil boring and/or monitoring well installation activities. As the existing paved areas are in fair to poor condition (including building slabs; the existing facility structures would be razed), the existing paved areas will need to be removed allowing for the installation of a uniform cap across the treatment areas. Due to the removal of the old asphalt and the building slabs, a soil management plan would need to be developed due to the potential disturbance of contaminated soils. The impervious cap would be constructed of a permeable geotextile liner, two (2) feet of certified clean fill subgrade material, and low permeability cap (e.g., asphalt) and is expected to encompass a total estimated area of approximately 18,000 square yards.

This remedial alternative scope cannot be expanded to also include the treatment of saturated soils as it is a barrier against exposure of COCs within the soil, and not a treatment alternative.

Installation of a surface barrier could have a potential negative impact to the tributary of Little Valley Creek, caused by increased stormwater runoff and erosion. The design would require incorporation of sufficient stormwater management controls. During construction, runoff would need to be controlled.

Installation of an impervious cap is considered to be a feasible remedial alternative for this Property. Additionally, the installation of an impervious cap would immediately mitigate the risks associated with dermal contact and ingestion of the contaminated surface soils and therefore provides short-term effectiveness, however, this is dependent on a non-residential classification for future property use. As a stand-alone engineering control remedy, when coupled with institutional controls to prevent the removal of the cap and to require routine inspection and maintenance of the cap in the future, this alternative could prevent future construction that could result in a breach to the cap. As such, this alternative alone does provide long-term effectiveness.

Installation of an impervious cap in the areas where contaminated surface soils are known to exist could be implemented with minimal impact to the current property use, except during construction. Additionally, as the impervious cap would remain in place, the alternative is considered permanent. A remedy timeline of 30 years is anticipated, with one (1) year of planning/design, less than one (1) year for remedy implementation, and 28 years for post construction monitoring.

The estimated total cost to complete the activities outlined above is $2,256,904. A breakdown of estimated costs for this alternative is provided as **Table 6**.

A pervious (soil) cap was also considered, but unlike an impervious cap, was determined to be not a stand-alone remedy as open exposure pathways would be present, and, therefore, not included in this analysis.

4.2.6 Engineering and Institutional Controls

The last remedial alternative examined for this analysis involves the implementation of institutional controls by means of an environmental covenant (e.g., deed restriction) that would restrict groundwater use and implement additional requirements during excavation

and construction activities as a protective measure to mitigate exposure to COCs within the soil. To further restrict exposure to soil COCs that exceed criteria values, the existing fence could be adjusted as necessary around the Property to encompass all identified areas of soil exceedances. Additional signs marking the area as a restricted access location could also be posted to warn local residents of the potential risks associated with contacting the soil at the Property.

An additional institutional control to implement as part of this alternative would be to establish activity and use limitations on the deed of the Property. This would include, but not be limited to, the prohibition of groundwater use, the requirement of the use of a vapor mitigation technology (e.g., vapor barrier, soil vapor intrusion mitigation system), and limiting ground floor and below ground floor occupancy as means to mitigate exposure to soil COCs at the Property.

This alterative would not actively remove or remediate the COCs at the Property, so the fence would require periodic maintenance to ensure that unauthorized access to the restricted areas does not occur. Implementation of the proposed institutional controls for the Property would restrict limit future land use and require exposure prevention measures during the construction and occupancy of new structures that would reduce the risk for dermal contact with the adsorbed-phase COCs and the inhalation of vapors volatilized from subsurface (unsaturated) contaminated soils. However, the direct contact exposure pathway would be complete for a potential trespasser on the Property.

Although the implementation of an environmental covenant and other institutional controls would mitigate some of the risks identified for the Property, these solutions will not address the potential risk of COCs leaching from subsurface soil to groundwater that have the potential to migrate beyond the Property boundaries with local groundwater flow. This alternative is considered to be only partially protective of human health and the environment and is not considered to be compliant with the PADEP ARARs unless paired with one or more technologies discussed in this section such as a surface barrier (an engineering control).

It is feasible to implement deed restrictions and institutional controls at the Property; an Administrative Order under Section 512 of HSCA could be issued to enforce deed restrictions in instances should PADEP be unable to secure a signed covenant. An environmental covenant is believed to be a potential long-term remedial alternative for the Property as it would limit future use for both soil and groundwater on the parcel, while the installation of a fence around the affected soil on the property and the implementation of an environmental covenant on the affected parcels is considered to be permanent.

This remedial alternative scope cannot be expanded to also include the treatment of saturated soils as it is a barrier against exposure of COCs within the soil and not a treatment alternative.

An environmental covenant and other institutional controls for activity use limitations are considered to be implementable at the Property. Installation of an institutional control (fence) around the affected areas could also be implemented, although the fence would encompass a large area of the property and would likely disrupt potential future land use at the Property. A remedy timeline of 30 years is anticipated, with one (1) year of planning/design, less than one (1) year for remedy implementation, and 28 years for post construction monitoring.

Copies of the recorded covenant would need to be distributed to certain entities, e.g., East Whiteland Township, Chester County Health Department, and the owners of any utilities located on the Property.

The estimated total cost to complete the activities outlined above is $796,257. A breakdown of estimated costs for this alternative is provided as **Table 7**.

5.0 EVALUATION OF ALTERNATIVES

The remedial alternatives presented in **Section 4.2** have been evaluated with numerous criteria in an effort to determine the appropriate remedy(ies) for the Property. However, comparing each alternative with one another is an essential part of the analysis. Therefore, the following table presents a comparison of the remedial alternatives presented above to provide a summary of total alternative costs, timeframes (including pre-design, remedy implementation, and long-term operation and maintenance), and effectiveness of each of the alternatives in addressing the identified exposure pathways.

	Alternative	Estimated Total Cost	Timeframe (years)[2]	Addresses Direct Contact Exposure Pathway?	Addresses Inhalation Exposure Pathway?	Addresses Soil Leaching Exposure Pathway?	Addresses Surface Soil Runoff Exposure Pathway?	Possible Saturated Zone Remedy?
1	Soil Excavation with Offsite Disposal	$7,823,725	4	Yes	Yes	Yes	Yes	Yes
2	Soil Excavation with Onsite Treatment	$5,204,485	4	Yes	Yes	Yes	Yes	Yes
3	In-situ Soil Stabilization	$5,315,125	4	Yes	Yes	Yes	Yes	Yes
4	In-situ Chemical Oxidation/Reduction via Soil Mixing	$3,514,048	4	Yes	Yes	Yes	Yes	Yes
5	Surface Barrier	$2,256,904	30[1]	Yes	Yes	Yes	Yes	No
6	Institutional Controls	$796,257	30[1]	Yes	Yes	No	No	No

NOTE:
[1] 30-year timeframe is used for cost estimation purposes. Actual timeframes may be longer or shorter.
[2] Estimated total cost includes design, construction, operation, maintenance, and monitoring costs as applicable for each alternative.

5.1 Cross-Over Technologies

The focus of this RAA is the evaluation of remedial alternatives to address unsaturated soils. However, it is recognized that efficiencies could be gained by considering approaches that could address unsaturated soil, as well as saturated soil in the unconsolidated zone. A preliminary review of several applicable technologies is presented in this section.

The extent of saturated adsorbed-phase impacts is not fully delineated and additional pre-design work would be necessary to better define the scope and extents (lateral and vertical) of impact. Additionally, the extent of CVOC versus inorganic (i.e., metals) impacts

may come into play in selecting a final approach, as some alternatives are not effective on inorganics.

5.1.1 Soil Excavation

Soil excavation, with either offsite disposal or onsite treatment, could be utilized to remove impacted unsaturated and saturated soils. Dewatering would be necessary to allow removal of saturated soil impacts. This would require treatment and disposal of the water. Potential negative impacts to the tributary of Little Valley Creek would primarily be from runoff following contact with excavated soils. These impacts would require a soil and erosion management plan during implementation, as well as a fugitive dust management plan.

5.1.2 In-situ Chemical Oxidation/Reduction via Soil Mixing

Chemical treatment via ISCO or ISCR could be used to address unsaturated and saturated soils within the unconsolidated zone for CVOCs and metals impact. Chemical treatment would include adding an amendment to the subsurface. The amendment could be an oxidant or a reductant that would be added in-situ via soil mixing.

Implementing ISCO/ISCR via soil mixing within the saturated soil zone could have potential negative effects on the tributary of Little Valley Creek, more so than soil mixing in the unsaturated zone only. Bench testing and pilot testing would be necessary as part of the pre-design work. Possible negative effects may include changes in geochemistry (e.g., pH, dissolved oxygen), amendment excursion (short-circuiting) into the tributary of Little Valley Creek, or increased mobility of metals, and temporary effects on naturally-occurring biodegradation. The latter two are primarily associated with oxidants (ISCO).

A direct injection approach could be utilized to target the saturated zone only, as it is not common practice to do direct injection in the unsaturated zone. This would only apply if another remedial alternative was selected for the unsaturated zone (e.g., excavation). Further, an ISCO/ISCR approach could potentially be implemented to an expanded target treatment zone that included the dissolved-phase impacts within bedrock. This would be a direct injection approach.

5.1.3 In-Situ Thermal Treatment

In-Situ Thermal Treatment (ISTT) consists of heating the subsurface to facilitate volatilization followed by contaminant extraction and treatment. The three major ISTT technologies are Steam Enhanced Extraction (SEE), Electrical Resistance Heating (ERH), and Thermal Conductive Heating (TCH). For the given site conditions, a TCH approach would be very effective at remediating CVOC impacts in unsaturated and saturated soil and could be evaluated as a treatment option in bedrock as well. The ability to capture the volatized contaminants is a key aspect of the approach. In order to address the short-comings of the previously-implemented SVE system and recognizing that some areas have less vadose zone, additional topsoil would likely need to be brought in to provide adequate capture of vapors. Horizontal and vertical vapor extraction wells would be utilized to ensure full capture. One of the primary limitations to ISTT is that it will not be effective at addressing metals impacts.

Another consideration is potential negative impacts to the tributary of Little Valley Creek due to the significant subsurface heating that occurs during ISTT. However, based on information received from a thermal remediation provider, increases in creek temperatures would not be expected, provided active treatment is not conducted closer than approximately 20 feet of the creek. Given the location of impacts and direction of groundwater flow, this concern could be addressed, but does warrant careful consideration and evaluation.

5.1.4 Multi-Phase Extraction

Multi-phase extraction is a combination of vapor extraction from the unsaturated zone and groundwater extraction. Groundwater pumping lowers the water table to allow vapor extraction of the adsorbed-phase impacts and reduces the potential, negative impact to this remedial alternative from the high groundwater table observed at the Site. Groundwater extraction was screened in the Feasibility Study Report via two alternatives. One of the alternatives was hydraulic control, which was retained. Multi-phase extraction would not be a beneficial modification to a hydraulic control approach. This is because typically hydraulic control is implemented at the leading edge of a plume or at a property boundary. The extent of adsorbed-phase impact at the property boundary is limited and, therefore, adding vapor extraction to the pumping wells would not recover substantial mass and would not address the source area. The other alternative, which was not retained, was using groundwater extraction for source removal. In this approach, the addition of vapor extraction would be beneficial and would be anticipated to increase CVOC mass removal rates significantly over groundwater extraction alone. A limitation of the multi-phase extraction approach is the limited effect at reducing inorganic impact. Pilot testing would be required to design a multi-phase approach. This approach should not have any potential negative effects on the tributary of Little Valley Creek.

5.2 Unsaturated Soil Alternatives Summary

The assessment of the remedial alternatives presented suggests that there are several alternatives that would address some or all of the risks to human health and the environment that remain at the Property. As there are multiple alternatives that can address the identified risks and also can serve as a potential remedy for unsaturated zone impacts, the selection of the proposed remedial technology is further determined based on cost, implementability, and remedial timeframe. Additionally, external factors beyond the scope of this analysis including final property development use, community stakeholder feedback, and anticipated groundwater and saturated zone soil remedies will need to be considered during the selection of remedial alternative technology for unsaturated soil remediation.

Based on the available data the following are viable remedial alternative technologies for unsaturated soils at the Property:

- Soil excavation with either offsite disposal or onsite treatment;
- In-situ soil stabilization;
- ISCO/ISCR via soil mixing; and
- Surface barrier.

These alternatives are protective of human health and the environment, and are compliant with the PADEP ARARs. They are also considered to be feasible, effective, and implementable due to the limited long-term impact on the property use.

Engineering and institutional controls are not protective as a stand-alone alternative. However, it can easily be paired with any of the viable alternatives listed above.

With multiple alternatives that can address the identified potential risks, it should be noted that these remedies may be combined and tailored to address specific areas of concern, where it may be more advantageous to utilize one remediation technology over another while utilizing a different technology for the balance of the Site. Examples would include implementing excavation with off-site disposal of CVOC impacted soils to address leaching of contaminants into groundwater or in-situ soil stabilization for designated areas of elevated impacts and installing a surface barrier on the site following stabilization efforts.

Although this alternatives analysis focused on unsaturated soils, several of these alternatives could be expanded to also address saturated soil impacts (excavation or ISCO/ISCR via soil mixing). Other cross-over technologies (multi-phase extraction or ISTT) are stand-alone alternatives that could address both the unsaturated and saturated zones. Additionally, the implementation of one of these viable alternatives in the saturated zone would complement groundwater treatment options considered for the Site with the reduction of source area COC mass and diffusion of COCs into the Site groundwater.

The final remedial technology selection will need to continue the evaluation of remedial lifespan cost, implementability, remedial timeframe, final clean-up criteria, and multiple external factors (e.g., final property use, community stakeholder feedback, groundwater and saturated zone soil remedies).

6.0 CONCLUSIONS

The following is a summary of conclusions based on the information presented in this report.

- The risk assessment indicates that there are four exposure pathways associated with the unsaturated soil contamination at the Property: inhalation of vapors volatilized from surface and subsurface soils; leaching of constituents from surface and subsurface soil to groundwater; dermal contact, ingestion, and inhalation of particulates from contaminated soil; and contact with surface water contaminated by runoff from contaminated surface soil.

- Several engineering and/or institutional controls can be implemented to mitigate contact with the surface and subsurface contaminated soil at the Property. The controls range from restricting Property access and land use activities to active remediation of the unsaturated soil contaminants at the Property.

- Viable remedial alternative technologies for unsaturated soils at the Property include:
    - Soil excavation with either offsite disposal or onsite treatment;
    - In-situ soil stabilization;
    - ISCO/ISCR via soil mixing; and
    - Surface Barrier.

- Demolition of the existing structures was deemed to be a required task for implementation of several remedial technologies.

- Several cross-over technologies were introduced that could potentially address both unsaturated and saturated soils including: soil excavation, ISCO/ISCR via soil mixing, ISTT, and multi-phase extraction.

- This remedial alternatives analysis focused on unsaturated soil. A comprehensive approach that addresses risk associated with vapor intrusion, unsaturated and saturated soil, surface water, DNAPL, and groundwater should be evaluated to determine the best-suited overall strategy.

7.0 REFERENCES

Environmental Standards, Inc., Remediation Scope of Work for Targeted Soil Excavation, Bishop Tube Facility, Revision 2. April 25, 2017.

Groundwater and Environmental Services, Inc., Technical Comments Memorandum: 2019 Remedial Investigation Report Former Bishop Tube Property. October 11, 2019

Groundwater and Environmental Services, Inc., Technical Comments Memorandum: 2019 Feasibility Study Former Bishop Tube Property. October 28, 2019

PADEP, 2001a. Pennsylvania Code, Title 25, Environmental Protection, Department of Environmental Protection, Chapter 250, Administration of Land Recycling Program. November 24, 2001.

Roux Associates, Inc., Feasibility Study Report, June 17, 2019.

Roux Associates, Inc., Remedial Investigation Report, June 10, 2019.

Tables

TABLE 1
REMEDIAL ALTERNATIVE TECHNOLOGY SCREENING
GTAC 7-1-342
Former Biship Tube Facility
East Whiteland Township, Chester County, Pennsylvania

Technology	Effectiveness in Achieving Remedial Goals	Implementability		Relative Remedial Timeframe	Overall Ranking of Option
		Technical (Constructability, O&M Requirements)	Administrative (Property Issues)		
Soil excavation with offsite disposal	GOOD Near complete removal of COC impacted soils above criteria	GOOD Remedy can easily be installed and minimal design required	FAIR Requires demo of facility structures; Requires regular access to the site for a moderate period	GOOD Little to no unsaturated COC above criteria following very short term treatment (~1 year)	**GOOD** This option meets remedial goals and can be completed in a short timeframe.
Soil excavation with onsite treatment	GOOD Near complete treatmtent of COC impacted soils above criteria	POOR Complex level remedy design required along with speciality subcontractor	POOR Requires demo of facility structures; Requires regular site access for a moderade period; Installation of large equipment	GOOD Little to no unsaturated COC above criteria following very short term treatment (~1 year)	**FAIR** This option meets remedial goals and can be completed in a short timeframe, but with an increased cost and complex implementability for a treatment technology to minimize offsite soil disposal.
In-situ soil stablization	GOOD Near complete stabilization of COCs in unsaturated soils above criteria	POOR Complex level remedy design required along with speciality subcontractor	FAIR Requires demo of facility structures; Requires regular site access for a short period; Temporary installation of equipment; Stabilization required post remedy for property development	GOOD Little to no unsaturated COC above criteria following very short term treatment (~1 year)	**GOOD** This option meets remedial goals and can be completed in a short timeframe, but with an increased cost for a treatment technology to minimize offsite soil disposal.
Soil vapor extraction	POOR Does not address all identified unsaturated COCs	FAIR Remedy can be designed and installed with moderate effort to overcome high groundwater	FAIR Requires regular site access for a moderade period; Installation of moderate equipment	FAIR Measureable unsaturated COCs above criteria likely to remain after completion of remedy (3-5 years)	**POOR** This option does not meet remedial goals. Previous implementation encountered operational performance difficulties, caused by high groundwater table.
Multi-phase extraction	POOR Does not address all identified COCs; Does not fully address unsaturated soils	GOOD Remedy can easily be installed and minimal design required	FAIR Requires regular site access for a moderade period; Installation of large equipment	FAIR Measureable unsaturated COCs above criteria likely to remain after completion of remedy (3-5 years)	**POOR** This option does not meet remedial goals with remedy primarly targeting saturated soils. May be paired with other identified remedial technologies to meet remedial goals.

TABLE 1
REMEDIAL ALTERNATIVE TECHNOLOGY SCREENING
GTAC 7-1-342
Former Biship Tube Facility
East Whiteland Township, Chester County, Pennsylvania

Technology	Effectiveness in Achieving Remedial Goals	Implementability		Relative Remedial Timeframe	Overall Ranking of Option
		Technical (Constructability, O&M Requirements)	Administrative (Property Issues)		
In-situ chemical oxidation/reduction (fluid delivery)	POOR Does not address all identified COCs; Does not fully address unsaturated soils	FAIR Remedy can be designed and installed with moderate effort	GOOD Requires regular site access for a short period; Temporary installation of equipment	FAIR Minimal unsaturated COCs above criteria would remain after completion of remedy (1-2 years)	**POOR** This option does not meet remedial goals with remedy primarly targeting saturated soils. May be paired with other identified remedial technologies to meet remedial goals.
In-situ chemical oxidation/reduction (soil mixing)	GOOD Near complete treatment of COC impacted unsaturated soils above criteria	POOR Complex level remedy design required along with speciality subcontractor	FAIR Requires demo of facility structures; Requires regular site access for a short period; Temporary installation of equipment; Stabilization required post remedy for property development	GOOD Little to no unsaturated COC above criteria following very short term treatment (~1 year)	**GOOD** This option meets remedial goals and can be completed in a short timeframe, but with an increased cost for a treatment technology to minimize offsite soil disposal.
Enhanced in-situ bioremediation	POOR Does not address all identified unsaturated COCs; Does not fully address unsaturated soils	GOOD Remedy can easily be installed and minimal design required	FAIR Requires regular site access for a moderade period; Installation of equipment	FAIR Measureable unsaturated COCs above critera likely to remain after completion of remedy (3-5 years)	**POOR** This option does not meet remedial goals with remedy primarly targeting saturated soils. May be paired with other identified remedial technologies to meet remedial goals.
Surface Barrier (Asphalt Cap)	FAIR Does address all exposure pathways; No treatment of COC impacted soils above criteria	GOOD Remedy can easily be installed and minimal design required	FAIR Requires demo of facility structures; Requires regular access to the site for a moderate period	POOR Measureable unsaturated COCs above criteria to remain for an indeterminate time into the future (30+ years)	**FAIR** This option does address exposure pathways but does not provide treatment of unsaturated soil impacts. Requires continued maintenance and associated costs for a long period into the future.

TABLE 1
REMEDIAL ALTERNATIVE TECHNOLOGY SCREENING
GTAC 7-1-342
Former Biship Tube Facility
East Whiteland Township, Chester County, Pennsylvania

Technology	Effectiveness in Achieving Remedial Goals	Implementability		Relative Remedial Timeframe	Overall Ranking of Option
		Technical (Constructability, O&M Requirements)	Administrative (Property Issues)		
Phytoremediation	POOR Does not address all identified unsaturated COCs; Does not fully address unsaturated soils	FAIR Moderate level design required along with speciality subcontractor	FAIR Requires demo of facility structures; Requires regular access to the site for a moderate period	POOR Measureable unsaturated COCs above criteria likely to remain after completion of remedy (10-20 years)	**POOR** This option does not meet remedial goals with remedy primarly targeting saturated soils, and requires continued maintenance and associated costs for a long period into the future. May be paired with other identified remedial technologies to meet remedial goals.
Monitored natural attenuation	POOR Does not close exposure pathways or address identified COC impacted soils	GOOD Remedy can easily be installed and minimal design required	POOR Requires regular access to the site for an indeterminate time into the future	POOR Measureable unsaturated COCs above criteria to remain for an indeterminate time into the future (30+ years)	**POOR** This options does not meet remedial goals.
Engineering and institutional controls	POOR Does not close exposure pathways or address identified COC impacted soils	GOOD Remedy can easily be installed and minimal design required	POOR Requires restricted future property use and binding agreement; Requires regular access to the site for an indeterminate time into the future	POOR Measureable unsaturated COCs above criteria to remain for an indeterminate time into the future (20+ years)	**POOR** This option does not meet remedial goals and requires continued maintenance and associated costs for a long period into the future. May be paired with other identified remedial technologies to meet remedial goals.
No action	POOR Does not close exposure pathways or address identified COC impacted soils	GOOD Remedy can easily be installed and no design required	POOR Requires regular access to the site for an indeterminate time into the future	POOR Measureable unsaturated COCs above criteria to remain for an indeterminate time into the future (30+ years)	**POOR** This options does not meet remedial goals.

TABLE 2
ALTERNATIVE 1 - SOIL EXCAVATION WITH OFFSITE DISPOSAL
GTAC 7-1-342
Former Bishop Tube Property
East Whiteland Township, Chester County, Pennsylvania

ASSUMPTIONS

An estimated 48,000 cubic yards of soil will be excavated from the site.
Weight of soil assumed to be 1.5 tons per cubic yard.
Excavation dewatering for accumulated water from precipitation and surface runoff.
Additional costs were not included for the disposal of impacted debris (e.g., slab or other building materials).

REMEDIATION COSTS

PHASE / TASK / SUBTASK	COST/UNIT		SCHEDULE COST/YEAR													
			Planning/Design		Implementation		Post Construction Monitoring/Reporting									
			1		2		3		4		5		6-10		11-30	
			UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS
Background Investigation																
Regulatory Agency Meeting	$1,500	/meeting	2	$3,000	2	$3,000	1	$1,500	1	$1,500		$0		$0		$0
Remedial Action Plan & Permitting																
Remedial Design	$25,000	/each	1	$25,000		$0		$0		$0		$0		$0		$0
Permitting/Permitting Equivalency	$3,000	/each	1	$3,000		$0		$0		$0		$0		$0		$0
Remedial Action/Cleanup Plan Report	$10,000	/each	1	$10,000		$0		$0		$0		$0		$0		$0
Soil Excavation & Disposal																
Site Prep/Facility Demo	$310,000	/site		$0	1	$310,000		$0		$0		$0		$0		$0
Excavation	$2.50	/cu yd		$0	48000	$120,000		$0		$0		$0		$0		$0
Excavation Dewatering & Disposal	$40,000	/site		$0	1	$40,000		$0		$0		$0		$0		$0
Soil Disposal	$57.00	/ton		$0	72000	$4,104,000		$0		$0		$0		$0		$0
Fill Material, Backfill, & Soil Cover	$16.00	/cu yd		$0	72000	$1,152,000		$0		$0		$0		$0		$0
Plantings/Site Stabilization	$10,000	/site		$0	1	$10,000		$0		$0		$0		$0		$0
Closure Assessment																
Soil Attainment Sampling	$45,000	/event		$0		$0	1	$45,000		$0		$0		$0		$0
Risk Assessment	$5,000	/event		$0		$0	1	$5,000		$0		$0		$0		$0
Final/Closure Report (soils only)	$12,000	/report		$0		$0		$0	1	$12,000		$0		$0		$0
TOTAL				$41,000		$5,739,000		$50,000		$12,000		$0		$0		$0
CONTINGENCY (30%)				$12,300		$1,721,700		$15,000		$3,600						
CUMULATIVE TOTAL W/ INFLATION (3%)				$53,300		$7,737,821		$7,806,721		$7,823,725						

TABLE 3
ALTERNATIVE 2 - SOIL EXCAVATION WITH ONSITE TREATMENT
GTAC 7-1-342
Former Bishop Tube Property
East Whiteland Township, Chester County, Pennsylvania

ASSUMPTIONS

An estimated 48,000 cubic yards of soil will be excavated.
Weight of soil assumed to be 1.5 tons per cubic yard.
5 percent of excavated soils will be disposed offsite.
Excavation dewatering for accumulated water from precipitation and surface runoff.
Additional costs were not included for the disposal of impacted debris (e.g., slab or other building materials).

REMEDIATION COSTS

PHASE / TASK / SUBTASK	COST/UNIT		SCHEDULE COST/YEAR													
			Planning/Design		Implementation		Post Construction Monitoring/Reporting									
			1		2		3		4		5		6-10		11-30	
			UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS
Background Investigation																
Regulatory Agency Meeting	$1,500	/meeting	2	$3,000	2	$3,000	1	$1,500	1	$1,500		$0		$0		$0
Remedial Action Plan & Permitting																
Remedial Design	$35,000	/each	1	$35,000		$0		$0		$0		$0		$0		$0
Permitting/Permitting Equivalency	$7,000	/each	1	$7,000		$0		$0		$0		$0		$0		$0
Remedial Action/Cleanup Plan Report	$10,000	/each	1	$10,000		$0		$0		$0		$0		$0		$0
Soil Excavation & Disposal																
Site Prep/Facility Demo	$310,000	/site		$0	1	$310,000		$0		$0		$0		$0		$0
Excavation	$2.50	/cu yd		$0	48000	$120,000		$0		$0		$0		$0		$0
Excavation Dewatering & Disposal	$40,000	/site		$0	1	$40,000		$0		$0		$0		$0		$0
Soil Disposal	$57.00	/ton		$0	3600	$205,200		$0		$0		$0		$0		$0
Ex-Situ Soil Treatment (via Stabilization)	$43.00	/ton		$0	68400	$2,941,200		$0		$0		$0		$0		$0
Backfill Treated Soil	$2.00	/cu yd		$0	45600	$91,200		$0		$0		$0		$0		$0
Fill Material, Backfill, & Soil Cover	$16.00	/cu yd		$0	2400	$38,400		$0		$0		$0		$0		$0
Plantings/Site Stabilization	$10,000	/site		$0	1	$10,000		$0		$0		$0		$0		$0
Closure Assessment																
Soil Attainment Sampling	$55,000	/event		$0		$0	1	$55,000		$0		$0		$0		$0
Risk Assessment	$5,000	/event		$0		$0	1	$5,000		$0		$0		$0		$0
Final/Closure Report (soils only)	$12,000	/report		$0		$0		$0	1	$12,000		$0		$0		$0
TOTAL				$55,000		$3,759,000		$60,000		$12,000		$0		$0		$0
CONTINGENCY (30%)				$16,500		$1,127,700		$18,000		$3,600						
CUMULATIVE TOTAL W/ INFLATION (3%)				$71,500		$5,104,801		$5,187,481		$5,204,485						

TABLE 4
ALTERNATIVE 3 - IN-SITU SOIL STABILIZATION
GTAC 7-1-342
Former Bishop Tube Property
East Whiteland Township, Chester County, Pennsylvania

ASSUMPTIONS

An estimated 48,000 cubic yards of soil will be treated at site.
Weight of soil assumed to be 1.5 tons per cubic yard.
40 percent of soils will be excavated and disposed offsite.
Additional costs were not included for the disposal of impacted debris (e.g., slab or other building materials).

REMEDIATION COSTS

PHASE / TASK / SUBTASK	COST/UNIT		SCHEDULE COST/YEAR													
			Planning/Design		Implementation		Post Construction Monitoring/Reporting									
			1		2		3		4		5		6-10		11-30	
			UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS
Background Investigation																
Regulatory Agency Meeting	$1,500	/meeting	2	$3,000	2	$3,000	1	$1,500	1	$1,500		$0		$0		$0
Remedial Action Plan & Permitting																
Remedial Design	$35,000	/each	1	$35,000		$0		$0		$0		$0		$0		$0
Permitting/Permitting Equivalency	$6,000	/each	1	$6,000		$0		$0		$0		$0		$0		$0
Remedial Action/Cleanup Plan Report	$10,000	/each	1	$10,000		$0		$0		$0		$0		$0		$0
Soil Excavation & Disposal																
Site Prep/Facility Demo	$310,000	/site		$0	1	$310,000		$0		$0		$0		$0		$0
Excavation	$2.50	/cu yd		$0	19200	$48,000		$0		$0		$0		$0		$0
Soil Disposal	$57.00	/ton		$0	28800	$1,641,600		$0		$0		$0		$0		$0
In-situ Soil Satabilization Treatment	$21.00	/ton		$0	43200	$907,200		$0		$0		$0		$0		$0
Stabilized Soil Disposal (Bulk Expansion)	$57.00	/ton		$0	10800	$615,600		$0		$0		$0		$0		$0
Fill Material, Backfill, & Soil Cover	$16.00	/cu yd		$0	19200	$307,200		$0		$0		$0		$0		$0
Plantings/Site Stabilization	$10,000	/site		$0	1	$10,000		$0		$0		$0		$0		$0
Closure Assessment																
Soil Attainment Sampling	$55,000	/event		$0		$0	1	$55,000		$0		$0		$0		$0
Risk Assessment	$5,000	/event		$0		$0	1	$5,000		$0		$0		$0		$0
Final/Closure Report (soils only)	$12,000	/report		$0		$0		$0	1	$12,000		$0		$0		$0
TOTAL				$54,000		$3,842,600		$60,000		$12,000		$0		$0		$0
CONTINGENCY (30%)				$16,200		$1,152,780		$18,000		$3,600						
CUMULATIVE TOTAL W/ INFLATION (3%)				$70,200		$5,215,441		$5,298,121		$5,315,125						

TABLE 5
ALTERNATIVE 4 - IN-SITU CHEMICAL OXIDATION/REDUCTION (SOIL MIXING)
GTAC 7-1-342
Former Bishop Tube Property
East Whiteland Township, Chester County, Pennsylvania

ASSUMPTIONS

An estimated 48,000 cubic yards of soil will be treated at site.
Weight of soil assumed to be 1.5 tons per cubic yard.
5 percent of soils will be excavated and disposed offsite.
Soil will not be stabilized following in-situ mixing treatment.
Additional costs were not included for the disposal of impacted debris (e.g., slab or other building materials).

REMEDIATION COSTS

PHASE / TASK / SUBTASK	COST/UNIT		SCHEDULE COST/YEAR													
			Planning/Design		Implementation		Post Construction Monitoring/Reporting									
			1		2		3		4		5		6-10		11-30	
			UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS
Background Investigation																
Regulatory Agency Meeting	$1,500	/meeting	2	$3,000	2	$3,000	1	$1,500	1	$1,500		$0		$0		$0
Remedial Action Plan & Permitting																
Remedial Design	$45,000	/each	1	$45,000		$0		$0		$0		$0		$0		$0
Permitting/Permitting Equivalency	$6,000	/each	1	$6,000		$0		$0		$0		$0		$0		$0
Remedial Action/Cleanup Plan Report	$10,000	/each	1	$10,000		$0		$0		$0		$0		$0		$0
Soil Excavation & Disposal																
Site Prep/Facility Demo	$310,000	/site		$0	1	$310,000		$0		$0		$0		$0		$0
Excavation	$2.50	/cu yd		$0	2400	$6,000		$0		$0		$0		$0		$0
Soil Disposal	$57.00	/ton		$0	3600	$205,200		$0		$0		$0		$0		$0
In-situ Chemical Reduction (MetaFix)	$28.00	/ton		$0	68400	$1,915,200		$0		$0		$0		$0		$0
Fill Material, Backfill, & Soil Cover	$16.00	/cu yd		$0	2400	$38,400		$0		$0		$0		$0		$0
Plantings/Site Stabilization	$10,000	/site		$0	1	$10,000		$0		$0		$0		$0		$0
Closure Assessment																
Soil Attainment Sampling	$55,000	/event		$0		$0	1	$55,000		$0		$0		$0		$0
Risk Assessment	$5,000	/event		$0		$0	1	$5,000		$0		$0		$0		$0
Final/Closure Report (soils only)	$12,000	/report		$0		$0		$0	1	$12,000		$0		$0		$0
TOTAL				$64,000		$2,487,800		$60,000		$12,000		$0		$0		$0
CONTINGENCY (30%)				$19,200		$746,340		$18,000		$3,600						
CUMULATIVE TOTAL W/ INFLATION (3%)				$83,200		$3,414,364		$3,497,044		$3,514,048						

TABLE 6
ALTERNATIVE 5 - SURFACE BARRIER
GTAC 7-1-342
Former Bishop Tube Property
East Whiteland Township, Chester County, Pennsylvania

ASSUMPTIONS

Assumes the area where surface soil exceedances have been documented is to be covered with an asphalt cap.
The area to be covered with a surface barrier measures approximately 18,000 square yards.
Areas where the road and parking areas are located will be removed to ensure adequate cap thickness.
An estimated 12,000 cubic yards of fill material will be imported to the site.
Weight of soil assumed to be 1.5 tons per cubic yard.
It has been assumed that the surface barrier will require routine maintenance on a quarterly basis.
Additional costs were not included for the disposal of impacted debris (e.g., slab or other building materials).

REMEDIATION COSTS

PHASE / TASK / SUBTASK	COST/UNIT		SCHEDULE COST/YEAR													
			Planning/Design		Implementation		Post Construction Monitoring/Reporting									
			1		2		3		4		5		6-10		11-30	
			UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS
Background Investigation																
Regulatory Agency Meeting	$1,500	/meeting	2	$3,000	2	$3,000	1	$1,500	1	$1,500	1	$1,500	5	$7,500	20	$30,000
Remedial Action Plan & Permitting																
Remedial Design	$15,000	/each	1	$15,000		$0		$0		$0		$0		$0		$0
Permitting/Permitting Equivalency	$6,000	/each	1	$6,000		$0		$0		$0		$0		$0		$0
Remedial Action/Cleanup Plan Report	$10,000	/each	1	$10,000		$0		$0		$0		$0		$0		$0
Surface Barrier Installation																
Site Prep/Facility Demo	$310,000	/site		$0	1	$310,000		$0		$0		$0		$0		$0
Geotextile Liner	$2.00	/sq yd		$0	18000	$36,000		$0		$0		$0		$0		$0
Fill Material	$16.00	/cu yd		$0	12000	$192,000		$0		$0		$0		$0		$0
Asphalt Cap	$28.00	/sq yd		$0	18000	$504,000		$0		$0		$0		$0		$0
Restoration	$10,000	/site		$0	1	$10,000		$0		$0		$0		$0		$0
Surface Barrier Maintenance																
Monitoring, Landscaping, and Due Care	$3,000	/quarter		$0	2	$6,000	4	$12,000	4	$12,000	4	$12,000	20	$60,000	80	$240,000
Closure Assessment																
Soil Attainment Sampling	$35,000	/event		$0		$0	1	$35,000		$0		$0		$0		$0
Risk Assessment	$5,000	/event		$0		$0	1	$5,000		$0		$0		$0		$0
Final/Closure Report (soils only)	$12,000	/report		$0		$0		$0	1	$12,000		$0		$0		$0
TOTAL				$34,000		$1,061,000		$53,500		$25,500		$13,500		$67,500		$270,000
CONTINGENCY (30%)				$10,200		$318,300		$16,050		$7,650		$4,050		$20,250		$81,000
CUMULATIVE TOTAL W/ INFLATION (3%)				$44,200		$1,464,879		$1,538,602		$1,574,736		$1,594,392		$1,700,569		$2,256,904

TABLE 7
ALTERNATIVE 6 - ENGINEERING CONTROLS AND INSTITUTIONAL CONTROLS
GTAC 7-1-342
Former Bishop Tube Property
East Whiteland Township, Chester County, Pennsylvania

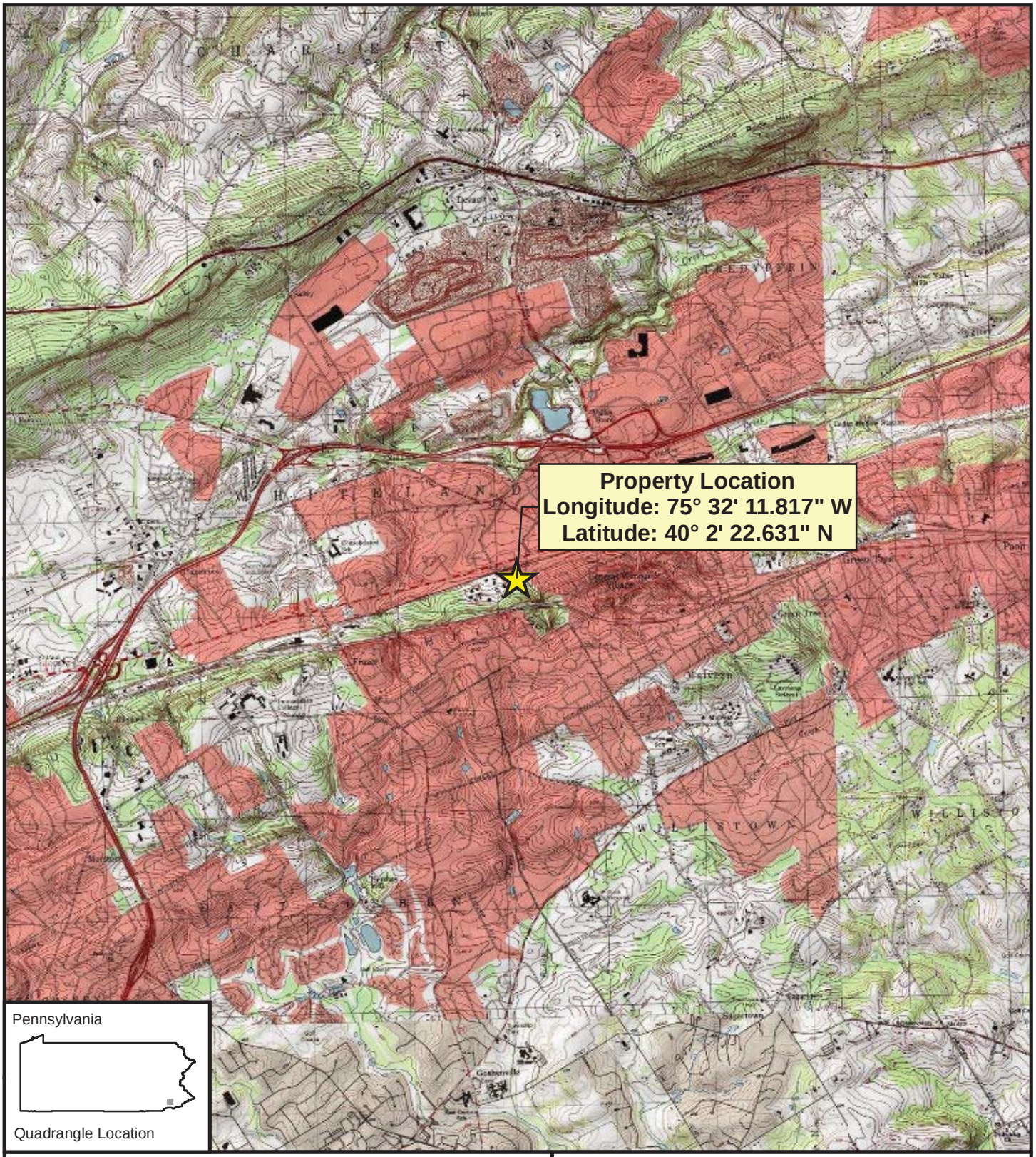
ASSUMPTIONS

Assumes one (1) property will require application of an environmental covenant.
Fencing to be constructed around entire affected area.
Assumes quarterly fence maintenance events.
Costs assume maintenance no longer required after 30 years.

REMEDIATION COSTS

PHASE / TASK / SUBTASK	COST/UNIT		SCHEDULE COST/YEAR													
			Planning/Design & Implementation				Post Construction Monitoring/Reporting									
			1		2		3		4		5		6-10		11-30	
			UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS	UNITS	COSTS
Background Investigation																
Regulatory Agency Meeting	$1,500	/meeting	2	$3,000		$0		$0		$0		$0		$0		$0
Environmental Covenant / Institutional Controls																
Coordination and Management	$10,000	/property	1	$10,000		$0		$0		$0		$0		$0		$0
Environmental Covenant	$7,000	/property	1	$7,000		$0		$0		$0		$0		$0		$0
Remedial Action Plan & Permitting																
Remedial Action/Cleanup Plan Report	$10,000	/each	1	$10,000		$0		$0		$0		$0		$0		$0
Fencing																
Fence Construction	$18.55	/ln ft	2900	$53,795		$0		$0		$0		$0		$0		$0
Gate Installation	$300	/each	2	$600		$0		$0		$0		$0		$0		$0
Maintenance	$3,000	/quarter	2	$6,000	4	$12,000	4	$12,000	4	$12,000	4	$12,000	20	$60,000	80	$240,000
Closure Assessment																
Risk Assessment	$5,000	/event		$0	1	$5,000		$0		$0		$0		$0		$0
Final/Closure Report (soils only)	$12,000	/report		$0	1	$12,000		$0		$0		$0		$0		$0
TOTAL				$90,395		$29,000		$12,000		$12,000		$12,000		$60,000		$240,000
CONTINGENCY (30%)				$27,119		$8,700		$3,600		$3,600		$3,600		$18,000		$72,000
CUMULATIVE TOTAL W/ INFLATION (3%)				$117,514		$156,345		$172,881		$189,885		$207,357		$301,737		$796,257

Appendix A – Site Figures (Roux, 2019)



SOURCE
SERVICE LAYER CREDITS: COPYRIGHT 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED.

NOTES
EASTING (X): 75° 32' 11.817" W
NORTHING (Y): 40° 2' 22.631" N

N

4,500 0 4,500 9,000 Feet

Title:

PROPERTY LOCATION MAP

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: AET	Date: 4/23/2019	FIGURE
Prepared by: AET	Scale: 1:54,000	1
Project Mgr: JAK	Office: NJ	
File No: 1020.F1(AP)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX\0003\PROJECT DATABASE\GIS\SRIR 2019\FINAL\F1(AP)SiteLocationMap.mxd

Legend

- Stream
- Drainage Swale
- Building Outline
- Property Boundary
- Parcels

AOC Number and Identification

- 1 "Transformer Pad"
- 2 "Sanitary Cesspool"
- 3 "Drum Storage Area 1"
- 4 "Drum Storage Area 2"
- 5 "Drum Storage Area 3"
- 6 "Vapor Degreaser Area 1 (Inside Building 5)"
- 7 "Vapor Degreaser Area 2 (Inside Building 8)"
- 8 "Solvent Distillery Area"
- 9 "Pickling Tank Pad and Floor Drain Area"
- 10A "Waste-Water Settling Lagoon", Area A
- 10B "Waste-Water Settling Lagoon", Area B
- 11A "Solvent AST, Area A (Potential Location)"
- 11B "Solvent AST, Area B (Potential Location)"
- 12 "Solvent AST/Vapor Degreaser Piping"
- 13A "Potential Solvent Spill Area A (Exterior Door)"
- 13B "Potential Solvent Spill Area B (Exterior Door)"
- 13C "Potential Solvent Spill Area C (Exterior Door)"
- 14 "Cooling Tower Area"
- 15 "Potential Vault/Seepage Pit Area"
- 16 "Former Pickle Rinse Water Disposal Tanks and Lagoon Area"
- 17 "A Potential Second Vapor Degreaser Area in Building 5"
- 18 "Potential Piping From Building 8 to the Drainage Swale Area"

DEP AOC Number and Identification (2018)

- 1 "Plant 5 Large Degreaser"
- 2 "Plant 5 Spinneret Degreaser"
- 3 "Plant 5 Pickle House/Cesspool"
- 4 "Met Lab Fire Waste Burial Area"
- 5 "Acid Rinse Water Spill Area"
- 6 "Plant 5 Railing Spill Area"

40 0 40 80 Feet

Notes:
1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/23/2019.
2. AOC = Area of Concern.
3. AST = Above-Ground Storage Tank.
4. AOC locations are based on historical documents. Locations of these features are therefore approximate.

Title:

REPORTED AND/OR ALLEGED AREA OF CONCERN MAP

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

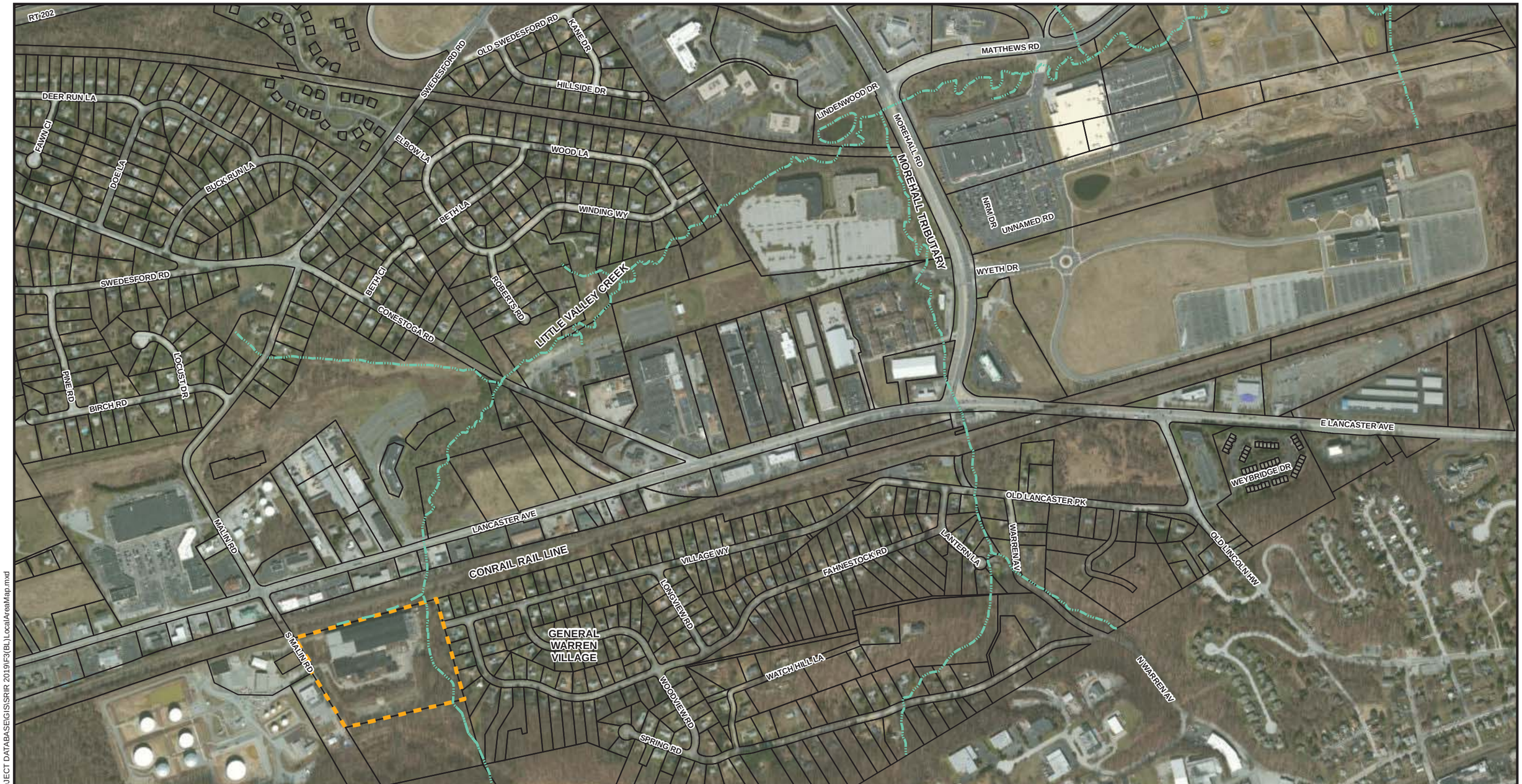
Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/23/2019	FIGURE
Prepared by: DEL	Scale: 1:480	2
Project Mgr: JAK	Office: NJ	
File No: 1020.F2(DL)	Project: 0539.0003J000	

G:\PROJECTS\0539\0539 - Sun Energy - SJ\0003\PROJECT DATA\GIS\ESRI\2019\FIG\AOCmap.mxd



Legend

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Note:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.

N

600 0 600 1,200 Feet

Title:

LOCAL AREA MAP

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE
Prepared by: AET	Scale: 1:7,200	3
Project Mgr: JAK	Office: NJ	
File No: 1020.F3(BL)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX\0003\PROJECT DATABASE\GIS\SRIR 2019\F3(BL)LocalAreaMap.mxd

Legend

- Property Boundary
- Stream
- Drainage Swale
- Fault Line (Dashed Where Inferred)

Bedrock Geology

- Cl, Ledger Formation
- Ce, Elbrook Formation
- OCc, Conestoga Formation
- Xo, Octoraro Formation

Note:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.
2. Geologic Layer Credits: Pennsylvania Department of Conservation and Natural Resources PaGEODE. Layer Accessed: 4/22/2019.

N

600 0 600 1,200 Feet

Title:

LOCAL GEOLOGIC MAP

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE
Prepared by: AET	Scale: 1:7,200	5
Project Mgr: JAK	Office: NJ	
File No: 1020.F5(BL)	Project: 0539.0003J000	

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Legend

Trichloroethene Concentration in Soil (mg/kg)

- ND - 0.5 (Residential Used Aquifer Soil to Groundwater MSC)
- 0.5 - 38 (Residential Direct Contact 0-15' MSC)
- 38 - 160 (Non-Residential Direct Contact 0-2' MSC)
- 160 - 180 (Non-Residential Direct Contact 2-15' MSC)
- 180+
- Not Analyzed for Trichloroethene

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCE IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	8A
Project Mgr: JAK	Office: NJ	
File No: 1020.F8A(CL)	Project: 0539.0003J000	

G:\PROJECTS-080539 - Saul Ewing - SX\00039\PROJECT DATABASE\GIS\SRIR 2019\F8A(CL)\DotTCE_Soil_AllSamples_AllDepths.mxd

Legend

Trichloroethene Concentration in Soil (mg/kg)

- ND - 0.5 (Residential Used Aquifer Soil to Groundwater MSC)
- 0.5 - 38 (Residential Direct Contact 0-15' MSC)
- 38 - 160 (Non-Residential Direct Contact 0-2' MSC)
- 160 - 180 (Non-Residential Direct Contact 2-15' MSC)
- 180+
- Not Analyzed for Trichloroethene

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the deepest sample at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCE IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	8B
Project Mgr: JAK	Office: NJ	
File No: 1020.F8B(CL)	Project: 0539.0003J000	

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Legend

1,1,1-Trichloroethane Concentration in Soil (mg/kg)

- ND - 20 (Residential Used Aquifer Soil to Groundwater MSC)
- 20 - 1000 (Residential Direct Contact 0-15' MSC, Non-Residential Direct Contact 0-2' MSC, Non-Residential Direct Contact 2-15' MSC)
- 1000+
- Not Analyzed for 1,1,1-Trichloroethane

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCA IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	9A
Project Mgr: JAK	Office: NJ	
File No: 1020.F9A(CL)	Project: 0539.0003J000	

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Legend

1,1,1-Trichloroethane Concentration in Soil (mg/kg)

- ND - 20 (Residential Used Aquifer Soil to Groundwater MSC)
- 20 - 1000 (Residential Direct Contact 0-15' MSC, Non-Residential Direct Contact 0-2' MSC, Non-Residential Direct Contact 2-15' MSC)
- 1000+
- Not Analyzed for 1,1,1-Trichloroethane

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the deepest sample at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCA IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE	
Prepared by: AET	Scale: 1:480		
Project Mgr: JAK	Office: NJ	9B	
File No: 1020.F9B(CL)	Project: 0539.0003J000		

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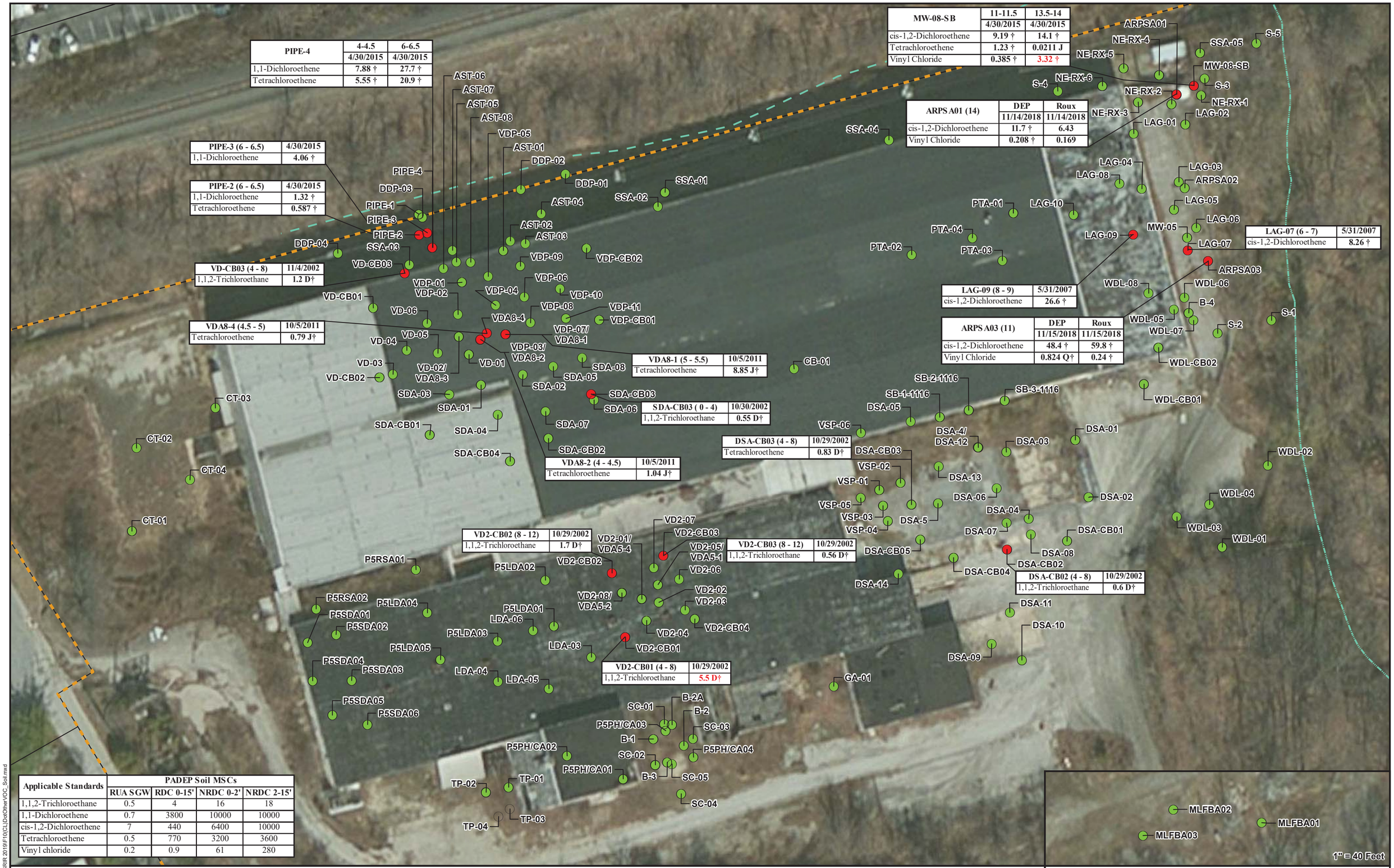

Applicable Standards	PADEP Soil MSCs			
	RUA SGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
1,1,2-Trichloroethane	0.5	4	16	18
1,1-Dichloroethene	0.7	3800	10000	10000
cis-1,2-Dichloroethene	7	440	6400	10000
Tetrachloroethene	0.5	770	3200	3600
Vinyl chloride	0.2	0.9	61	280

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for VOCs
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Sample Location — Depth (ft bgs)

LAG-07 (6 - 7)	5/31/2007
cis-1,2-Dichloroethene	8.26 †

Parameter — Sample Date — Concentration (mg/kg)

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP,swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. VOCs = Volatile Organic Compounds.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.

40 0 40 80 Feet

N

Title:

DISTRIBUTION OF OTHER VOCS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE
Prepared by: AET	Scale: 1:480	10
Project Mgr: JAK	Office: NJ	
File No: 1020.F10(CL)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX0003\PROJECT DATABASE\GIS\SRIR 2019\F10(CL)DistOtherVOC_Soil.mxd

VD-02 (3 - 4)	6/27/2001
Benzo(a)pyrene	2.4 D

VD-03 (3 - 4)	6/27/2001
Benzo(a)pyrene	1.2

VD-01 (1 - 4)	6/27/2001
Benzo(a)pyrene	2.3 D

ARPS A03 (11)	DEP	Roux
	11/15/2018	11/15/2018
Hexachlorobenzene	2.1 †	0.381

WDL-04 (2 - 3)	6/19/2001
Benzo(a)pyrene	1.3

Applicable Standards	PADEP Soil MSCs			
	RUA SGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
Benzo(a)pyrene	46	0.58	12	190000
Hexachlorobenzene	0.96	12	57	190000

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for SVOCs
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Depth (ft bgs)
Sample Location
Sample Date

VD-01 (1 - 4)	6/27/2001
Benzo(a)pyrene	2.3 D

Parameter
Concentration (mg/kg)

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP,swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. SVOCs = Semi-Volatile Organic Compounds.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF SVOCS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE
Prepared by: AET	Scale: 1:480	11
Project Mgr: JAK	Office: NJ	
File No: 1020.F11(CL)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX0003\PROJECT DATABASE\GIS\SRIR 2019\F11(CL)DotOtherSVOC_Soil.mxd

NOTE:
1. In the absence of speciated data, total chromium was compared to hexavalent chromium criteria (i.e., the more stringent of the trivalent and hexavalent chromium criteria) for the purpose of this evaluation.

Legend

Chromium Concentration in Soil (mg/kg)

- ND - 4 (Residential Direct Contact 0-15' MSC)
- 4 - 190 (Residential Used Aquifer Soil to Groundwater MSC)
- 190 - 220 (Non-Residential Direct Contact 0-2' MSC)
- 220 - 20000 (Non-Residential Direct Contact 2-15' MSC)
- 20000+
- Not Analyzed for Chromium

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:
1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 6/3/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. Depiction of total chromium data utilizes hexavalent chromium standards.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TOTAL CHROMIUM IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 6/3/2019	FIGURE	
Prepared by: AET	Scale: 1:480		
Project Mgr: JAK	Office: NJ	12A	
File No: 1020.F12A(CL)	Project: 0539.0003J000		

G:\PROJECTS-0810539 - Saul Ewing - SX\0003\PROJECT DATABASE\GIS\SRIR 2019\F12A(CL)\DotChromium_Soil.mxd

NOTE:
1. In the absence of speciated data, total chromium was compared to hexavalent chromium criteria (i.e., the more stringent of the trivalent and hexavalent chromium criteria) for the purpose of this evaluation.

Legend

Chromium Concentration in Soil (mg/kg)

- ND - 4 (Residential Direct Contact 0-15' MSC)
- 4 - 190 (Residential Used Aquifer Soil to Groundwater MSC)
- 190 - 220 (Non-Residential Direct Contact 0-2' MSC)
- 220 - 20000 (Non-Residential Direct Contact 2-15' MSC)
- 20000+
- Not Analyzed for Chromium

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:
1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 6/3/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. Depiction of total chromium data utilizes hexavalent chromium standards.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TOTAL CHROMIUM IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 6/3/2019	FIGURE
Prepared by: AET	Scale: 1:480	
Project Mgr: JAK	Office: NJ	12B
File No: 1020.F12B(CL)	Project: 0539.0003J000	

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Legend

Vanadium Concentration in Soil (mg/kg)

- ND - 15 (Residential Direct Contact 0-15' MSC)
- 15 - 220 (Non-Residential Direct Contact 0-2' MSC)
- 220 - 290 (Residential Used Aquifer Soil to Groundwater MSC)
- 290 - 190000 (Non-Residential Direct Contact 2-15' MSC)
- 190000+
- Not Analyzed for Vanadium

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/31/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF VANADIUM IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/31/2019	FIGURE
Prepared by: AET	Scale: 1:480	13A
Project Mgr: JAK	Office: NJ	
File No: 1020.F13A(CL)	Project: 0539.0003J000	

G:\PROJECTS-0/80539 - Saul Ewing - SX\00003\PROJECT DATABASE\GIS\SRIR 2019\F13A(CL)\DotVanadium_Soil.mxd

Legend

Vanadium Concentration in Soil (mg/kg)

- ND - 15 (Residential Direct Contact 0-15' MSC)
- 15 - 220 (Non-Residential Direct Contact 0-2' MSC)
- 220 - 290 (Residential Used Aquifer Soil to Groundwater MSC)
- 290 - 190000 (Non-Residential Direct Contact 2-15' MSC)
- 190000+
- Not Analyzed for Vanadium

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/31/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF VANADIUM IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/31/2019	FIGURE
Prepared by: AET	Scale: 1:480	13B
Project Mgr: JAK	Office: NJ	
File No: 1020.F13B(CL)	Project: 0539.0003J000	

G:\PROJECTS-0/0539 - Saul Ewing - SX\00003\PROJECT DATABASE\GIS\SRIR 2019\F13B(CL)\DotVanadium_SoilVertDelin.mxd

Legend

Arsenic Concentration in Soil (mg/kg)

- ND - 12 (Residential Direct Contact 0-15' MSC)
- 12 - 29 (Residential Used Aquifer Soil to Groundwater MSC)
- 29 - 61 (Non-Residential Direct Contact 0-2' MSC)
- 61 - 190000 (Non-Residential Direct Contact 2-15' MSC)
- 190000+
- Not Analyzed for Arsenic

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF ARSENIC IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	14A
Project Mgr: JAK	Office: NJ	
File No: 1020.F14A(CL)	Project: 0539.0003J000	

G:\PROJECTS-080539 - Saul Ewing - SX00039\PROJECT DATABASE\GIS\SRIR 2019\F14A(CL)\DotArsenic_Soil.mxd

Legend

Arsenic Concentration in Soil (mg/kg)

- ND - 12 (Residential Direct Contact 0-15' MSC)
- 12 - 29 (Residential Used Aquifer Soil to Groundwater MSC)
- 29 - 61 (Non-Residential Direct Contact 0-2' MSC)
- 61 - 190000 (Non-Residential Direct Contact 2-15' MSC)
- 190000+
- Not Analyzed for Arsenic

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF ARSENIC IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

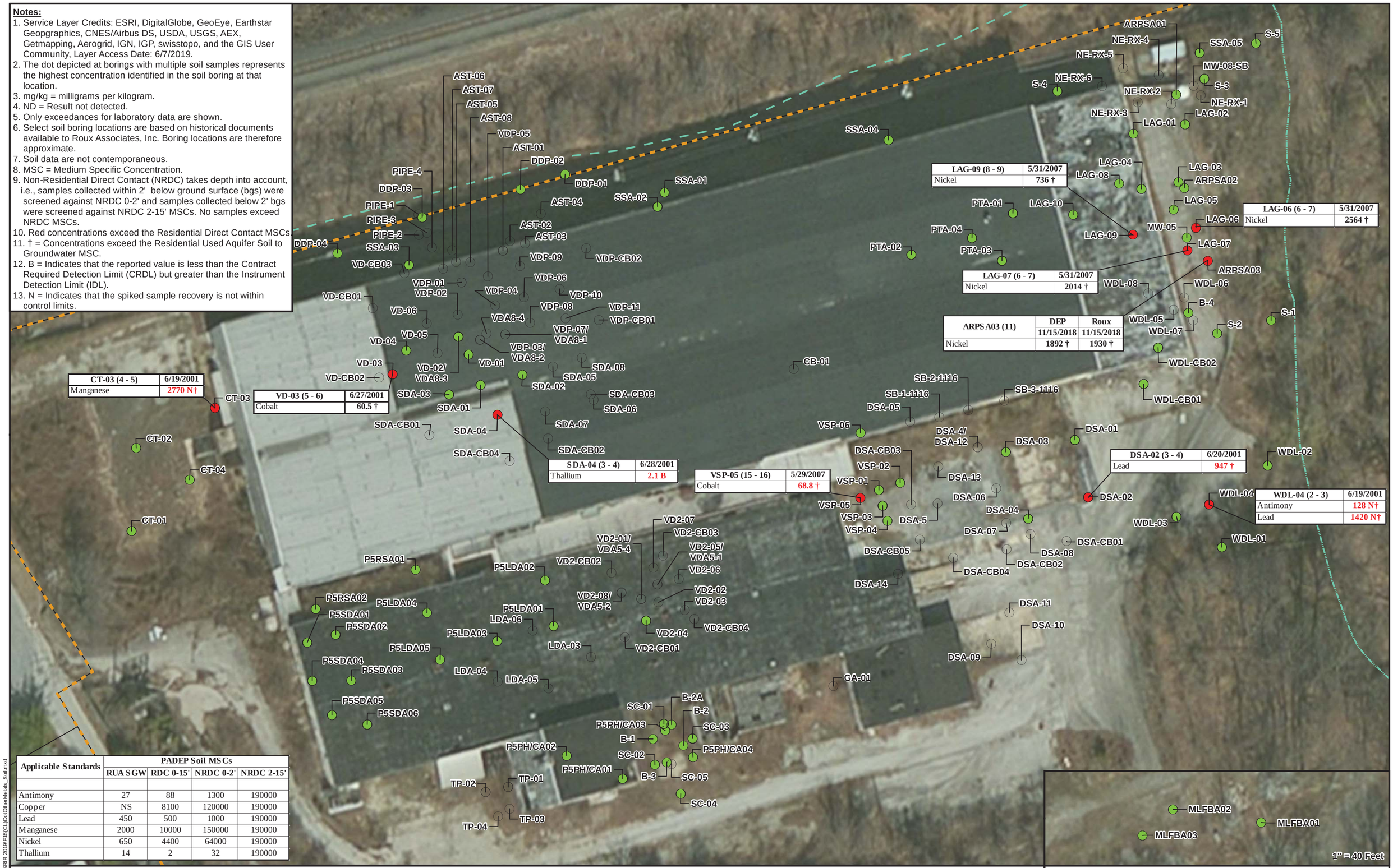
ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	14B
Project Mgr: JAK	Office: NJ	
File No: 1020.F14B(CL)	Project: 0539.0003J000	

G:\PROJECTS-080539 - Saul Ewing - SX\00039\PROJECT DATABASE\GIS\SRIR 2019\F14B(CL)\DotArsenic_SoilVertDelin.mxd

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 6/7/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Only exceedances for laboratory data are shown.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.
12. B = Indicates that the reported value is less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL).
13. N = Indicates that the spiked sample recovery is not within control limits.



LAG-09 (8 - 9)	5/31/2007
Nickel	736 †

LAG-06 (6 - 7)	5/31/2007
Nickel	2564 †

LAG-07 (6 - 7)	5/31/2007
Nickel	2014 †

ARPSA03 (11)	DEP	Roux
	11/15/2018	11/15/2018
Nickel	1892 †	1930 †

CT-03 (4 - 5)	6/19/2001
Manganese	2770 N†

VD-03 (5 - 6)	6/27/2001
Cobalt	60.5 †

SDA-04 (3 - 4)	6/28/2001
Thallium	2.1 B

VSP-05 (15 - 16)	5/29/2007
Cobalt	68.8 †

DSA-02 (3 - 4)	6/20/2001
Lead	947 †

WDL-04 (2 - 3)	6/19/2001
Antimony	128 N†
Lead	1420 N†

Applicable Standards	PADEP Soil MSCs			
	RUASGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
Antimony	27	88	1300	190000
Copper	NS	8100	120000	190000
Lead	450	500	1000	190000
Manganese	2000	10000	150000	190000
Nickel	650	4400	64000	190000
Thallium	14	2	32	190000

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for Metals
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Depth (ft bgs)
Sample Location
Sample Date

LAG-09 (8 - 9)	5/31/2007
Nickel	736 †

Parameter
Concentration (mg/kg)

40 0 40 80 Feet

N

Title:

DISTRIBUTION OF OTHER METALS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 6/7/2019	FIGURE
Prepared by: AET	Scale: 1:480	15
Project Mgr: JAK	Office: NJ	
File No: 1020.F15(CL)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX00003\PROJECT DATABASE\GIS\SRIR 2019\F15(CL)\OtherMetals_Soil.mxd

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. PCBs = Polychlorinated Biphenyls.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for PCBs
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Depth (ft bgs)
Sample Location — Sample Date

DSA-02 (3-4)	6/20/2001
Aroclor 1260	18

Parameter — Concentration (mg/kg)

Applicable Standards	PADEP Soil MSCs			
	RUASGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
Aroclor 1260	170	9.39	46	190000

40 0 40 80 Feet

N

Title:

DISTRIBUTION OF PCBS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE
Prepared by: AET	Scale: 1:480	16
Project Mgr: JAK	Office: NJ	
File No: 1020.F16(CL)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX0003\PROJECT DATABASE\GIS\SRIR 2019\F16(CL)DstOtherPCB_Soil.mxd

NOTE:
1. DNAPL transport in a fractured media occurs primarily through the fracture fabric of the bedrock, therefore a simplistic interpretation of DNAPL transport based on the orientation of potentiometric head contours is often erroneous.
2. The monitoring wells identified are located proximate to where DNAPL is suspected to exists in bedrock (overburden wells are excluded) based on a) monitoring wells where the most recent concentration of TCE exceeds 14,720 ug/l (i.e., 1% of its solubility limit in water) and/or b) physical observations by Baker and/or Roux.

Legend

- Overburden Monitoring Well Location and Identification
- Damaged/Abandoned Overburden Monitoring Well Location and Identification
- Bedrock Monitoring Well Location and Identification
- Abandoned Bedrock Monitoring Well Location and Identification
- Production Well Location and Identification
- Bedrock Monitoring Well Suspected to be Located Proximate to DNAPL
- Stream
- Drainage Swale
- Property Boundary

N

Note:
1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 6/6/2019.
2. ' indicates nested bedrock monitoring well location (3 wells at each location).
3. " indicated nested bedrock monitoring well location (2 wells at each location)

Title:

SUSPECTED DNAPL IN BEDROCK MONITORING WELLS

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 6/6/2019	FIGURE
Prepared by: AET	Scale: 1:2,400	47
Project Mgr: JAK	Office: NJ	
File No: 1020.F47(DL)	Project: 0539.0003J000	

U:\PROJECTS\0539.0003J\ Bad Ewing - BISHOP\PROJECT DATA\GIS\SSPR\ 2019\FIG47(DL) DNAPL.mxd

Appendix B – Soil Treatment Areas

Area(s) boxed out in red are the approximate remedial treatment area extent based on review of soil analytical data against the applicable PADEP standards by GES.

Legend

Trichloroethene Concentration in Soil (mg/kg)

- ND - 0.5 (Residential Used Aquifer Soil to Groundwater MSC)
- 0.5 - 38 (Residential Direct Contact 0-15' MSC)
- 38 - 160 (Non-Residential Direct Contact 0-2' MSC)
- 160 - 180 (Non-Residential Direct Contact 2-15' MSC)
- 180+
- Not Analyzed for Trichloroethene

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCE IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	8A
Project Mgr: JAK	Office: NJ	
File No: 1020.F8A(CL)	Project: 0539.0003J000	

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Legend

Trichloroethene Concentration in Soil (mg/kg)

- ND - 0.5 (Residential Used Aquifer Soil to Groundwater MSC)
- 0.5 - 38 (Residential Direct Contact 0-15' MSC)
- 38 - 160 (Non-Residential Direct Contact 0-2' MSC)
- 160 - 180 (Non-Residential Direct Contact 2-15' MSC)
- 180+
- Not Analyzed for Trichloroethene

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the deepest sample at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCE IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	8B
Project Mgr: JAK	Office: NJ	
File No: 1020.F8B(CL)	Project: 0539.0003J000	

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Legend

1,1,1-Trichloroethane Concentration in Soil (mg/kg)

- ND - 20 (Residential Used Aquifer Soil to Groundwater MSC)
- 20 - 1000 (Residential Direct Contact 0-15' MSC, Non-Residential Direct Contact 0-2' MSC, Non-Residential Direct Contact 2-15' MSC)
- 1000+
- Not Analyzed for 1,1,1-Trichloroethane

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCA IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	9A
Project Mgr: JAK	Office: NJ	
File No: 1020.F9A(CL)	Project: 0539.0003J000	

G:\PROJECTS-0\0539 - Saul Ewing - SX\0003\PROJECT DATABASE\GIS\SRIR 2019\F9A(CL)DistTCA_Soil.mxd

Legend

1,1,1-Trichloroethane Concentration in Soil (mg/kg)

- ND - 20 (Residential Used Aquifer Soil to Groundwater MSC)
- 20 - 1000 (Residential Direct Contact 0-15' MSC, Non-Residential Direct Contact 0-2' MSC, Non-Residential Direct Contact 2-15' MSC)
- 1000+
- Not Analyzed for 1,1,1-Trichloroethane

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the deepest sample at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. The dot depicted at locations where borings coincide represents the most recent laboratory analytical result. Where laboratory analytical results exist, mobile lab data is not depicted.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF TCA IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	9B
Project Mgr: JAK	Office: NJ	
File No: 1020.F9B(CL)	Project: 0539.0003J000	

G:\PROJECTS-0/80539 - Saul Ewing - SX\0003\PROJECT DATABASE\GIS\SRIR 2019\F9B(CL)DotTCA_SoilVertDelin.mxd

Area(s) boxed out in red are the approximate remedial treatment area extent based on review of soil analytical data against the applicable PADEP standards by GES.

PIPE-4	4-4.5	6-6.5
	4/30/2015	4/30/2015
1,1-Dichloroethene	7.88 †	27.7 †
Tetrachloroethene	5.55 †	20.9 †

PIPE-3 (6 - 6.5)	4/30/2015
1,1-Dichloroethene	4.06 †

PIPE-2 (6 - 6.5)	4/30/2015
1,1-Dichloroethene	1.32 †
Tetrachloroethene	0.587 †

VD-CB03 (4 - 8)	11/4/2002
1,1,2-Trichloroethane	1.2 D†

VDA8-4 (4.5 - 5)	10/5/2011
Tetrachloroethene	0.79 J†

VDA8-1 (5 - 5.5)	10/5/2011
Tetrachloroethene	8.85 J†

SDA-CB03 (0 - 4)	10/30/2002
1,1,2-Trichloroethane	0.55 D†

DSA-CB03 (4 - 8)	10/29/2002
Tetrachloroethene	0.83 D†

VDA8-2 (4 - 4.5)	10/5/2011
Tetrachloroethene	1.04 J†

VD2-CB02 (8 - 12)	10/29/2002
1,1,2-Trichloroethane	1.7 D†

VD2-CB03 (8 - 12)	10/29/2002
1,1,2-Trichloroethane	0.56 D†

VD2-CB01 (4 - 8)	10/29/2002
1,1,2-Trichloroethane	5.5 D†

DSA-CB02 (4 - 8)	10/29/2002
1,1,2-Trichloroethane	0.6 D†

MW-08-SB	11-11.5	13.5-14
	4/30/2015	4/30/2015
cis-1,2-Dichloroethene	9.19 †	14.1 †
Tetrachloroethene	1.23 †	0.0211 J
Vinyl Chloride	0.385 †	3.32 †

ARPS A01 (14)	DEP	Roux
	11/14/2018	11/14/2018
cis-1,2-Dichloroethene	11.7 †	6.43
Vinyl Chloride	0.208 †	0.169

LAG-07 (6 - 7)	5/31/2007
cis-1,2-Dichloroethene	8.26 †

LAG-09 (8 - 9)	5/31/2007
cis-1,2-Dichloroethene	26.6 †

ARPS A03 (11)	DEP	Roux
	11/15/2018	11/15/2018
cis-1,2-Dichloroethene	48.4 †	59.8 †
Vinyl Chloride	0.824 Q†	0.24 †

Applicable Standards	PADEP Soil MSCs			
	RUA SGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
1,1,2-Trichloroethane	0.5	4	16	18
1,1-Dichloroethene	0.7	3800	10000	10000
cis-1,2-Dichloroethene	7	440	6400	10000
Tetrachloroethene	0.5	770	3200	3600
Vinyl chloride	0.2	0.9	61	280

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for VOCs
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Sample Location — Depth (ft bgs)

LAG-07 (6 - 7)	5/31/2007
cis-1,2-Dichloroethene	8.26 †

Parameter — Sample Date — Concentration (mg/kg)

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP,swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. VOCs = Volatile Organic Compounds.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.

40 0 40 80 Feet

1" = 40 Feet

Title:

DISTRIBUTION OF OTHER VOCS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE	
Prepared by: AET	Scale: 1:480	10	
Project Mgr: JAK	Office: NJ		
File No: 1020.F10(CL)	Project: 0539.0003J000		

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Area(s) boxed out in red are the approximate remedial treatment area extent based on review of soil analytical data against the applicable PADEP standards by GES.

VD-02 (3 - 4)	6/27/2001
Benzo(a)pyrene	2.4 D

VD-03 (3 - 4)	6/27/2001
Benzo(a)pyrene	1.2

VD-01 (1 - 4)	6/27/2001
Benzo(a)pyrene	2.3 D

ARPS A03 (11)	DEP 11/15/2018	Roux 11/15/2018
Hexachlorobenzene	2.1 †	0.381

WDL-04 (2 - 3)	6/19/2001
Benzo(a)pyrene	1.3

Applicable Standards	PADEP Soil MSCs			
	RUA SGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
Benzo(a)pyrene	46	0.58	12	190000
Hexachlorobenzene	0.96	12	57	190000

1" = 40 Feet

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for SVOCs
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Depth (ft bgs)
Sample Location
Sample Date
Parameter
Concentration (mg/kg)

VD-01 (1 - 4)	6/27/2001
Benzo(a)pyrene	2.3 D

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP,swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. SVOCs = Semi-Volatile Organic Compounds.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.

40 0 40 80 Feet

N

Title:

DISTRIBUTION OF SVOCS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE	
Prepared by: AET	Scale: 1:480	11	
Project Mgr: JAK	Office: NJ		
File No: 1020.F11(CL)	Project: 0539.0003J000		

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Legend

Arsenic Concentration in Soil (mg/kg)

- ND - 12 (Residential Direct Contact 0-15' MSC)
- 12 - 29 (Residential Used Aquifer Soil to Groundwater MSC)
- 29 - 61 (Non-Residential Direct Contact 0-2' MSC)
- 61 - 190000 (Non-Residential Direct Contact 2-15' MSC)
- 190000+
- Not Analyzed for Arsenic

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF ARSENIC IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/22/2019	FIGURE	
Prepared by: AET	Scale: 1:480		
Project Mgr: JAK	Office: NJ	14A	
File No: 1020.F14A(CL)	Project: 0539.0003J000		

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Legend

Arsenic Concentration in Soil (mg/kg)

- ND - 12 (Residential Direct Contact 0-15' MSC)
- 12 - 29 (Residential Used Aquifer Soil to Groundwater MSC)
- 29 - 61 (Non-Residential Direct Contact 0-2' MSC)
- 61 - 190000 (Non-Residential Direct Contact 2-15' MSC)
- 190000+
- Not Analyzed for Arsenic

- Stream
- Drainage Swale
- Property Boundary
- Parcels

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/22/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.

N

40 0 40 80 Feet

Title:

DISTRIBUTION OF ARSENIC IN SOIL (DEEPEST SAMPLE FROM EACH BORING)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

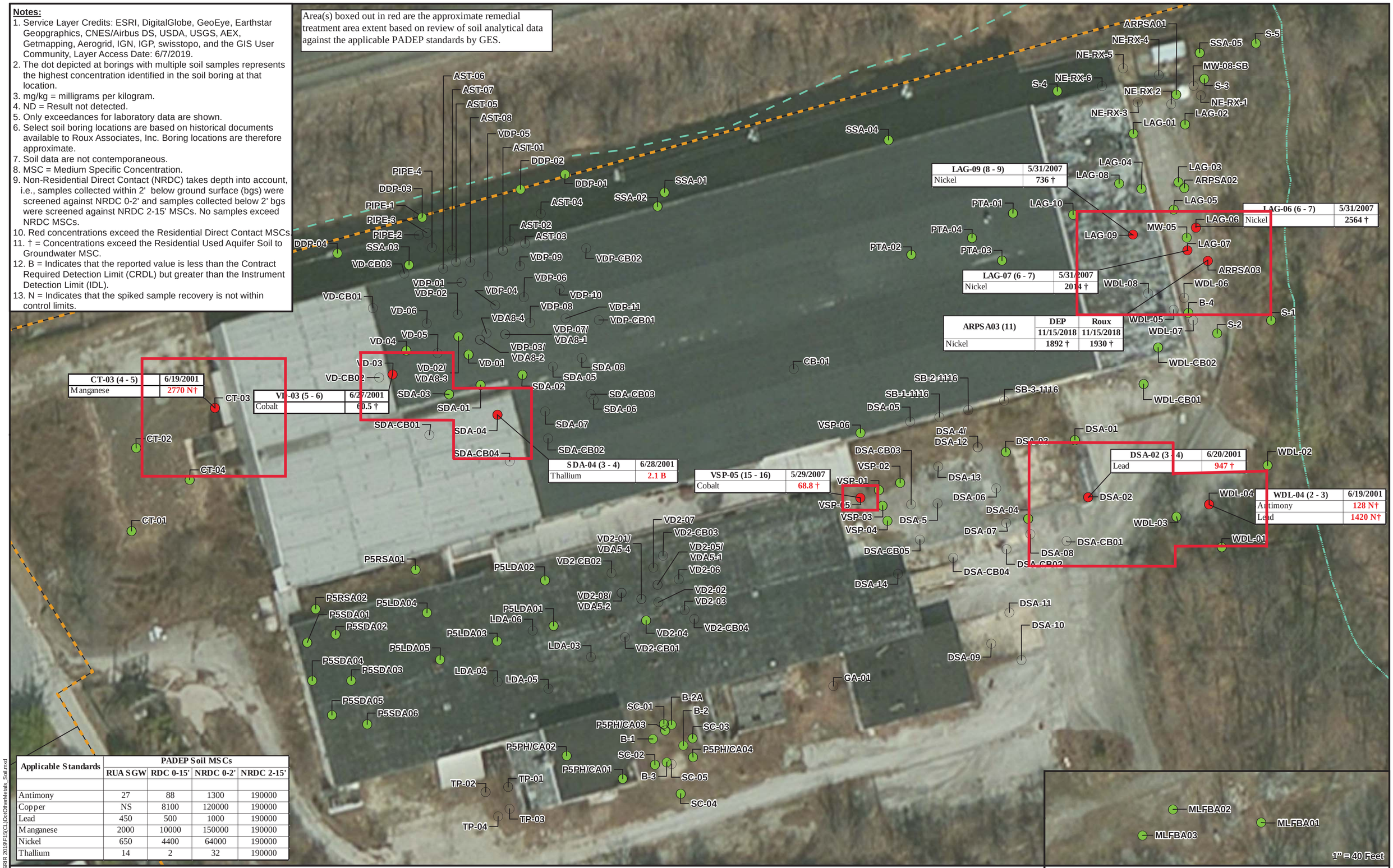
Compiled by: SSPR	Date: 5/22/2019	FIGURE
Prepared by: AET	Scale: 1:480	14B
Project Mgr: JAK	Office: NJ	
File No: 1020.F14B(CL)	Project: 0539.0003J000	

G:\PROJECTS-080539 - Saul Ewing - SX0003\PROJECT DATABASE\GIS\SRIR 2019\F14B(CL)\DotArsenic_SoilVentDelin.mxd

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 6/7/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Only exceedances for laboratory data are shown.
6. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
7. Soil data are not contemporaneous.
8. MSC = Medium Specific Concentration.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.
12. B = Indicates that the reported value is less than the Contract Required Detection Limit (CRDL) but greater than the Instrument Detection Limit (IDL).
13. N = Indicates that the spiked sample recovery is not within control limits.

Area(s) boxed out in red are the approximate remedial treatment area extent based on review of soil analytical data against the applicable PADEP standards by GES.



LAG-09 (8 - 9)	5/31/2007
Nickel	736 †

LAG-06 (6 - 7)	5/31/2007
Nickel	2564 †

LAG-07 (6 - 7)	5/31/2007
Nickel	2014 †

ARPSA03 (11)	DEP	Roux
	11/15/2018	11/15/2018
Nickel	1892 †	1930 †

CT-03 (4 - 5)	6/19/2001
Manganese	2770 N†

VD-03 (5 - 6)	6/27/2001
Cobalt	60.5 †

SDA-04 (3 - 4)	6/28/2001
Thallium	2.1 B

VSP-05 (15 - 16)	5/29/2007
Cobalt	68.8 †

DSA-02 (3 - 4)	6/20/2001
Lead	947 †

WDL-04 (2 - 3)	6/19/2001
Antimony	128 N†
Lead	1420 N†

Applicable Standards	PADEP Soil MSCs			
	RUASGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
Antimony	27	88	1300	190000
Copper	NS	8100	120000	190000
Lead	450	500	1000	190000
Manganese	2000	10000	150000	190000
Nickel	650	4400	64000	190000
Thallium	14	2	32	190000

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for Metals
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Depth (ft bgs)
Sample Location
Sample Date

LAG-09 (8 - 9)	5/31/2007
Nickel	736 †

Parameter
Concentration (mg/kg)

40 0 40 80 Feet

Title:

DISTRIBUTION OF OTHER METALS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 6/7/2019	FIGURE
Prepared by: AET	Scale: 1:480	15
Project Mgr: JAK	Office: NJ	
File No: 1020.F15(CL)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX00003\PROJECT DATABASE\GIS\SRIR 2019\F15(CL)\OtherMetals_Soil.mxd

Notes:

1. Service Layer Credits: ESRI, DigitalGlobe, GeoEye, Earthstar Geopgraphics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Layer Access Date: 5/20/2019.
2. The dot depicted at borings with multiple soil samples represents the highest concentration identified in the soil boring at that location.
3. mg/kg = milligrams per kilogram.
4. ND = Result not detected.
5. Select soil boring locations are based on historical documents available to Roux Associates, Inc. Boring locations are therefore approximate.
6. Soil data are not contemporaneous.
7. MSC = Medium Specific Concentration.
8. PCBs = Polychlorinated Biphenyls.
9. Non-Residential Direct Contact (NRDC) takes depth into account, i.e., samples collected within 2' below ground surface (bgs) were screened against NRDC 0-2' and samples collected below 2' bgs were screened against NRDC 2-15' MSCs. No samples exceed NRDC MSCs.
10. Red concentrations exceed the Residential Direct Contact MSCs.
11. † = Concentrations exceed the Residential Used Aquifer Soil to Groundwater MSC.

Area(s) boxed out in red are the approximate remedial treatment area extent based on review of soil analytical data against the applicable PADEP standards by GES.

Legend

- No Exceedance of Most Stringent Standard
- Exceeds Most Stringent Standard
- Not Analyzed for PCBs
- Stream
- Drainage Swale
- Property Boundary
- Parcels

Depth (ft bgs)
Sample Location — Sample Date

DSA-02 (3-4)	6/20/2001
Aroclor 1260	18

Parameter — Concentration (mg/kg)

Applicable Standards	PADEP Soil MSCs			
	RUASGW	RDC 0-15'	NRDC 0-2'	NRDC 2-15'
Aroclor 1260	170	9.39	46	190000

40 0 40 80 Feet

N

Title:

DISTRIBUTION OF PCBS IN SOIL (ALL SAMPLES FOR ALL DEPTHS)

FORMER BISHOP TUBE FACILITY
CHESTER COUNTY, PENNSYLVANIA

Prepared For:

BISHOP TUBE PROJECT TEAM

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: SSPR	Date: 5/20/2019	FIGURE
Prepared by: AET	Scale: 1:480	16
Project Mgr: JAK	Office: NJ	
File No: 1020.F16(CL)	Project: 0539.0003J000	

G:\PROJECTS-08\0539 - Saul Ewing - SX0003\PROJECT DATABASE\GIS\SRIR 2019\F16(CL)DotOtherPCB_Soil.mxd