FEASIBILITY STUDY REPORT
FORMER BEAROFF METALLURGICAL, SITE # 401069

WORK ASSIGNMENT NO. D007619-41

Prepared for:

New York State Department of Environmental Conservation
Albany, New York

Prepared by:

MACTEC Engineering and Geology, P.C.
Portland, Maine

MACTEC: 3611171207

JANUARY 2020

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
COCs	contaminants of concern
cy	cubic yard
EC	engineering controls
FS	Feasibility Study
ft	foot/feet
GPR	ground penetrating radar
HDPE	high density polyethylene
IC	institutional control
LTM	long term monitoring
MACTEC	MACTEC Engineering and Geology, P.C.
mg/kg	milligram per kilogram
NY	New York
NY-CRR	New York Codes, Rules, and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYDOS	New York State Department of State
O&M	operation and maintenance
OMB	Office of Management and Budget

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (CONTINUED)

OM&M	operations, monitoring and maintenance
PCB	polychlorinated biphenyl
POTW	publicly owned treatment works
PW	present worth
RAO	Remedial Action Objective
RI	Remedial Investigation
SC	site characterization
SCGs	standards, criteria, and guidance values
SCO	soil cleanup objective
sf	square feet
SGV	Sediment Guidance Value
Site	Former Bearoff Metallurgical, Colonie, NY
SVOC	semivolatile organic compound
TSCA	Toxic Substances Control Act
USEPA	United States Environmental Protection Agency
WA	work assignment

1.0 INTRODUCTION

This Feasibility Study (FS) report has been prepared by MACTEC Engineering and Geology, P.C. (MACTEC), in response to Work Assignment (WA) No. D007619-41 from the New York State (NYS) Department of Environmental Conservation (NYSDEC) for the Former Bearoff Metallurgical Site located in Colonie, New York (Site) (Figure 1.1).

This FS report has been prepared in accordance with the WA, as well as with applicable portions of the following documents:

- NYSDEC DER-10 "Technical Guidance for Site Investigation and Remediation" (NYSDEC, 2010)
- 6 New York Codes, Rules and Regulations (NY-CRR) Part 375 "Environmental Remediation Programs"
- United States Environmental Protection Agency (USEPA) "Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)" (USEPA, 1988)

The NYSDEC has determined that the Site poses a significant threat to public health and the environment as defined in 6 NY-CRR 375 (NYS, 2006). The determination is based on results of the Site Characterization (SC) performed in 2015 (MACTEC, 2015) which documents soil, sediment, and groundwater contamination, as well as the presence of contaminated building material. A remedial investigation (RI) was subsequently performed (MACTEC, 2018a) to further assess the extent of site-related contamination to provide the data needed to evaluate the remedial action alternatives presented in this report. A Data Gap Investigation was performed to further evaluate groundwater at the site (MACTEC, 2018b).

1.1 PURPOSE

The purpose of this FS Report is to develop and evaluate remedial action alternatives designed to remove, reduce, or control the primary sources of contamination. This report integrates data and conclusions presented in previous reports including the draft RI Report (MACTEC, 2018a) and the draft Data Gap Investigation Report (MACTEC, 2018b) and develops, screens, and evaluates proposed remedial action alternatives from engineering, environmental, public health, and economic perspectives.

2.0 SUMMARY AND CONCLUSIONS OF THE REMEDIAL INVESTIGATION

2.1 SITE BACKGROUND

The Site is located at 152 Spring Street Road, in the Town of Colonie, Albany County, New York (NY) (Figure 1.1). The Site property consists of approximately 10.6 acres and is currently vacant with no buildings or paved roads.

The AL Tech Specialty Steel property is located adjacent to the Site to the north (the Waste Management Area) and south (the Main Plant Area). A small unnamed tributary, a Class C water body, to the Kromma Kill flows from west to east along the north side of the Site, originating in the AL Tech Specialty Steel Waste Management Area. A residential property abuts the Site to the southeast. A portion of a 150-foot (ft) long driveway for this residence appears to be located on the Bearoff property according to a 2017 Site survey (Appendix A). The Niagara Mohawk Power Corporation has a utility right of way for power lines that run along the eastern edge of the Site on AL Tech property (Figure 2.1).

The known history of Bearoff Metallurgical operations is vague. Activities at the Site appear to have occurred between 1952 and 1978 based on available aerial photographs which are included in the SC report. It is believed that the Site was used for disposal of waste from the AL Tech Specialty Steel property prior to waste regulation (MACTEC, 2015). Bearoff Metallurgical was incorporated with New York State Department of State (NYDOS) on May 4, 1976 (ID # 398795; NYDOS, 2014). The County of Albany acquired the Site through tax foreclosure, and Lewis Growick purchased the Site from the County of Albany on January 17, 2013 (Albany County Clerk, 2013).

A RI was performed in 2016 to determine the extent of contamination and to support the evaluation of remedial action alternatives.

2.2 SITE INVESTIGATION ACTIVITIES

MACTEC conducted SC field activities at the Site in November 2014 and April-May 2015.

A geophysical survey was conducted in November 2014 to (1) screen for the presence of waste disposal areas, (2) screen for the presence of underground storage tanks, and (3) screen proposed soil boring and test pit locations for possible subsurface obstructions in advance of completing subsurface explorations. Following review of electromagnetic survey results which identified an area of disposed waste material (waste boundary), selected ground penetrating radar (GPR) profiling was conducted in open areas of the Site. The purpose of the GPR profiling was to further evaluate the nature of the subsurface waste boundary identified during the electromagnetic survey. GPR survey results were inconclusive and not usable due to a lack of radio wave penetration through the native soils and cover material.

SC results indicate that the contaminants of concern (COCs) for the Site consist of metals (including chromium and hexavalent chromium), semi-volatile organic compounds (SVOCs), and polychlorinated biphenyls (PCBs). These contaminants which are distributed throughout the Site are associated with steel manufacturing waste materials, similar to what has been found at the adjacent Al Tech Specialty Steel site.

The following gaps were identified in the SC data:

- Extent of soil contamination at the Site is not defined
- Extent of groundwater contamination on-site and migrating off-site is unknown
- Extent of sediment contamination in the unnamed tributary is unknown.

To address the SC data gaps, MACTEC performed an RI. RI field activities were conducted from August through September 2017 in accordance with the specifications presented in the Quality Assurance Program Plan (MACTEC, 2011a) and the Field Activities Plan (MACTEC, 2017). The following activities were carried out during the RI:

- Surface soil sampling (0 to 0.2 ft)
- Shallow subsurface soil sampling (0.2 to 2 ft)
- Subsurface soil sampling (greater than 2 ft)
- Monitoring well installation
- Groundwater sampling
- Surface water and sediment sampling in the Unnamed Tributary

Following the RI, a data gap investigation (MACTEC, 2018b) was conducted to further evaluate groundwater at the site. The investigation included:

- Installation and geophysical logging of two open bedrock boreholes
- Synoptic groundwater measurements or both new and existing wells on and in the vicinity of the Site
- Groundwater and seep sampling

2.3 REMEDIAL INVESTIGATION CONCLUSIONS

This section summarizes the current understanding of the geology, hydrogeology, and nature and extent of soil, groundwater, and sediment contamination on-site based on the RI sampling activities.

2.3.1 Geology and Hydrogeology

The Site is located approximately 5 miles north of the center of the City of Albany, NY and approximately 0.8 miles west of the Hudson River.

Overburden in the area consists of steel manufacturing waste fill (where present) and clayey till, which is illustrated in cross sections in Appendix B. The fill is variable in nature and is comprised of debris such as slag, metal fragments, brick, fire brick, and concrete, as well as sand and gravel. Fill thickness varies across the extent of the Site. Fill is generally underlain by competent clay alluvial deposits which are underlain by bedrock. Bedrock encountered consists of dark gray shale, which is consistent with area bedrock maps. According to published maps, the bedrock in the area of the Site consists of the Middle Ordivician Normanskill Shale (Fisher et al, 1970) also referred to as Snake Hill Shale (United States Geological Survey, 2014). Snake Hill Shale is characteristically medium to dark gray, silty, micaceous, and pyritic with occasional thin interbeds of siltstone and fine-grained calcareous mudstone. The Snake Hill Shale is intensely folded and well cleaved.

The Site is unpaved and has no structures. Precipitation that does not infiltrate into the ground will run-off overland to the unnamed tributary to the north and into natural swales that drain to the east. Both the unnamed tributary and drainage swales flow to the Kromma Kill east of the Site and ultimately drain into the Hudson River.

Water level measurements and pressure transducers were employed to develop an understanding of groundwater hydrology at the Site. Monitoring wells installed at the Site indicate that groundwater is greater than 25 ft below ground surface (bgs) across the west central portion of the Site. An evaluation of the site hydrogeology was conducted by evaluating the bedrock surface elevations and overburden and bedrock groundwater levels at and near the Site. The bedrock surface map is presented on Figure 2.2. The interpreted potentiometric surface of the overburden and bedrock aquifers are presented on Figures 2.3 and 2.4, respectively. This data indicate that groundwater is flowing from west to east towards the Hudson River, and that overburden groundwater is not present in the northern and eastern portions of the Site.

An evaluation of available data from the SC, RI, data gap investigation, and explorations on the AL Tech Waste Management Area indicates that perched groundwater may be impacted by Site COCs; however, deeper, non-perched groundwater does not appear to be impacted by downward percolation/infiltration of Site COCs. Although the bedrock structure documented on the geophysical logging indicates that there are transmissive fractures dipping to the east-northeast in the direction of observed seeps on the steep Site slopes, the relative elevations and dip angles of the fractures suggest that bedrock groundwater is not a likely source for the seeps. A comparison of the cation/anion geochemistry results from bedrock groundwater and the seep samples suggests that the seeps are the result of infiltrating precipitation migrating along the shallow impermeable clay/silt surface and are not the result of daylighting bedrock groundwater.

2.3.2 Nature and Extent of Contamination

Contaminants detected on-site are associated with waste materials/fill apparently deposited at the Site on the ground surface and used to fill low areas throughout the site. The fill is variable in content and includes areas of fire brick, ash, slag, metal fragments, and concrete construction debris. PCB contamination in shallow soil samples is present at the highest concentrations in the north and central portions of the Site; lower PCB concentrations reported in samples collected from the on-site dirt road, which may be due to tire tracking by vehicles. Fill materials containing both metals and PCB contamination sloughed over steep embankment close to the unnamed tributary, and precipitation infiltrating through the fill material mobilized contaminants to the tributary sediments and surface water.

2.3.2.1 SOURCE AREAS AND POINTS OF ENTRY

On-site contamination originated from dumping of waste reportedly from area steel mills including the Al Tech Specialty Steel Site. Waste was generated through industrial processes including melting, grinding, forging, and extruding of steel. Contamination from these processes may have been released into the environment at the Site through disposal of waste materials on the ground surface.

Contaminant source areas in soil identified at the Site and depicted on Figure 2.5 include:

- PCB Hot Spots
- Sitewide Soils Containing Fill and Debris

Infiltration of precipitation through the soil source areas and fill material spilling over steep inclines adjacent to the unnamed tributary resulted in contaminant impacts in sediment and surface water in the unnamed tributary. Metals and PCBs in sediment exceed the applicable Class A Sediment Guidance Value (SGV). Hexavalent chromium in surface water exceeds the applicable Class C surface water quality standard. The portion of the unnamed tributary with sediment and/or surface water exceedances is depicted in Figure 2.6.

2.3.2.2 PCB HOTSPOTS

PCBs were detected throughout the site in 71 of 100 soil samples collected. Samples with concentrations exceeding standards, criteria and guidance values (SCGs) are limited to the northern portion of the site. Four shallow surface soil samples from the northern portion of the site exceeded the Toxic Substance Control Act (TSCA) regulatory limit of 50 milligrams per kilogram (mg/kg). Two of these samples are located north of the access road near the property boundary, and two samples are located in the northeastern portion of the site. Figure 2.5 depicts two areas of PCBs with concentrations exceeding 50 mg/kg representing an estimated volume of 1,000 cubic yards (cy). Figure 2.5 also depicts the estimated areas of PCBs with concentrations exceeding 1 and 25 mg/kg. PCB concentrations over 50 mg/kg and 25 mg/kg were observed in soil samples collected from the top two feet of soil. However, in many instances with these observed concentrations deeper soil samples had not been collected as part of the investigations. Therefore, for estimating purposes it was assumed that the areas that exceed 50 mg/kg of PCBs extend vertically to 5 ft bgs and areas that exceed 25 mg/kg of PCBs extend vertically to 10 ft bgs.

2.3.2.3 SITEWIDE FILL/DEBRIS

In addition to the on-site PCB impacts, several metals associated with waste materials/fill were detected sitewide. Metals that exceed the NYSDEC soil cleanup objectives (SCOs) (6 NY-CRR, Part 375, Table 375-6.8[b]) most frequently are arsenic, chromium, and nickel and were generally co-located with the visual presence of fill/waste materials including slag, metal fragments, fire brick, and concrete construction debris. However, some samples located beyond the visual extent of waste material also contain reported metal concentrations exceeding the SCOs. Figure 2.5 depicts the approximate limits of visual waste and the estimated extent of metals contamination. Soil samples with PCB and metals concentrations exceeding SCOs ranged in depth from less than 2 ft bgs and up to 20 ft bgs. An average depth of 4.5 ft for soils exceeding SCOs was assumed which resulted in an estimated volume of 1,591,000 cy of impacted material.

2.3.2.4 CONTAMINANT MIGRATION

Mobility of PCBs in the environment is generally low; metals may be more mobile depending on the ionic state of the metal and site geochemistry. Processes including infiltration, percolation, and erosion can cause migration from one environmental medium to another and/or one area of the Site to another.

<u>PCBs</u>

PCBs with concentrations exceeding 1 mg/kg are present in soil and unnamed tributary sediment, in perched groundwater collected via push point samplers in the overburden, and in infiltrated precipitation collected at seeps entering the unnamed tributary. Migration of PCBs leaching with precipitation into the bedrock groundwater is expected to be minimal because:

- PCBs are hydrophobic and tend to adsorb to soil particles
- PCB concentrations in soil decrease with depth
- PCBs were not detected in bedrock groundwater.

PCBs in surface soils can migrate by erosional processes, with infiltrating precipitation, or by tracking as people and vehicles move through the area. PCB contamination of surface soils and waste materials adjacent to the unnamed tributary may be contributing to contamination detected in sediments.

Metals

Metals in soils/waste material are impacting perched groundwater and migrating to the unnamed tributary adjacent to the Site through seeps. Metals may impact bedrock groundwater by leaching with infiltrating precipitation, however, site COCs have not been detected in bedrock groundwater. Metals are likely also migrating through erosional processes.

2.3.2.5 SITE RECEPTORS

Although the Site is currently vacant and vehicle entrances are gated, trespassing across the Site has been noted. Therefore, Site receptors currently include:

- trespassers, and
- flora and fauna in the unnamed tributary

Future potential receptors include site occupants and construction workers should the Site be redeveloped.

3.0 DEVELOPMENT OF REMEDIAL ACTION GOALS AND OBJECTIVES

The results of the RI and Data Gap Investigation indicate that soil, sediment, and surface water contamination exceed contaminant-specific SCGs at the Site. As a result of infiltrating precipitation, perched groundwater within the impacted soil area and infiltrated precipitation (seeps) also contain Site COCs in concentrations exceeding SCGs; these contaminated media will be addressed as a result of the selected soil remedy.

Remedial Action Objectives (RAOs) have been developed consistent with the remedy selection process set forth in 6 NY-CRR Part 375 (NYS, 2006) and DER-10 (NYSDEC, 2010).

The goal for remedial action is to restore the Site, to the extent practicable, to pre-disposal/pre-release conditions. Where attainment of pre-disposal/pre-release conditions is impracticable, remediation goals shall include attainment of the following chemical-specific SCGs:

- Restricted Residential SCOs (NYS, 2006) for soil to a depth of 24 inches,
- NYS Class A SGV for sediment in the unnamed tributary, and
- NYS Class C surface water quality standard for surface water.

At a minimum, the remedy shall eliminate or mitigate all significant threats to public health and the environment presented by the contaminants disposed/released at the Site through the proper application of scientific and engineering principles (NYSDEC, 2010).

3.1 REMEDIAL ACTION OBJECTIVES FOR SOIL

Potentially complete human-health exposure pathways for soil at the Site include exposure to trespassers, potential future residents or commercial/industrial business employees, and future construction workers via:

- direct contact with impacted soil
- ingestion of impacted soil
- inhalation of fugitive dust

Impacted soils and fugitive dust contain metals and PCBs having concentrations exceeding contaminant-specific SCG values. Additionally, surface soils present a potential source of contamination to sediment in the unnamed tributary as the result of transport of metals and PCBs via erosion and wind transport of fugitive dust. The impacted surface soils and fugitive dust could also migrate to Kromma Kill and impact sediment and/or surface water quality.

Therefore, RAOs for the Site soils are to:

- prevent ingestion/direct contact with contaminated soil
- prevent the migration of contaminants in soil that would result in groundwater, sediment, or surface water contamination
- prevent impacts to biota from ingestion/direct contact with soil causing toxicity or impacts from bioaccumulation through the terrestrial food chain.

3.2 REMEDIAL ACTION OBJECTIVES FOR GROUNDWATER

Perched groundwater within the impacted soil area and water seeps contain site COCs with concentrations exceeding SCGs. However, groundwater is not being used as a drinking water source nor does it not extend outside the area of soil impacts either laterally or vertically in bedrock.

Therefore, the RAOs for groundwater are to:

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
- Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
- Prevent the discharge of contaminants to surface water.
- Remove the source of ground or surface water contamination

3.3 REMEDIAL ACTION OBJECTIVES FOR SEDIMENT

Potentially complete human health exposure pathways for sediment at the Site include exposure to trespassers via direct contact with contaminated sediment, and biota within the unnamed tributary. Sediments could also migrate to Kromma Kill and/or impact surface water quality in the tributary or in Kromma Kill.

Therefore, the RAOs for sediment are to:

- prevent direct contact with contaminated sediments
- prevent surface water contamination which may result in fish advisories
- prevent releases of contaminants from sediments that would result in surface water levels in excess of Ambient Water Quality Criteria

- prevent impacts to biota from ingestion/direct contact with contaminated sediments causing toxicity or impacts from bioaccumulation through the aquatic food chain
- restore sediments to pre-release/background conditions to the extent feasible.

3.4 REMEDIAL ACTION OBJECTIVES FOR SURFACE WATER

Potential human health exposure pathway for surface water at the Site includes exposure to trespassers via direct contact with contaminated surface water. It is assumed that surface water will not require direct remediation, as remediation of sediment and overburden soil will eliminate impacted seep water and migration of contaminants to surface water. Surface water is classified as a Class C surface water body and will not be used as a source of drinking water.

Therefore, the RAOs for surface water are to:

- prevent ingestion of water impacted by contaminants.
- prevent contact or inhalation of contaminants from impacted water bodies.
- prevent surface water contamination which may result in fish advisories.
- restore surface water to ambient water quality criteria for the COCs.
- prevent impacts to biota from ingestion/direct contact with surface water causing toxicity and impacts from bioaccumulation through the marine or aquatic food chain.

4.0 EXTENT OF CONTAMINATION REQUIRING REMEDIAL ACTION AND IDENTIFICATION OF GENERAL RESPONSE ACTIONS

4.1 CONTAMINATION REQUIRING REMEDIAL ACTION

PCB Hot Spots. PCBs were detected across the majority of the Site; however, concentrations exceeding restricted residential SCO are limited to the northern half of the Site, over an area of approximately 119,000 square feet (sf). Within the area that exceeds restricted residential SCOs, there are two hot spots with PCB concentrations in soil that exceed the NYS industrial SCO of 25 mg/kg and the TSCA threshold of 50 mg/kg. The approximate combined area that exceeds the NYS industrial SCO is 15,000 sf. The approximate combined area that exceeds the TSCA threshold is 5,300 sf and is located within the footprint of the industrial SCO exceedances.

The majority of PCB exceedances are reported in samples collected from 0 to 2ft bgs; however, in several instances, samples from deeper than 2 ft were not collected as part of the investigations. For cost estimating purposes it is assumed that the soil with PCBs exceeding industrial SCOs extends to an average depth of 10 ft, and soil with PCBs exceeding the TSCA threshold extends to an average depth of 5 ft. Therefore, the estimated volume of soil with PCBs exceeding the TSCA threshold of 50 mg/kg is 1,000 cy and an additional 4,600 cys of soil exceeds the industrial SCOs for PCBs of 25 mg/kg.

PCB hot spot areas interpreted to exceed the Commercial and Industrial SCO and the TSCA threshold of 50 mg/kg are shown on Figure 2.5. Pre-design investigations will be required to further delineate the extents of these hotspots.

Sitewide Soil.

Metals concentrations in soil exceeding Commercial and Industrial SCOs are typically associated with the waste/fill materials. However, several samples with metals concentrations exceeding SCOs were detected beyond the visual extent of waste. This is likely due to leaching or erosion of the waste materials. Figure 2.5 shows the estimated extent of soil contamination which includes a 25 ft buffer as an estimated extent of contaminant migration. The estimated volume of contaminated soil and debris fill at the Site is 58,500 cy.

Arsenic was detected on the abutting residential property (SS-G16) at a concentration exceeding the residential SCO; the detected concentration is similar to typical background concentrations (NYSDOH, 2006).

The estimated extent of impacted sitewide soil and debris fill is shown on Figure 2.5 along with the location of the PCB hotspots located within the footprint of the sitewide impacted soils.

Surface Water and Sediment. The unnamed tributary, which flows to the Kromma Kill, is located north of the site, downgradient and north of the PCB hotspots. Tributary surface water is contaminated with hexavalent chromium at concentrations exceeding the Class C standard at the eastern portion of the Site. Sediments are contaminated with both PCBs and metals exceeding SCGs along the entire length of the section of the tributary located within the site boundary. PCB contaminated sediments are located throughout approximately 75 ft of the stream bed; concentrations become non-detect downstream of the Site. Metals, including chromium, are present in the streambed along the entire length of the Site and downstream. The AL Tech Site may also be contributing contamination to the unnamed tributary downstream of the Site. The volume of contaminated sediment with concentrations exceeding the SCGs and requiring remedial action is estimated at 5009 cy.

The estimated extent of impacted sediment contamination is shown on Figure 2.6.

4.2 GENERAL RESPONSE ACTIONS

General response actions describe those actions that will satisfy the RAOs (USEPA, 1988). Like RAOs, general response actions are medium-specific.

The following general response actions will address the RAOs identified for soil, and are appropriate for the contamination requiring remediation:

- Institutional Controls
- In-situ Treatment
- Containment
- Removal

The following general response actions will address the RAOs identified for sediment, and are appropriate for the contamination requiring remediation:

- Access Restrictions
- Containment
- Removal

5.0 IDENTIFICATION/SCREENING OF TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES

This section presents the identification and screening of potential remedial technologies.

Following identification, candidate technologies are screened based on their applicability to site- and contaminant-limiting characteristics. The purpose of the screening is to produce an inventory of suitable technologies for assembly into remedial alternatives capable of mitigating actual or potential site risks. Potential technologies representing a range of general response actions are considered. Technology screening results in a list of potential remedial technologies that may be developed into candidate remedial action alternatives.

5.1 INITIAL SCREENING OF TREATMENT TECHNOLOGIES

Remedial technologies and specific process options applicable to hazardous waste sites are identified in USEPA's Guidance for Conducting RI/FS (USEPA, 1988). Table 5.1 summarizes the preliminary review of applicable remedial options. The screening focuses on technology types capable of remediating the COCs present in soils sediments and evaluates the implementability of the technology. Based on this evaluation, technologies retained were determined to be potentially viable treatment options for the contaminated site media. These technologies will undergo a more detailed evaluation in the following report subsections.

5.2 DETAILED SCREENING OF TECHNOLOGIES

Consistent with DER-10, the remedial action technologies retained from the initial screening process (Table 5.1) were screened on the basis of whether they have the ability to meet the RAOs (Effectiveness) and whether they are technically implementable (Implementability). Additionally, based upon available information, the relative cost of each remedial alternative is also evaluated. The rationale for either retaining or eliminating treatment options for soil and sediment, is presented and summarized in Table 5.2. The remedial action options retained from the detailed screening process were used to develop the proposed remedial alternatives discussed in Subsection 5.3 and further described in Section 6.0.

5.3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Media-specific remedial components retained in Table 5.2 were compiled into five remedial alternatives which address contamination in media at the Site. The remedial alternatives are summarized in Table 5.3 below, followed by alternative descriptions.

Table 5.3 Proposed Remedial Alternatives

Alternative Components	**Proposed Alternatives**			
	1	**2**	**3**	**4**
No Action	X			
Sitewide excavation to pre-disposal conditions		X		
Sediment Excavation		X	X	X
PCB Hotspot Excavation (remove >50 mg/kg PCBs)			X	
PCB Hotspot Excavation (remove >25 mg/kg PCBs)				X
Cap System			X	X
Consolidate Contaminated Soil under an Impermeable Containment				X
Long Term Monitoring for Surface Water			X	X
Institutional Controls			X	X

5.3.1 Alternative 1

This alternative will be used as a baseline for comparison to other remedial alternatives. No action will be taken to address contamination at the site, and the site will remain as a NYS Class 2 Hazardous Waste Site.

5.3.2 Alternative 2

Sitewide soils containing PCBs and metals will be excavated to pre-disposal conditions and transported off-site for disposal. This alternative includes:

- Excavation and off-site disposal of soils containing PCBs and metals to the estimated extent of contamination.

- Grading of the site using clean site soils and clean fill from an outside source.
- Excavation and off-site disposal of impacted sediments in the unnamed tributary.

5.3.3 Alternative 3

Alternative 3 involves a combined approach to address contaminated soils and sediments including:

- Excavation and off-site disposal of impacted sediments within unnamed tributary.
- Excavation and off-site disposal of PCB hotspots in soil with concentrations greater than 50 mg/kg.
- Minimal consolidation and grading of remaining PCB and metals impacted areas, followed by installation of a cap system
    - that will both prevent direct exposure and further minimize stormwater infiltration.
- Long term monitoring (LTM) of surface water to evaluate the effectiveness of the remedy.
- Institutional controls including fencing and land use restrictions.

5.3.4 Alternative 4

Alternative 4 will include the same combined approach to address contaminated soils, sediments, and groundwater as Alternative 3 with the following exceptions:

- PCB hotspot excavations will be targeted to remove soils with PCB concentrations greater than 25 mg/kg to meet industrial clean-up levels.
- Sitewide contaminated soils will be consolidated into a smaller footprint prior to installing a cap system.

6.0 DEVELOPMENT AND DETAILED DESCRIPTION OF ALTERNATIVES

This section provides a detailed description of the alternatives retained in Section 5.0. These conceptual designs were used to estimate the associated costs for each alternative, and the following assumptions were made:

1. Surface water contamination originates from sediment contamination and seeps from precipitation infiltrating through the impacted overburden soil. Direct remediation of the surface water is not necessary, as remediation of the impacted soil and sediment will eliminate contamination in surface water.
2. Sediment will be remediated last to prevent earth movement on the slope adjacent to the tributary from causing re-contamination of the tributary.
3. Perched groundwater and its associated seep impacts will be eliminated by remediation of overburden soil, removing potential future impacts to groundwater.
4. Minimal restoration within the unnamed tributary will be required following sediment removal due to its bedrock bottom with little natural sediment or observed fauna.
5. Additional lateral and vertical delineation will be required as part of pre-design investigations, however it has been assumed that:
   a. The depth of soil with PCB impacts >50 mg/kg is five ft within the hotspot depicted in Figure 2.5.
   b. The depth of soil with PCB impacts >25 mg/kg is ten ft within the hotspot depicted in Figure 2.5.
   c. The average depth of the site-wide contamination has been estimated to be 4.5 ft.
   d. A 20 % contingency on the soil quantities has been included in the cost estimates, however, quantities described in the text and in the figures do not include the 20 % contingency to be consistent with the RI report.

6.1 ALTERNATIVE 1

Alternative 1 will involve no further action at the Site. This alternative will be used as a baseline for comparison to other remedial alternatives. This alternative will not allow future use of the Site, as the Site will remain classified as a hazardous waste site.

6.2 ALTERNATIVE 2

This alternative consists of the following components, depicted on Figure 6.1:

- pre-design investigation
- mobilization of temporary facilities and controls
- excavation and off-site disposal of all on-site contaminated soils, followed by backfilling and grading
- excavation and off-site disposal of impacted sediments in the unnammed tributary

Pre-Design Investigation: A pre-design investigation will be conducted to support the remedial design of Alternative 2. The investigation will include:

- a sitewide topographic survey
- a bathymetric survey and existing condition characterization of the impacted portions of the unnamed tributary, including surveying the slope of the channel and surrounding area to identify areas that may require slope stabilization
- assessment of access to the unnamed tributary for sediment removal purpose
- characterizing plant life along the banks of the unnamed tributary, and the area to be excavated, for restoration purposes
- collection of geotechnical data for excavation support design and slope stability during and post-excavation
- collection of soil samples to complete horizontal and vertical delineation extents of PCB hotspots and sitewide contamination
- collection of composite soil samples for pre-characterization of soil to be transported off-site

Site preparation, mobilization, and temporary facilities and controls: Activities required to prepare the Site for excavation, include, but are not limited to:

- delivery and setup of contractor site trailers
- installation of temporary utilities
- installation of a decontamination pad
- implementation of erosion and sediment control measures
- implementation of unnamed tributary dewatering/diversion measures
- placement of temporary fencing around work areas
- equipment delivery (excavator, grader, etc.)
- setup of soil stockpile and soil loading areas
- setup of temporary water treatment system for stormwater entering the excavation dewatering
- clearing and grubbing within the area of excavation and in staging areas and along the unnamed tributary

Soil Excavation: Soil excavation will be conducted with conventional earthmoving equipment (e.g., backhoes and front-end loaders). Excavated soils will be loaded directly onto trucks for off-site transportation and disposal or, if needed, temporarily stockpiled on impervious liners in a designated area of the Site. Impervious liners will also be used to cover the soil stockpiles to prevent the infiltration and runoff of precipitation. While excavating, large debris such as tires, large scrap metal, or concrete will be segregated by type for disposal and/or recycling.

The transportation of the soils off-site will be in accordance with applicable regulations for the transport of contaminated waste materials. As the soil excavation progresses, confirmatory samples will be collected from the bottom and sidewalls of the excavation to verify that site remediation goals are achieved.

Depending on depth and soil types, some areas may require excavation support, however, it is assumed for cost estimating purposes that most of the excavation will not include excavation support, and instead the sidewalls will be benched. Groundwater is not likely to be encountered, however, storm water that collects in the excavation will need to be captured and treated prior to discharge. It is assumed that a temporary water treatment facility will include, at a minimum, two 20,000 gallon fractionation tanks with weirs for solids removal, followed by bag filters and granular activated carbon canisters. This system may also require pH adjustment and/or clarification to assist with metals removal if the water comes in contact with impacted soil. A treated water discharge permit will be required. Influent and effluent samples will be collected and tested for volatile organic compounds, SVOCs, pH, metals and PCBs at a minimum, depending on whether the water is discharged to publicly owned treatment works (POTW) or to the unnamed tributary, at a frequency determined by the discharge permit.

Excavation will begin in the areas with PCB impacts greater than 50 mg/kg and then with PCB impacts greater than 25 mg/kg as described below.

Excavation of PCB hotspots containing >50 mg/kg PCBs: Excavation will take place first within the area with PCB concentrations greater than 50 mg/kg. In accordance with USEPA's TSCA (USEPA, 1976) and 40 CFR §761.61(a)(3) a work plan will be prepared and submitted to USEPA Region 2 for review and approval prior to conducting this excavation, which will include the results of pre-excavation delineation and pre-characterization sampling.

Soils containing PCB concentrations greater than 50 mg/kg will be disposed of as TSCA-regulated waste. The estimated area of TSCA-regulated waste is approximately 5,300 sf as depicted in Figure 2.5. Although the depth of the excavation will vary pending results of pre-design investigations, the estimated average depth of impacted soil with PCB impacts greater than 50 mg/kg is five ft, for a total of approximately 1,000 cy of soil to be disposed as TSCA-regulated waste. The sidewalls of the excavation within this area will be benched to prevent collapse, and it is assumed that dewatering will not be necessary to remove this soil. In the event of heavy rain resulting in saturated, excavated soil, the soil will be stockpiled to drain prior to off-site disposal. Otherwise, the soil will be loaded directly into awaiting trucks for disposal.

Excavation of PCB hotspots containing <50 mg/kg and >25mg/kg PCBs: Upon completion of excavating TSCA-regulated waste, the excavated areas will be extended laterally for an estimated additional 9,800 sf. The excavation will extend vertically to varying depths, with an estimated average depth of ten ft, for a total of approximately 4,600 cy of soil to be disposed as non-hazardous soil at a facility licensed to accept soil with PCB concentrations lower than 50 mg/kg. Similar to the TSCA-regulated waste, soil will be loaded directly onto to awaiting trucks for disposal or staged to drain as needed. The sidewalls of the excavation will be sloped sufficiently to enable an excavator to enter and exit the excavation.

Excavate Remaining Impacted Soils: Upon completion of excavation and off-site disposal of soil with PCB impacts greater than 25 mg/kg, excavation of the remaining impacted areas will begin. Areas previously identified as impacted will likely be direct loaded onto trucks for disposal. Non-impacted areas may need to be excavated and stockpiled for re-use to allow safe access to portions of the site. For example, there is impacted soil that has sloughed over and onto steep inclines towards the unnamed tributary. In such areas, excavation may be required near the edge of the steep incline to provide a flat, safe working surface for excavators to be able to reach over the edge. There are also some areas that have waste impacts to a depth of 25 or more ft, which may also require temporary excavation of non-impacted areas and/or the installation of shoring to access waste at this depth. Actual means and methods for excavation will be determined by the engineer during design, or by the remedial action contractor. Shoring, however, was not included in the cost estimate.

Although impacted soils reach depths of greater than 25 ft, groundwater has not been observed to be present within these waste areas. Stormwater, however, will need to be controlled, collected during excavation activities, and treated prior to off-site discharge either to the POTW or to surface water under a discharge permit.

Confirmation samples will be collected from the limits of the excavation. It has been assumed that one sample per 30 linear ft from the excavation sidewalls, and one sample per 900 sf from the bottom of the excavation will be collected and analyzed for metals and PCBs. Additional excavation will be conducted as needed based on analytical results. Once the sample results confirm the RAOs have been achieved, the excavated areas will be backfilled. Soil segregated and deemed reusable will be used first. Then imported, certified clean fill will be used and compacted. It is assumed that the final grades will have shallower slopes than those currently existing down to the unnamed tributary with no mounding, therefore, it is anticipated that approximately half of the volume of soil excavated and removed will need to be replaced. Sloped areas may be stabilized with erosion control mats and/or riprap as needed, and the disturbed area will be seeded and/or planted with trees and shrubs to prevent erosion.

Sediment Excavation: Contaminated sediments in the unnamed tributary, containing metals at concentrations greater than or equal to the Class C SGV, will be excavated, stockpiled, and dewatered if necessary prior to off-site disposal. Based upon interpretation of the existing analytical data, the extent of materials to be excavated consists of approximately 500 cy of sediment. The sediment is characterized as Class C sediment (based primarily on metals concentrations). The depth of excavation is estimated to be to the top of bedrock, likely to be no deeper than 1.5 ft. Should an area of sediment deeper than 1.5 ft be encountered, confirmation samples of sediment will be collected at 1.5 ft, and if needed, the area will be excavated deeper.

The tributary runs dry from time to time, and if possible, excavation will be scheduled around a dry period of the year. However, there may be a need to divert water around active excavations and dewatering within the active excavation may be required. Dewatering effluent and decant from the sediment stockpiles will be collected and treated through the temporary treatment facility. Excavated sediments, if overly wet, will be mixed with a stabilizing agent or with other site soils (of similar chemical characteristics) prior to off-site disposal to an approved facility.

Once bedrock surfaces are reach along the tributary and/or the sample results confirm the RAOs have been achieved, minimal restoration of the bed and banks of the tributary will be conducted and will follow an approved restoration design. This may involve placement of riprap or other bank armoring in areas where bedrock surfaces have not been exposed, and planting of vegetation in disturbed areas outside of the unnamed tributary.

6.3 ALTERNATIVE 3

Alternative 3 includes the following components, depicted on Figure 6.2:

- pre-design investigation
- mobilization of temporary facilities and controls
- excavation of soils containing greater than 50 mg/kg PCBs (hotspots)
- minimal consolidation of impacted soil
- placement of a cap system
- Aexcavation and off-site disposal of impacted sediments in the unnamed tributary
- surface water monitoring to evaluate the effectiveness of the remedy

Pre-Design Investigation: A pre-design investigation will be conducted to support the remedial design of Alternative 3. The investigation will include:

- a sitewide topographic survey
- a bathymetric survey and existing condition characterization of the impacted portions of the unnamed tributary, including surveying the slope of the channel and surrounding area to identify areas that may require slope stability
- assessment of access to the unnamed tributary for sediment removal purposes
- characterizing plant life along the banks of the unnamed tributary, and the areas to be excavated or covered, for restoration purposes
- collection of geotechnical data for slope stability during and post remediation activities
- collection of composite soil samples for pre-characterization of soil to the transported off-site for disposal

Site preparation, mobilization, and temporary facilities and controls: Activities required to prepare the Site for implementation of Alternative 3 will be similar to those activities required for Alternative 2, which includes, but is not limited to:

- delivery and setup of site trailers
- installation of temporary utilities
- installation of a decontamination pad
- implementation of erosion and sediment control measures

- implementation of unnamed tributary dewatering/diversion measures
- placement of temporary fencing around work areas
- equipment delivery (excavator, grader, etc.)
- setup of soil stockpiles and soil loading areas
- setup of temporary water treatment system for sediment excavation dewatering at the unnamed tributary
- clearing and grubbing within the areas to be excavated, covered, staging areas and along the unnamed tributary.

Excavation of PCB hotspots containing >50 mg/kg PCBs: Upon completion of site setup, excavation and off-site disposal of soil containing PCB concentrations greater than 50 mg/kg as TSCA-regulated wastes will be conducted as described for Alternative 2. Upon completion of the excavation of these areas, confirmation samples will be collected to ensure that remaining soils contain less than 50 mg/kg of PCBs. An estimated 1,000 cy will be estimated and transported off-site for disposal.

Consolidation and Cap System: Prior to placement of a cap system, impacted soils along the northern and eastern steep embankments will be excavated and consolidated over the flatter portion of the site as shown on Figure 6.2. Excavation of non-impacted soil may be required to help support excavation along the steep incline and provide a stable embankment. The additional excavated soil will be used to create a gradual incline away from the center of the impacted area to promote stormwater runoff rather than infiltration through the fill prior to placement of a cap system. A cap system will then be installed over an approximate 268,000 sf area which will include an impermeable cap system (Alternative 3B), as follows:

***Alternative 3 – Impermeable Cap System*:** Similar to the soil cap system, the impermeable cap system will also provide 2-ft of clean material to minimize direct exposure to underlying impacted soil. A 6-inch layer of sand will be placed over the existing impacted soil to provide a cushion layer to protect the liner from debris such as slag and metal fragments. A 60 one-thousandth of an inch (mil) high density polyethylene (HDPE) liner will be placed over the sand layer. The 60-mil HDPE liner will extend past the lateral extents of the impacted soil and will be keyed into the ground. A layer 6-inch layer of clay followed by a 6-inch layer of common borrow, a 6-inch layer of topsoil, seed and mulch will then be placed. This cap system will provide a direct contact barrier and will further mitigate precipitation through the impacted area.

Following the completion of the remedy, the Site will be surrounded by a security fence to deter trespassers.

Excavation of Sediments: Contaminated sediments in the unnamed tributary, containing metals at concentrations greater than or equal to the Class C SGV, will be excavated, stockpiled, and dewatered as necessary prior to off-site disposal and associated restoration will occur as described in Alternative 2.

Long Term Monitoring, Maintenance and Inspection: LTM of surface water along the unnamed tributary will be conducted to evaluate the effectiveness of the remedy. It is assumed that surface water samples will be collected from three locations twice per year for the first five years following remediation and once per year thereafter. Surface water samples will be analyzed for site COCs including metals and PCBs.

The cap system will require mowing up to three times per year, and annual inspections will be conducted to evaluate the condition of the cap system. Surface water sampling results and inspection results will be summarized in annual reports.

6.4 ALTERNATIVE 4

Alternative 4 includes the following components, depicted on Figure 6.3:

- pre-design investigation
- mobilization of temporary facilities and controls
- excavation of soils containing greater than 25 mg/kg PCBs
- consolidation of impacted soil to a smaller footprint
- placement of a cap system
- excavation and off-site disposal of impacted sediments in the unnamed tributary
- surface water monitoring to evaluate the effectiveness of the remedy

Pre-Design Investigation: A pre-design investigation similar to that described for Alternative 3 will be conducted to support the remedial design of Alternative 4.

Site preparation, mobilization, and temporary facilities and controls: Activities required to prepare the Site will be similar to those described for Alternative 3.

Excavation of hotspots containing >25 mg/kg PCBs: Alternative 4 will include excavation and off-site transportation and disposal of PCB-impacted soils with concentrations greater than 25 mg/kg. Similar to Alternative 2, approximately 1,000 cy of soil containing greater than 50 mg/kg of PCBs will be excavated first and disposed as TSCA-regulated waste followed by excavation of an estimated 4,600 cy soil containing greater than 25 mg/kg of PCBs to be disposed as non-hazardous soil.

Consolidation and Cap System: Prior to placement of a cap system, similar to Alternative 3, impacted soils along the northern and eastern steep embankments will be excavated and consolidated over the flatter portion of the site. Additional impacted soil will also be consolidated to create an overall smaller footprint of impacted soil. It has been assumed for cost estimating purposed that the footprint of the consolidated area will approximately follow the 1 mg/kg of PCBs in soil contour, which would result in a footprint of approximately 83,000 sf as shown on Figure 6.3. The consolidated mound of impacted soil will have an approximate average height of 15 ft. A cap system will then be installed over the consolidated area to include an impermeable cap system (Alternative 4). The installation of the cap system will be similar to those described for Alternative 3.

Following the completion of the remedy, the Site will be surrounded by a security fence to deter trespassers.

Excavation of Sediments: Contaminated sediments in the unnamed tributary containing metals at concentrations greater than or equal to the Class C SGV will be excavated, stockpiled, and dewatered as necessary prior to off-site disposal and associated restoration will occur as described in Alternative 2.

Long Term Monitoring, Maintenance and Inspection: LTM of surface water in the unnamed tributary, and cap system mowing and inspections will be conducted as described in Alternative 3 with results documented in annual reports.

7.0 Detailed Analysis and Comparison of Alternatives

7.1 DETAILED ANALYSIS EVALUATION CRITERIA

The detailed analysis of each remedial alternative addressing soil and sediment was performed using the evaluation criteria identified in DER-10 (NYSDEC, 2010) and Subpart 375-1.8(f) (NYS, 2006). Table 7.1 provides the detailed evaluation, which includes, where appropriate, a discussion of limitations, assumptions, and uncertainties for each evaluation criteria to support an alternatives comparison. Evaluation criteria include:

- Compliance with Standards, Criteria and Guidance
- Overall Protection of Public Health and the Environment
- Short-term Impacts
- Short-term Effectiveness
- Long-term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume with Treatment
- Implementability
- Land Use
- Sustainability / Green Remediation (DER-31)
- Cost-Effectiveness

Compliance with Standards, Criteria, and Guidance: Compliance with SCGs addresses whether a remedy will meet applicable environmental laws, regulations, standards, and guidance. SCGs for the Site are listed along with a discussion of whether the remedy will achieve compliance. For those SCGs that will not be met, there is a discussion and evaluation of the impacts of each, and whether waivers are necessary. Chemical-specific SCGs were discussed in Section 3. Table 7.2 summarizes the list of applicable SCGs used in the evaluation of alternatives.

Overall Protection of Public Health and the Environment: This criterion is an evaluation of the remedy's ability to protect public health and the environment, assessing how risks posed through each existing or potential pathway of exposure are eliminated, reduced, or controlled through removal, treatment, engineering controls (ECs), or institutional controls (ICs). The remedy's ability to achieve each of the RAOs is evaluated.

Short-term Impacts and Effectiveness: The potential short-term adverse impacts and risks of the remedy upon the community, the workers, and the environment during the construction and/or implementation are evaluated. A discussion of how the identified adverse impacts and health risks to the community or workers at the Site will be controlled, and the effectiveness of the controls, are presented, along with a discussion of ECs that will be used to mitigate short term impacts (e.g., contaminant migration/odor control measures). The length of time needed to achieve the remedial objectives is estimated.

Long-term Effectiveness and Permanence: This criterion evaluates the long-term effectiveness of the remedy after implementation. If wastes or treated residuals remain on-site after the selected remedy has been implemented, the following items will be evaluated:

1. magnitude of remaining risks
2. adequacy of the engineering and ICs intended to limit the risk
3. reliability of these controls
4. ability of the remedy to continue to meet RAOs in the future

Effectiveness is a measure of how well the alternatives will protect human health and the environment after implementation of the remedy. This includes an evaluation of the permanence of the alternative, the magnitude of residual risk, and the adequacy and reliability of controls required to manage wastes or residuals remaining at the Site.

Reduction of Toxicity, Mobility, or Volume with Treatment: The remedy's ability to reduce the toxicity, mobility or volume of site contamination is evaluated. Preference is given to remedies that permanently and significantly reduce the toxicity, mobility, or volume of the wastes at the Site.

Implementability: The technical and administrative feasibility of implementing the remedy is evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, or other issues.

Land Use: The current, intended, and reasonably anticipated future land uses of the Site and its surroundings is considered in the evaluation of remedial alternatives.

Sustainability/Green Remediation (DER-31): Compliance with DER-31 (NYSDEC, 2011) is evaluated, including application of green remediation concepts such as minimizing energy consumption, reducing greenhouse gas emissions, maximizing the reuse of land and the recycling of materials, and conserving natural resources such as soil, water, and habitat to the extent possible while still implementing remedies that are protective of public health and the environment.

Cost-Effectiveness: Capital and Site Management costs including operating, monitoring, and maintenance (OM&M) costs, are estimated based on the conceptual designs described in Section 6 for each remedial alternative and are compared on a present worth (PW) basis.

7.2 COST ANALYSIS PROCEDURES

Estimated costs presented in this report are intended to be within the target accuracy range of minus 30 to plus 50 % of actual cost (USEPA, 1988). Costs are presented as a PW and as a total cost for up to a 30-year period.

A summary of the costs for each alternative identifying capital and PW costs are presented in Tables 7.3 through 7.6. Each cost estimate includes a PW analysis to evaluate expenditures that occur over different time periods. The analysis discounts future costs to a PW and allows the cost of remedial alternatives to be compared on an equal basis. PW represents the amount of money that, if invested now and disbursed as needed, will be sufficient to cover costs associated with the remedial action over its planned life. A discount rate of 3.6 %, as published by the Office of Management and Budget (OMB), was used to prepare the cost estimates (OMB, 2018).

Consistent with USEPA FS cost estimating guidance (USEPA, 2000), the remedial alternative cost estimates include costs for project management, remedial design, construction management, technical support, and scope contingency.

Project management includes planning and reporting, community relations support during construction or OM&M, bid or contract administration, permitting (not already provided by the construction or OM&M contractor), and legal services outside of ICs. Project management costs are generally between 5 and 10 % of total direct costs.

Remedial design cost includes cost for various design components such as design analysis, plans, specifications, cost estimate, and schedule. Remedial design cost may also include additional pre-design investigation sample collection and or treatability study/pilot scale testing. Remedial design cost is generally between 6 and 20 % of total direct costs.

Construction management cost includes cost associated with services to manage construction or installation of the remedial action, except any similar services provided as part of regular construction activities. Activities include review of submittals, design modifications, construction observation or oversight, engineering survey for construction, preparation of an operation and maintenance (O&M) manual, documentation of quality control/quality assurance, and record drawings. Construction management cost is generally between 6 and 15 % of total direct costs.

Technical support during O&M includes services to monitor, evaluate, and report progress of remedial action. This includes oversight of O&M activities, update of the O&M manual, and progress reporting and is generally between 10 % and 20 % of total annual O&M costs depending on complexity of the remedial action (USEPA, 2000).

Scope contingency represents project risks associated with the feasibility-level of design presented in this FS Report. This type of contingency represents costs, unforeseeable at the time of estimate preparation, which are likely to become known as the remedial design proceeds. Scope contingency ranges from 10 to 25 %, with higher values appropriate for alternatives with greater levels of cost growth potential (USEPA, 2000). A contingency of 20 % was added to each of the alternatives presented in this report.

Project management, remedial design, and construction management costs, related to implementation of the chosen remedial alternative, presented in this FS Report are based upon the following matrix presented in the USEPA FS cost estimating guidance (USEPA, 2000).

Professional and Technical Costs as Percentage of Direct Costs					
Indirect Cost	< $100K (%)	$100K-$500K (%)	$500K-$2M (%)	$2M-$10M (%)	>$10M (%)
Project Management	10	8	6	5	5
Remedial Design	20	15	12	8	6
Construction Management	15	10	8	6	6

7.3 COMPARATIVE ANALYSIS OF ALTERNATIVES

The comparative analysis evaluates the relative performance of each alternative using the same criteria by which the detailed analysis of each remedial component was conducted. A supplemental detailed analysis of the remedial alternatives and their respective remedial components, using the evaluation criteria identified in DER-10 (NYSDEC, 2010) and Subpart 375-1.8(f) (NYS, 2006), is provided in Table 7.1. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another to aid in selecting an overall remedy for the Site.

The comparative analysis presented in this document uses a qualitative approach to comparison, with the exceptions of comparing alternative costs to implement each alternative. A comparison of the capital and long-term costs associated with the remedial alternatives is presented in Table 7.3. Detailed cost analysis backup is provided in Appendix C.

Compliance with Standards, Criteria and Guidance. Alternative 1 does not include actions to address contamination at the Site. This remedy is not compliant with site specific and chemical specific SCGs.

Alternative 2 will result in full compliance with site specific and chemical specific SCGs as it will return the site to pre-disposal site conditions. Alternative 3 will result in partial compliance with site specific and chemical specific SCGs as Alternative 3 will leave soils with PCB concentrations less than 50 mg/kg and metals impacted soil below a cap system. Alternative 4 also relies on a cap system, however, PCB concentrations will be reduced to below industrial standards. Therefore

Alternative 2 ranks highest for meeting site-specific and chemical-specific SCGs, followed by Alternatives 4 and 3.

Overall Protection of Public Health and the Environment. Other than Alternative 1, each of the proposed alternatives will result in overall protection of public health and the Environment. However, Alternative 2 ranks highest for this criterion since it will not require inspections, maintenance or monitoring to ensure long term effectiveness. Alternatives 4 and 3 rank second and third as they will greatly minimize precipitation through the covered impacted area.

Short Term Impacts and Effectiveness. Although ECs will be used and health and safety plans prepared and followed, there is potential for short-term adverse impacts and risks upon the community, the workers, and the environment during the excavation, construction and implementation of Alternatives 2 through 4. Alternative 2 ranks lowest with regards to short term impacts for this criterion, based on the duration of the remedy implementation and degree of intrusiveness of the remedy. However, Alternative 2 ranks highest for short term effectiveness because it does not require long term maintenance or monitoring. Alternatives 4 and 3 rank second and third for short term effectiveness.

Long-term Effectiveness and Permanence: Alternative 1 does not include actions to address contamination at the Site. This remedy does not currently meet RAOs and will not be expected to meet RAOs in the future.

Alternative 2 ranks the highest for long-term effectiveness because sitewide impacted soils and sediments will be excavated and transported off-site for disposal and will not require prolonged inspection or maintenance in the long term.

Although protective of human health and the environment, Alternatives 3 and 4 will leave impacted soils in place below a cap system, requiring periodic inspections and maintenance, and surface water will require monitoring to evaluate the effectiveness of the remedies. Therefore, these alternatives rank equal for long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume with Treatment: Alternative 1 will not result in the reduction of toxicity, mobility, or volume of contamination through treatment.

Alternative 2 will most effectively reduce the toxicity, mobility and volume of site contamination through excavation to pre-disposal conditions. Alternative 4 will remove a greater volume of mass than Alternative 3. Therefore, Alternative 2 ranks first using this criterion followed by Alternatives 3 and 4.

Implementability: Alternative 1 includes no action, therefore there are no technical difficulties associated with this alternative. However, obtaining regulatory approval of this alternative will be difficult. Alternative 3 requires less excavation and soil movement than Alternatives 2 and 4. However, alternative 4 includes the most challenging area to excavate, namely, the impacted soil sloughed over the steep embankments as well as challenges with excavations in the unnamed tributary. Alternatives 2 and 4 will be equally difficult to implement and they each require significant earth moving. Therefore, Alternative 3 ranked highest for ease of implementability.

Land Use. Alternative 1 requires no action, and therefore is not compatible with current or foreseeable land use. Alternative 2 will result in no restrictions to land use. Alternative 4 will result in no restrictions to land use in some areas, however, a tall consolidated area adjacent to future residential properties would be unsightly and would not appeal to a residential neighborhood. Alternative 3 meets current and future land use as it would conform to restricted residential use. Therefore Alternative 2 ranks highest for this criterion followed by Alternative 3 and Alternative 4.

Sustainability/Green Remediation (DER-31): Alternative 1 does not require any resources to implement, however it is not protective of human health and the environment. Alternative 3 is likely to result in lower energy consumption than Alternatives 2 and 4 because it will not require as much transportation and disposal of soil and sediment and will include less overall earth movement over a shorter construction period. Therefore Alternative 3 ranks highest for Sustainability/Green Remediation.

Cost: The estimated capital cost and present worth of the remedial alternatives are tabulated below. Cost summaries for each alternative are included in Tables 7.3 through 7.6, and detailed costs are included in Appendix C.

Remedial Alternative	**Capital Cost**	**Total Present Worth**	**Average Annual Cost (Present Worth)**
Alternative 1	$ 0	$ 0	$ 0
Alternative 2	$ 17,900,000	$ 17,900,000	$ 0
Alternative 3	$ 5,010,000	$ 5,410,000	$ 13,200
Alternative 4	$ 9,520,000	$ 9,920,000	$ 13,200

Based on a review of the presented alternatives, it is recommended that Alternative 4 be implemented as the selected remedy.

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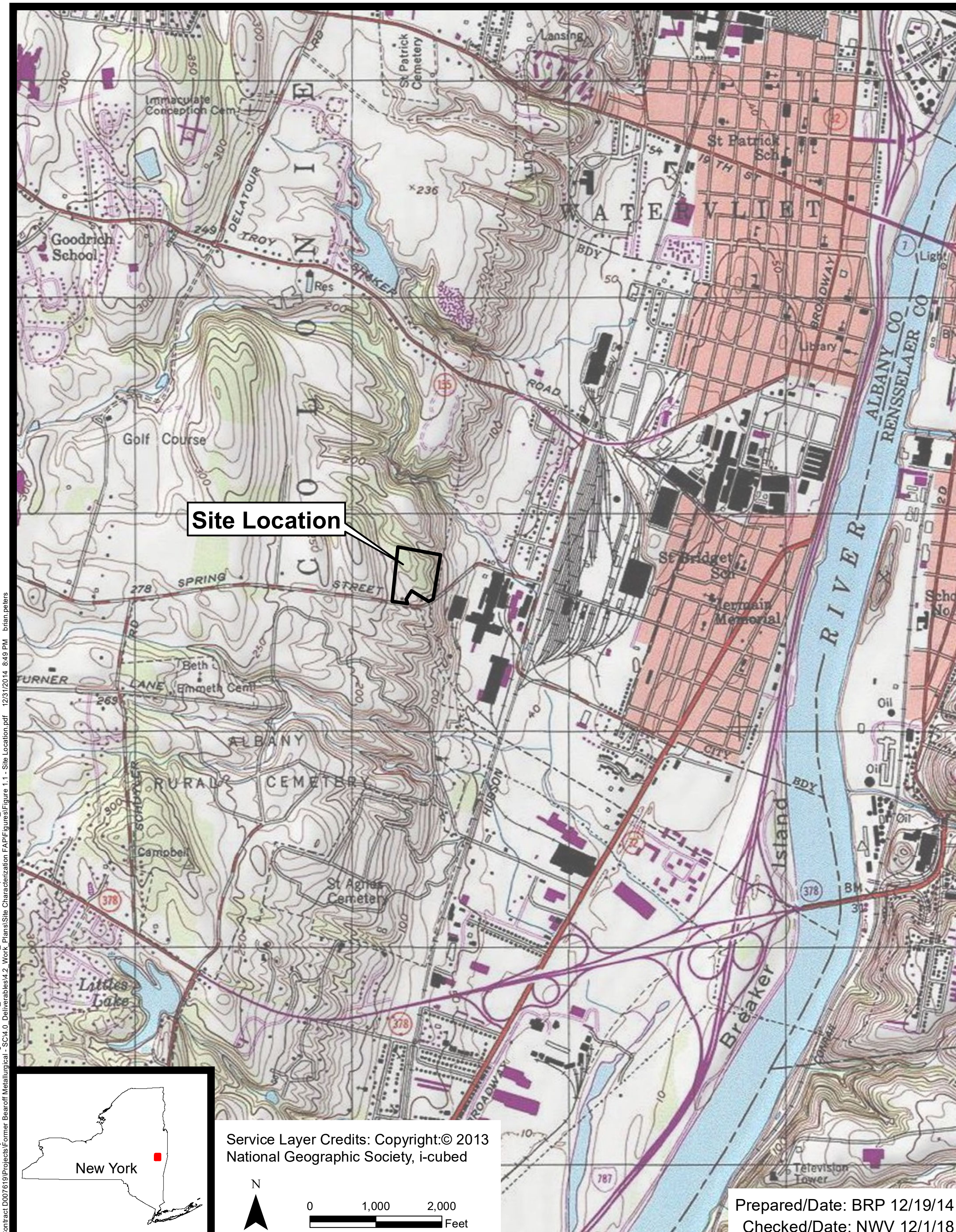
FIGURES

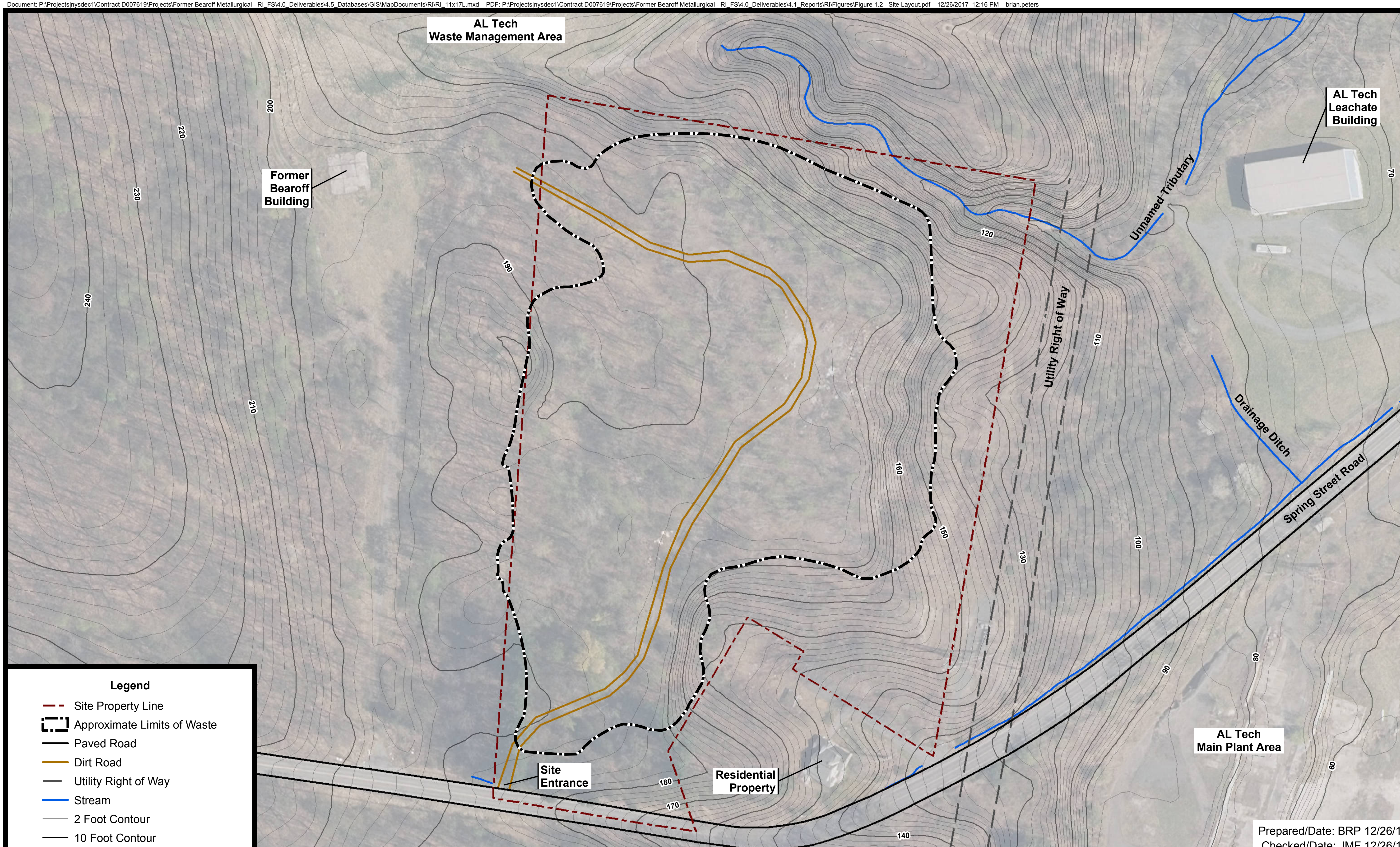


NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

MACTEC

Site Location

Project 3611171207 Figure 1.1



Prepared/Date: BRP 12/26/17
Checked/Date: JMF 12/26/17

Albany County color digital orthoimagery (2014) obtained from New York State GIS Clearinghouse at: http://www.nysgis.state.ny.us

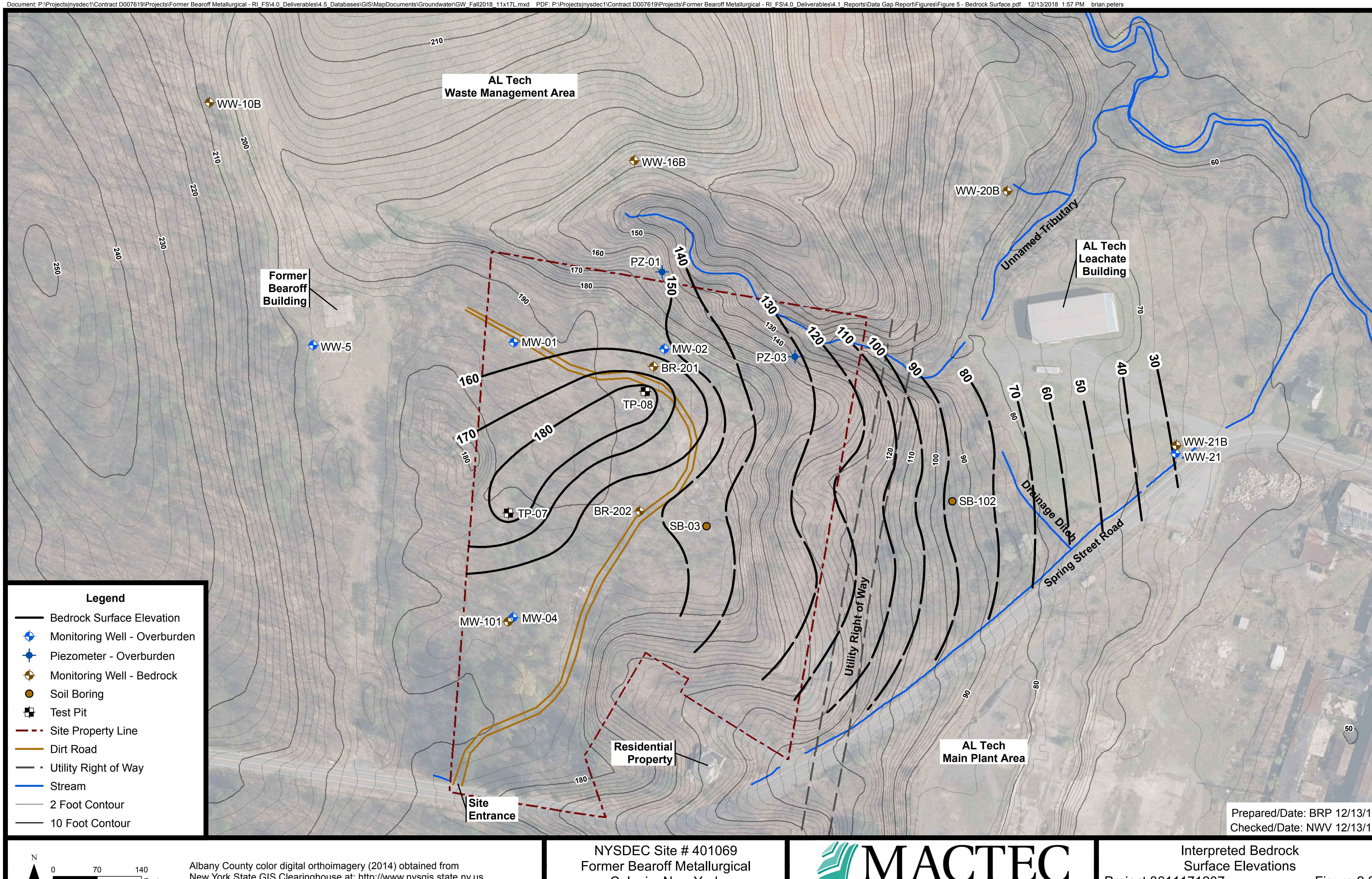
NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

MACTEC

Site Layout

Project 3611171207

Figure 2.1



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NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

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Interpreted Bedrock Surface Elevations

Project 3611171207

Figure 2.2

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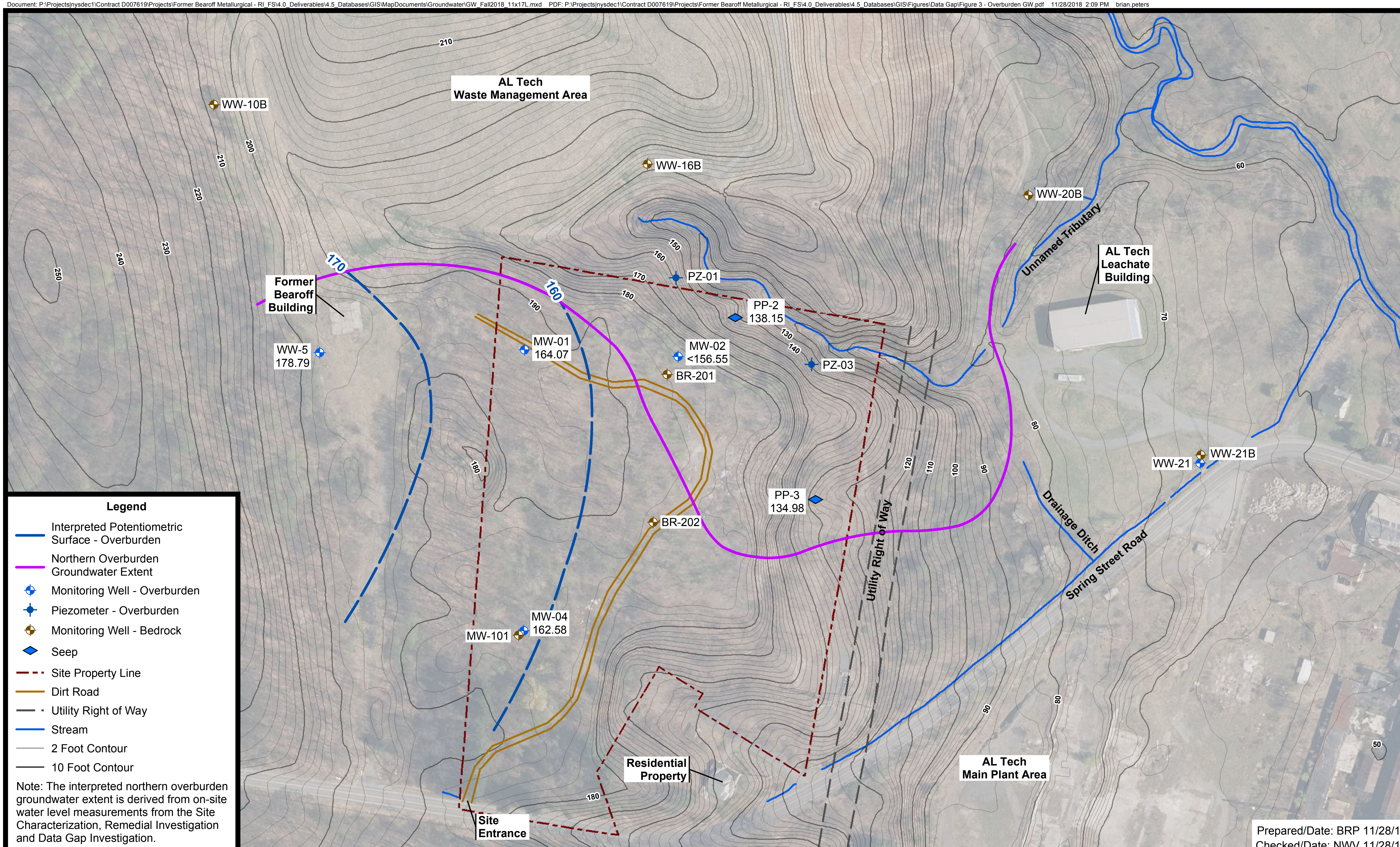

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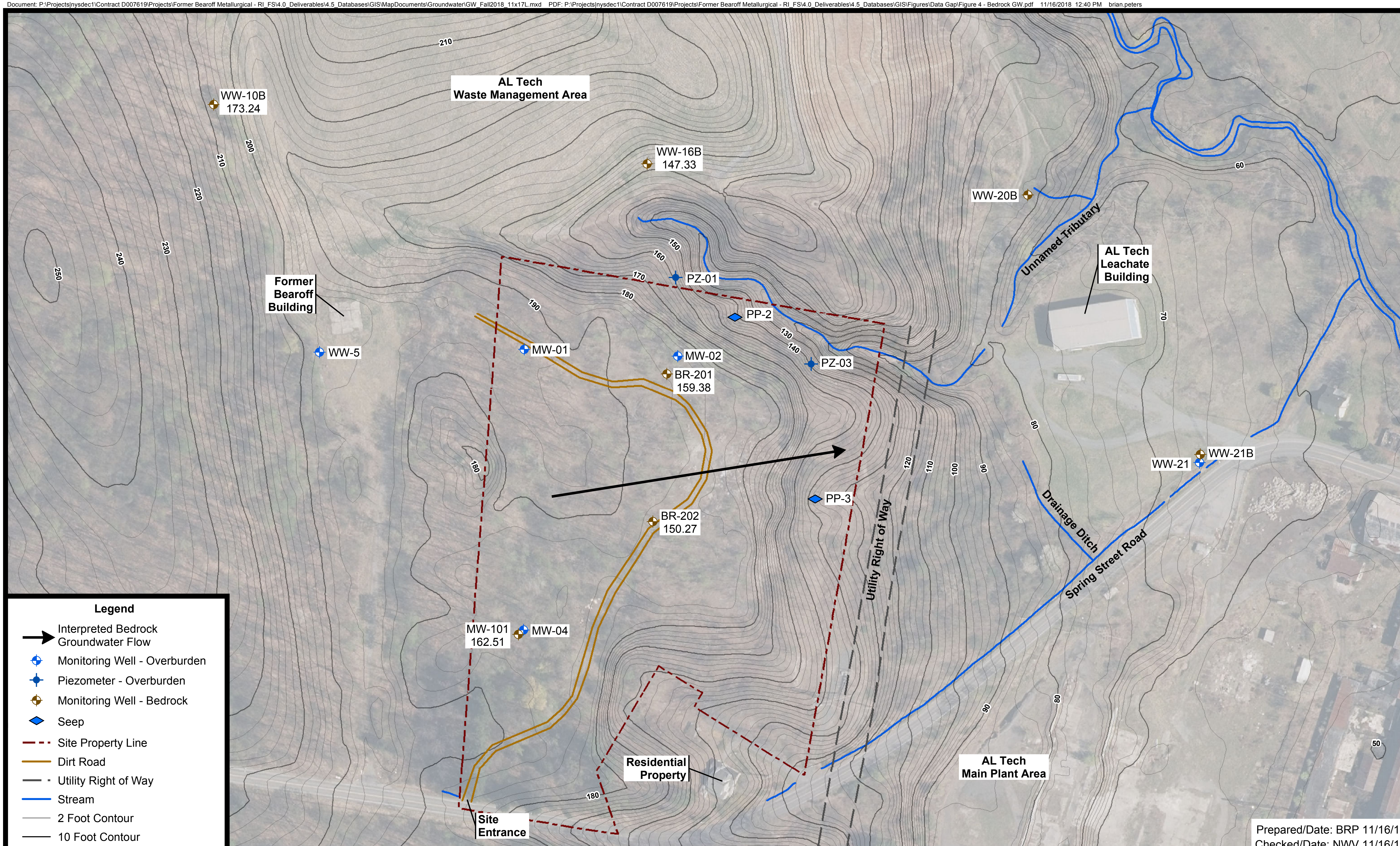
Albany County color digital orthoimagery (2014) obtained from New York State GIS Clearinghouse at: http://www.nysgis.state.ny.us

NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

MACTEC

Interpreted Overburden Potentiometric Surface
Project 3611171207 Figure 2.3



Albany County color digital orthoimagery (2014) obtained from New York State GIS Clearinghouse at: http://www.nysgis.state.ny.us

NYSDEC Site # 401069
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Colonie, New York

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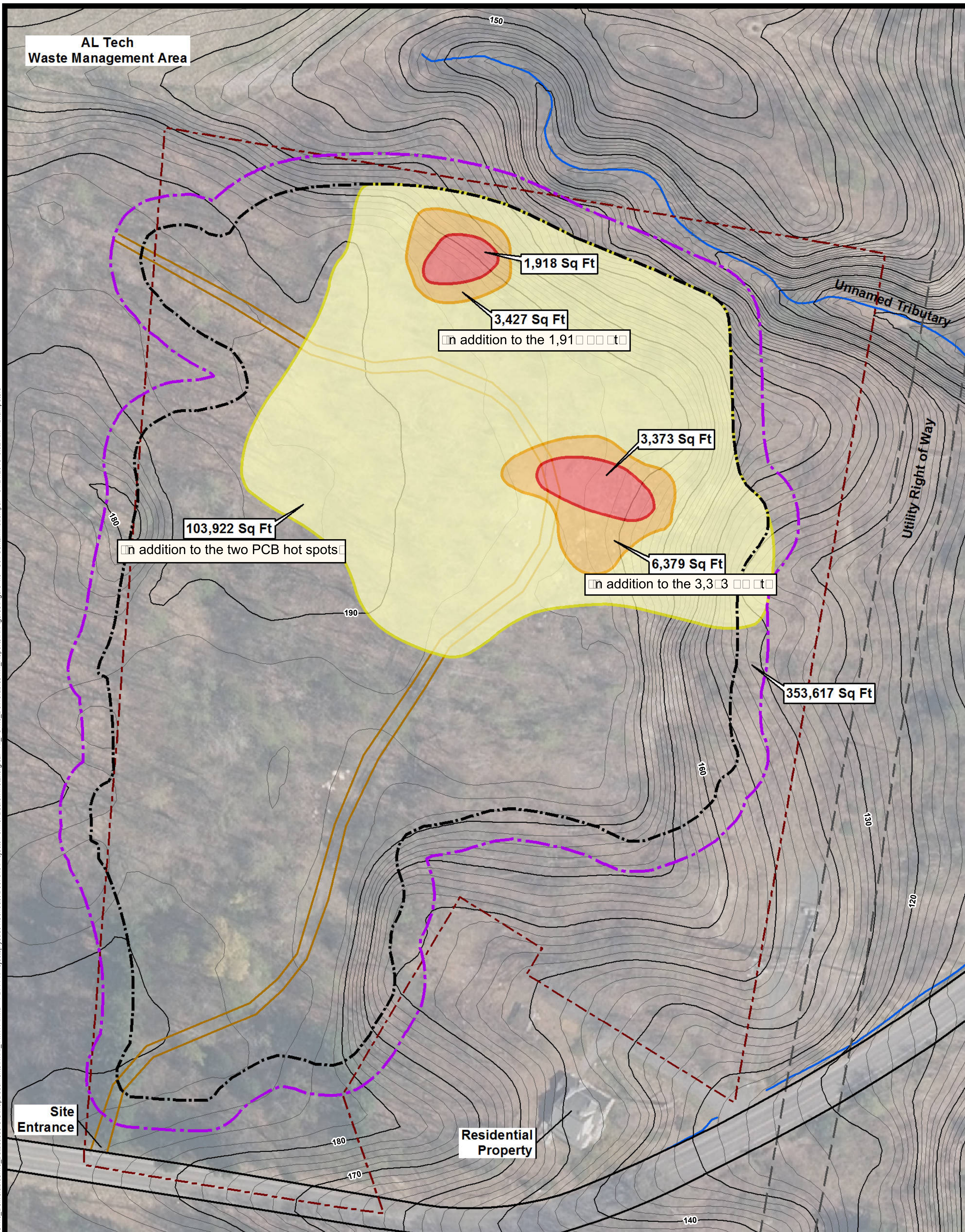
Interpreted Bedrock Groundwater Flow

Project 3611171207

Figure 2.4



Legend

Soil Contamination:

- PCBs > 1 mg/kg
- PCBs > 25 mg/kg
- PCBs > 50 mg/kg
- Estimated Extent of Contamination (PCBs and Metals)
- Approximate Limits of Waste
- Site Property Line
- Paved Road
- Dirt Road
- Utility Right of Way
- 2 Foot Contour
- 10 Foot Contour
- Stream

N

0 40 80 Feet

Soil	Estimated Volume (Cu Ft)	Estimated Volume (Cu Yd)
PCBs > 50 mg/kg	26,000	1,000
PCBs > 25 mg/kg	125,000	4,600
Extent of Contamination	1,591,000	58,900

110
90
100

Prepared/Date: BRP 01/24/18
Revised/Date: JDW 04/05/19

NYSDEC Site # 401069
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Estimated Extent of Soil Contamination

Project 3611171207

Figure 2.5

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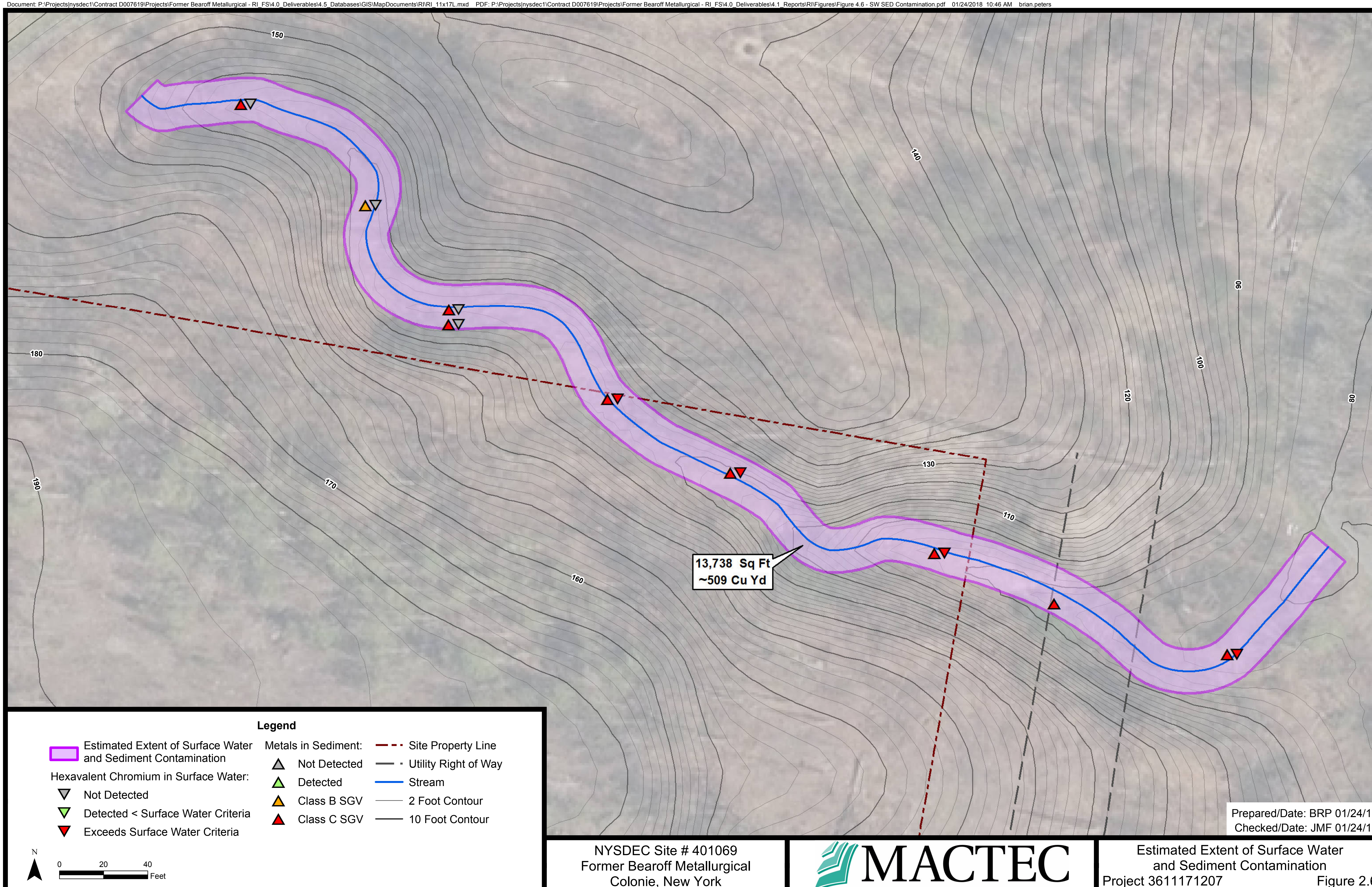

Prepared/Date: BRP 01/24/18
Checked/Date: JMF 01/24/18

NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

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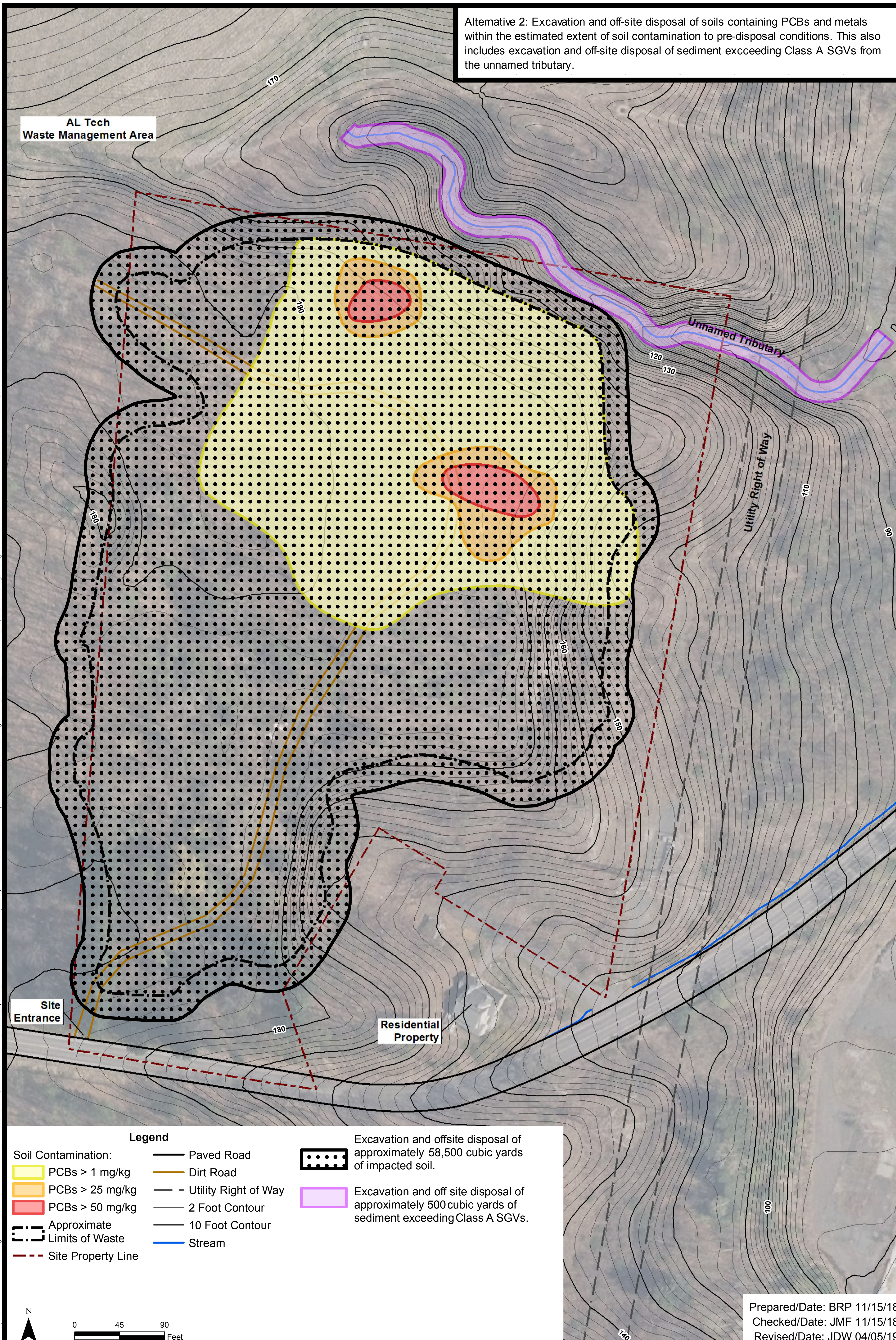
Estimated Extent of Surface Water and Sediment Contamination
Project 3611171207 Figure 2.6



NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

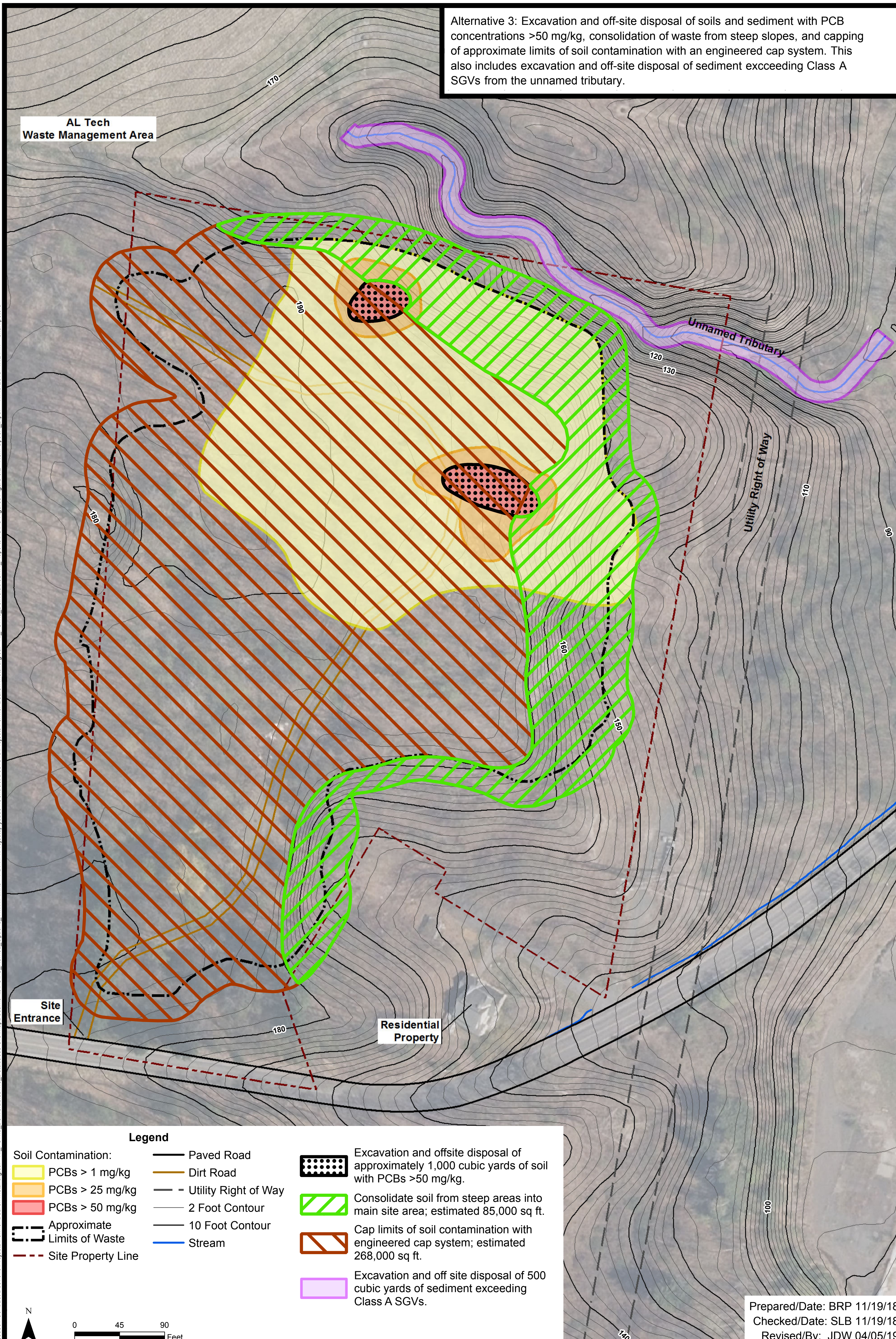
MACTEC

Remedial Alternative 2

Project 3611171207

Figure 6.1

Alternative 3: Excavation and off-site disposal of soils and sediment with PCB concentrations >50 mg/kg, consolidation of waste from steep slopes, and capping of approximate limits of soil contamination with an engineered cap system. This also includes excavation and off-site disposal of sediment excceeding Class A SGVs from the unnamed tributary.



Legend

Soil Contamination:
- PCBs > 1 mg/kg
- PCBs > 25 mg/kg
- PCBs > 50 mg/kg
- Approximate Limits of Waste
- Site Property Line
- Paved Road
- Dirt Road
- Utility Right of Way
- 2 Foot Contour
- 10 Foot Contour
- Stream
- Excavation and offsite disposal of approximately 1,000 cubic yards of soil with PCBs >50 mg/kg.
- Consolidate soil from steep areas into main site area; estimated 85,000 sq ft.
- Cap limits of soil contamination with engineered cap system; estimated 268,000 sq ft.
- Excavation and off site disposal of 500 cubic yards of sediment exceeding Class A SGVs.

N

0 45 90 Feet

Prepared/Date: BRP 11/19/18
Checked/Date: SLB 11/19/18
Revised/By: JDW 04/05/19

NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

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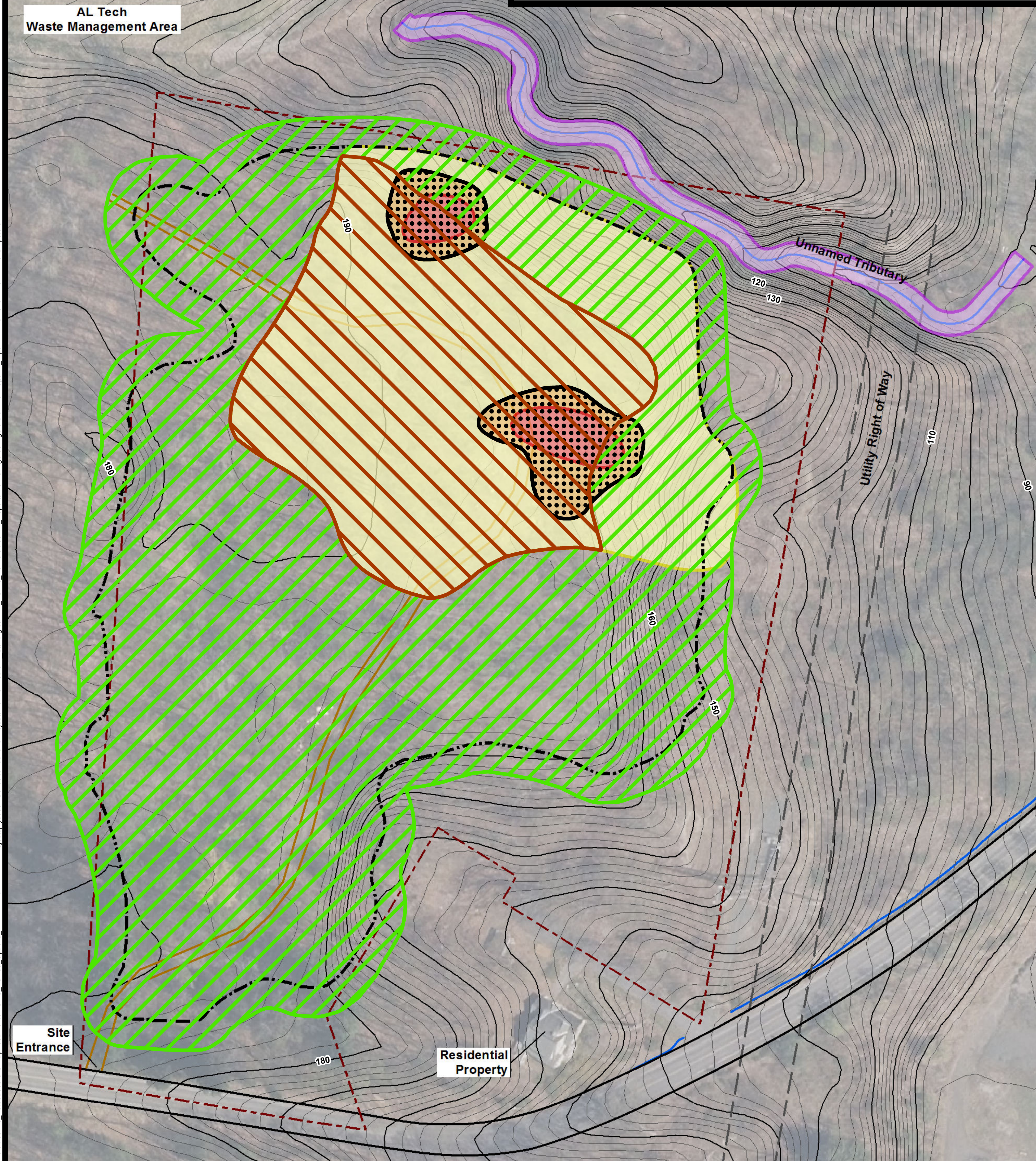
Remedial Alternative 3

Project 3611171207

Figure 6.2

Alternative 4: Excavation and off-site disposal of soils and sediment with PCB concentrations >25 mg/kg, consolidation of remaining contaminated soils over the approximate area of PCB's >1 mg/kg, and capping with an engineered cap system. This alternative also includes excavation and off-site disposal of sediment excceeding Class A SGVs from the unnamed tributary.



Legend

Soil Contamination:
- PCBs > 1 mg/kg
- PCBs > 25 mg/kg
- PCBs > 50 mg/kg
- Approximate Limits of Waste
- Site Property Line
- Paved Road
- Dirt Road
- Utility Right of Way
- 2 Foot Contour
- 10 Foot Contour
- Stream

- Excavation and offsite disposal of 1,000 cubic yards of soil with PCBs >50 mg/kg and 4,600 cubic yars of soil with PCBs >25 mg/kg.
- Consolidate soil from approximate extent of soil contamination; estimated 270,000 sq ft, to a smaller area.
- Cap consiloated area with engineered cap system; estimated 83,000 sq ft.
- Excavation and off site disposal of 500 cubic yards of sediment exceeding Class A SGVs.

N

0 45 90 Feet

Prepared/Date: BRP 11/19/18
Checked/Date: SLB 11/19/18
Revised/Date: JDW 04/05/19

NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

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Remedial Alternative 4

Project 3611171207 Figure 6.3

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TABLES

Table 5.1 Identification and Screening of Potential Remedial Technologies and Process Options

Matrix		General Response Action	Remedial Technology	Process Option	Applicability to Site-Limiting Characteristics	Applicability to Waste-Limiting Characteristics	Screening Status	Comments
PCB Hotspots - Soil	PCB contamination in soil exceeding Industrial SCO and TSCA levels	No Action	Not Applicable	Not Applicable	Not Applicable	Will not reduce toxicity, mobility, or volume of PCB contaminants.	Retained	Retained to be carried through as a baseline comparison to other alternatives.
		Institutional Controls	Land Use Restrictions	Land Use Restrictions	None	Will not reduce toxicity, mobility, or volume of PCB contamination.	Eliminated	Eliminated as a stand-alone alternative, however, institutional controls may be required in conjunction with other remedial action alternatives.
			Fencing	Fencing	None	Will not reduce toxicity, mobility, or volume of PCB contamination.	Eliminated	
		In-Situ Treatment	Biological Treatment	Enhanced Biodegradation	Much of the impacted soils are in the vadose zone which is not conducive to biological treatment.	Biological treatment of PCBs is considered an emerging technology, and case studies indicate varied effectiveness in destroying PCBs at high concentrations.	Eliminated	
			Physical Treatment	Solidification/ Stabilization	Existing landscape and presence of large debris will make stabilization/solidification difficult.	Stabilization or solidification will reduce the mobility, but will not decrease the volume or toxicity of PCB contaminants.	Eliminated	
		Containment	Capping	Soil Cover	Existing trees will need to be removed.	Will not reduce toxicity or volume of PCB contamination, but will minimize direct exposure.	Eliminated	Eliminated as a stand-alone alternative because PCB concentrations are greater than 50 mg/kg, therefore, TSCA requires disposal at a licensed facility.
				Cap System	Existing trees will need to be removed and stormwater controls will need to be implemented.	Will not reduce toxicity or volume of PCB contamination, but will minimize direct exposure and decrease mobility.	Eliminated	
		Removal	Excavation	Soil Excavation	Clearing, grubbing, and benching of excavation sidewalls will be required. Large debris will need to be segregated prior to off-site disposal.	None	Retained	Soils containing elevated concentrations (i.e., PCBs greater than 50 mg/kg) cannot be left on-site. Could be combined with other remedial action alternatives to address soils with PCB concentrations less than 50 mg/kg.

Prepared by: TNG 5/31/2018
Checked/Revised by: JDW 03/25/2019

Table 5.1 Identification and Screening of Potential Remedial Technologies and Process Options

Matrix		General Response Action	Remedial Technology	Process Option	Applicability to Site-Limiting Characteristics	Applicability to Waste-Limiting Characteristics	Screening Status	Comments
Soil	Impacted soil outside of the PCB hotspots (primarily metals)	No Action	Not Applicable	Not Applicable	Not Applicable	Will not reduce toxicity, mobility, or volume of PCB contaminants.	Retained	Retained to be carried through as a baseline comparison to other alternatives.
		Institutional Controls	Land Use Restrictions	Land Use Restrictions	None	Will not reduce toxicity, mobility, or volume of PCB contamination.	Eliminated	Eliminated as a stand-alone alternative, however, institutional controls may be required in conjunction with other remedial action alternatives.
			Fencing	Fencing	None	Will not reduce toxicity, mobility, or volume of PCB contamination.	Eliminated	
		In-Situ Treatment	Biological Treatment	Enhanced Biodegradation	Much of the impacted soils are in the vadose zone which is not conducive to biological treatment.	Not applicable to metals, and case studies indicate varied effectiveness in destroying PCBs.	Eliminated	
			Physical Treatment	Solidification/ Stabilization	The steep slopes of the existing topography and presence of large debris will make complete mixing for stabilization/solidification difficult.	Stabilization or solidification will reduce the mobility, but will not decrease the volume or toxicity of PCBs and metals in soil.	Eliminated	
			Thermal Treatment	Electrical Resistance Heating	Requires the installation and operation of an on-site treatment system. Also requires a substantial power source.	Not applicable to metals or PCB contamination.	Eliminated	
		Containment	Cover System	Soil Cover	Existing trees will need to be removed.	Will not reduce toxicity or volume of impacted soil, and will not reduce impacts from leaching to groundwater and surface water.	Eliminated	
				Cap System	Trees will need to be cleared, and impacted soil that has been pushed or sloughed over steep ridges will need to be pulled back and consolidated. Stormwater controls will need to be included.	Will prevent exposure to impacted soils and reduce mobility, however, toxicity and volume of contamination will remain the same.	Retained	
		Removal	Excavation	Soil Excavation	Clearing, grubbing, and benching of excavation sidewalls will be required; this will be challenging due to the site topography. Large debris will need to be segregated prior to off-site disposal.	None	Retained	Retained to be carried through as an alternative to meet pre-disposal conditions.

Table 5.1 Identification and Screening of Potential Remedial Technologies and Process Options

Matrix		General Response Action	Remedial Technology	Process Option	Applicability to		Screening Status	Comments
					Site-Limiting Characteristics	Waste-Limiting Characteristics		
Sediment	Sediment at bottom of the unnamed tributary	No Action	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Retained	Retained to be carried through as a baseline comparison to other alternatives.
Sediment	Sediment at bottom of the unnamed tributary	In-Situ Treatment	Physical Treatment	In-situ Solidification	Access to the unnamed tributary is difficult even with small equipment; in-situ solidification requires large rigs with augers for mixing. The impacted sediments are underlain by rock which will make mixing for solidification difficult.	Solidification of metals and PCB waste has proven to be effective in subsurface soil to prevent migration, but limited data is available regarding the effectiveness of this technology in sediments.	Eliminated	
Sediment	Sediment at bottom of the unnamed tributary	Containment	Capping	Conventional sediment capping	Access to the unnamed tributary is difficult. A properly sized capping system in the tributary will minimize available flood storage and cause erosion.	Capping will not reduce the volume or toxicity of contaminants. Due to condition of streambed, cap will likely wash away over time, exposing contaminated sediments.	Eliminated	
Sediment	Sediment at bottom of the unnamed tributary	Containment	Capping	Amended Sediment capping		Capping with amendments (e.g. AquateGate™ or AquaBlok®) will not reduce the volume or toxicity of contaminants.	Eliminated	
Sediment	Sediment at bottom of the unnamed tributary	Removal	Excavation	Dewater and/or Divert and Excavate	Access to the unnamed tributary is difficult. Roads may need to be constructed, which will require clearing and grubbing. The tributary will need to be diverted during excavation activities. Due to the rocky nature of the underlying material, vacuum excavation or hand digging may be the most appropriate method.	None	Retained	

Table 5.2: Development of Remedial Components by Media

Specific Media	Retained Remedial Technologies	Effectiveness	Implementability	Relative Cost	Retained Remedial Components
PCB Hotspots: Soils	No Action	Not effective for reducing contamination concentrations or addressing the identified exposure pathways.	No technical issues with implementing this alternative.	No associated cost.	**No Action - Retained for use as a baseline for comparison to other alternatives.**
	Excavation	Excavation will be an effective way to remove the soils containing PCBs at high concentrations (>50 mg/kg or >25 mg/kg)	This alternative could be implemented relatively easily and will involve excavation and removal of soils containing PCB concentrations greater than 50 mg/kg, which require special disposal methods. Alternatively soil with PCB concentrations greater than 25 mg/kg could be removed to meet the industrial SCG.	Relative costs are high.	**Excavation - Retained as two remedial components:** **(1) Excavation of Soil Hotspots Containing PCB Concentrations Greater than 50 mg/kg.** **(2) Excavation of Soil Hotspots Containing PCB Concentrations Greater than 25 mg/kg.**
Site Soil	No Action	Not effective for reducing contamination concentrations or addressing the identified exposure pathways.	No technical issues with implementing this alternative.	No associated cost.	**No Action - Retained for use as a baseline for comparison to other alternatives.**
	Institutional Controls (including site security and environmental monitoring)	Not effective for reducing contamination concentrations or migration but could be effective in protecting identified exposure pathways.	No significant technical issues with implementing this alternative.	Relative costs are low.	**Retained for use in conjunction with other alternatives.**
	Soil Cover System	This alternative is effective in minimizing direct contact with impacted soils.	This alternative is considered medium to have a difficult degree of implementability. It will require clearing and grubbing, and consolidating soil that has spilled over steep ridges.	Relative cost will be medium to high	**Soil Cover System - Retained as two potential remedial components:** **(1) Cover in place (minimal soil movement/relocation prior to placing soil cover).** **(2) Consolidate impacted soils within a smaller footprint prior to placing a soil cover.**

Prepared by: JDW 5/31/2018
Reviewed by: JMF 11/15/2018
Revised by: JDW 03/25/2019

Table 5.2: Development of Remedial Components by Media

Specific Media	Retained Remedial Technologies	Effectiveness	Implementability	Relative Cost	Retained Remedial Components
Site Soil	Impervious Cover System	This alternative is effective in minimizing direct contact with impacted soils, and will reduce mobility by minimizing stormwater from leaching through the impacted soil prior to discharge to the unnamed tributary.	This alternative is considered to have a medium to hard degree of implementability. It will require clearing and grubbing and consolidating soil that has spilled over steep ridges.	Relative cost will be medium to high	**Impervious Cover - Retained as two potential remedial components:** **(1) Cover in place (minimal soil movement/relocation prior to placing impermeable cover).** **(2) Consolidate impacted soils within a smaller impermeable footprint.**
	Excavation	Excavation is an effective way to remove contaminated soil which is a continuing source to downgradient groundwater contamination. Although not economically feasible due to the amount of impacted soils on-Site, complete removal to pre-disposal conditions will be considered for an order of magnitude cost comparison.	This alternative is considered difficult with regards to implementability. Sheet pile walls will be required due to depth of the required excavation. Excavation dewatering and treatment of water prior to discharge will also be required. Large pieces of debris will need to be segregated from soil prior to disposal.	Relative costs for this alternative are high. The primary items contributing to cost include sheet-pile installation, soil excavation, excavation dewatering, transportation and disposal of contaminated soil, backfilling, compaction and grading. High costs of this remedy are driven by the overall quantity of material requiring excavation.	**Excavation - Retained**
Sediment	No Action	Not effective for reducing contamination concentrations or addressing the identified exposure pathways.	No technical issues with implementing this alternative.	No associated cost.	**No Action - Retained** **For use as a baseline for comparison to other alternatives.**
	Excavation	Excavation is an effective way to remove contamination from the unnamed tributary. Removing all the contaminated sediment should not be difficult, as bedrock is only 0.5-1.5 feet below the bed of the tributary.	There will be some technical difficulties with implementing this alternative. A system will be required to dewater the area to be excavated and upgradient flow of the unnamed tributary entering the excavation area will need to be redirected during the work. Excavated sediment will need to be dried or solidified prior to transportation and disposal. Access to the tributary is difficult due to site topography, so access routes will have to be created.	Cost for this alternative will be medium to high. Excavating the tributary itself may be conducted with hand tools or vacuum excavation because bedrock is near the surface, but accessing the tributary for excavation will require additional infrastructure, which could be expensive.	**Excavation - Retained**

Prepared by: JDW 5/31/2018
Reviewed by: JMF 11/15/2018
Revised by: JDW 03/25/2019

Table 7.1: Detailed Analysis and Comparison of Remedial Alternatives

Remedial Alternative	Breakdown of Remedy Components[1]	Compliance with Standards, Criteria and Guidance[2] (Meets / Partially Meets / Does Not Meet)	Overall Protection of Public Health and the Environment (Is / Partially / Is Not Protective)	Short-term Impacts[3] (Will / Will Not Result)	Short-term Effectiveness[3] (Not/ Partially/ Effective)	Long-term Effectiveness and Permanence (Not/ Partially /Effective)	Reduction of Toxicity, Mobility, or Volume with Treatment (Will Not / Will Partially / Will Reduce)	Implementability (No / Some Technical Difficulties)	Land Use (Compatible / Not Compatible)	Sustainability / Green Remediation (DER-31) (High / Medium / Low Compliance)	Cost (Numerically Ranked, 1=Lowest cost)
Alternative 1	**No Action for all site media**	Does not meet	Not Protective	Will not result	Not effective	Not effective or permanent	Will not reduce	No technical difficulties	Not compatible	High	1: There are no costs associated with this alternative.
Alternative 2	**Soil: Excavated all impacted site soil to predisposal conditions.**	Meets	Protective	Will result	Effective	Effective	Will reduce	Some technical difficulties	Compatible	Low	5
	Sediment: Sediment excavation with off-site disposal.	Meets	Protective	Will result	Effective	Effective	Will reduce	Some technical difficulties	Compatible	Low	
Alternative 3	**Soil: Excavate PCB hotspots >50 ppm and place an impermeable cover over the remaining impacted areas.**	Partially Meets	Protective	Will result	Partially effective	Partially effective	Will partially reduce	Some technical difficulties	Somewhat Compatible	Medium	2
	Sediment: Sediment excavation with off-site disposal.	Meets	Protective	Will result	Effective	Effective	Will reduce	Some technical difficulties	Compatible	Low	
Alternative 4	**Soil: Excavate PCB hotspots >25 ppm. Consolidate and place an impermeable cover over and around the remaining impacted areas.**	Meets	Protective	Will result	Effective	Partially effective	Will partially reduce	Some technical difficulties	Compatible	Medium	3
	Sediment: Sediment excavation with off-site disposal.	Meets	Protective	Will result	Effective	Effective	Will reduce	Some technical difficulties	Compatible	Low	

Notes:

(1) Remedial action components are broken down by media. Components associated with sediment are for the unnamed tributary.

(2) In alternatives where standards, criteria, and guidance values (SCGs) will not be met, contamination in excess of SCG values will remain onsite, leading to potential adverse human health and environmental impacts. It is possible that SCGs may be met at some time in the future due to natural attenuation processes.

(3) Adverse short-term impacts and health risks will be managed using temporary controls to prepare the Site for remedial action implementation, including but not limited to installation of an equipment decontamination area, implementation of erosion and sediment control measures, and the placement of temporary fencing around work areas. Implementation will also include preparation of and adherence to a construction work plan and a health and safety plan.

Color indicates relative ranking of the remedial option based on the evaluation criteria. Green indicates the most desirable result , orange indicates an somewhat less desirable result and pink indicates an negative result for the evaluation criteria.

Prepared by: SLB 11/13/2018
Checked/Revised by: JDW 3/15/19
Revised by: NWV 1/23/20

Table 7.2: Applicable Location- and Action-Specific Standards, Criteria, and Guidance

Requirement	Consideration in the Remedial Response Process
NYSDEC Division of Fish, Wildlife and Marine Resources - Freshwater Sediment Guidance Values (June 2014)	May be applicable due to the impacted sediment in the unnamed tributary.
NYSDEC / Corps of Engineers Joint Permit for activities affecting streams, waterways, waterbodies, Wetlands, coastal areas, sources of water, and engangered and threatened species.	May be applicable for remediation work in the unnamed tributary.
29 CFR Part 1910.120 - Hazardous Waste Operations and Emergency Response	Applicable to Health and Safety implementation, enforcement, and emergency response.
6 NYCRR Part 371 - Identification and Listing of Hazardous Wastes (November 1998)	Applicable to the characterization, handling, transportation, and treatment/disposal of investigative derived waste and other soils/liquids generated that require removal from the Site.
6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities (November 1998)	Applicable to the handling, transportation, and treatment/disposal of investigative derived waste and other soils/liquids generated that require removal from the Site as hazardous wastes.
6 NYCRR Part 375 - Environmental Remediation Programs (as amended December 2006)	Applicable to the development and implementation of remedial programs.
6 NYCRR Part 376 - Land Disposal Restrictions	Applicable to disposal of hazardous wastes. Identifies those wastes that are restricted from land disposal.
6 NYCRR Parts 700-706 - Water Quality Standards (June 1998)	Applicable to construction in and adjacent to the unnamed tributary and any for dewatering effluent discharges to surface water.
6 NYCRR Part 750 through 758 - Implementation of NPDES Program in NYS ("SPDES Regulations")	Applicable to excavation dewatering, treatment and assocciated surface water discharge.
DER-10 Technical Guidance for Site Investigation and Remediation	Applicable to the development and implementation of remedial programs.
Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guidebook (June 1998)	Applicable to the development and implementation of remedial programs.
DER-31 - Green Remediation (August 2010)	Applicable to the development and implementation of remedial programs.
TSCA Regulation 40 CFR Part 761	Applicable for handling and disposal of PCB-contaminated materials.
USEPA 40 CFR Part 261	Applicable for handling and disposal of PCB-contaminated materials.
Solidification/Stabilization and its Application to Waste Materials	May be applicable to sediment from the unnamed tributtary if solidication is required prior to disposal.

Prepared by: JDW 07/30/2018
Checked by: JMF 11/15/2018

Table 7.3
Summary of Estimated Remedial Alternative Costs

Item	Description	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1	Capital Costs	$ -	$ 17,900,000	$ 5,010,000	$ 9,520,000
2	Average Annual Cost (Present Worth)	$ -	$ -	$ 13,200	$ 13,200
2	Present Worth of Annual and Periodic Costs	$ -	$ -	$ 395,000	$ 395,000
3	Total Present Worth (Item 1 plus item 2)	$ -	$ 17,900,000	$ 5,410,000	$ 9,920,000
4	Total Non-Discounted Cost	$ -	$ 17,900,000	$ 5,650,000	$ 10,200,000

Notes:
Costs have been rounded to three significant figures compared to the summary tables for each alternative
Alternative 1: No Action
Alternative 2: Site-Wide Excavation to Pre-Disposal Conditions
Alternative 3: Site-Wide Cap System with Excavation and Off-Site Disposal of PCB Hotspots Exceeding 50 mg/kg and Sediments
Alternative 4: Consolidated Cap System with Excavation and Off-Site Disposal of PCB Hotspots Exceeding 25 mg/kg

Prepared by: JDW 04/05/2019
Checked by: MJS 04/09/2019

Table 7.4: Cost Summary for Alternative 2
Site-Wide Excavation to Pre-Disposal Conditions

Item No.	Item Description		COST
DIRECT CAPITAL COSTS			
2	Pre-Design for Site-Wide Soils (Excavation)	$	151,000
8	Mobilization, Site Preparation and De-Mobilization	$	321,000
11	Site-Wide Excavation to Pre-Disposal Conditions	$	12,196,000
17	Sediment Excavation and Off-Site Disposal	$	410,000
	Direct Cost Subtotal	$	13,078,000
INDIRECT CAPITAL COSTS			
	Project Management (@ 5 Percent)	$	654,000
	Remedial Design (@ 6 Percent)	$	785,000
	Construction Management (@ 6 Percent)	$	785,000
	Contingency (@ 20 Percent)	$	2,616,000
	Indirect Cost Subtotal	$	4,840,000
TOTAL CAPITAL COSTS		**$**	**17,918,000**
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$**	**-**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$**	**17,918,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$**	**17,918,000**

NOTES:
Costs have been rounded to the nearest thousand.

Prepared by: JDW 04/05/2019
Checked by: MJS 04/09/2019

Table 7.5: Cost Summary for Alternative 3
Site-Wide Cap System with Excavation and Off-Site Disposal of PCB Hotspots Exceeding 50 mg/kg and Sediments Exceeding Class A SGVs

Item No.	Item Description	COST
DIRECT CAPITAL COSTS		
1	Pre-Design for Site-Wide Cover System	$ 57,000
7	Mobilization, Site Preparation and Demobilization	$ 279,000
9.3	Install Impermable Cover System - Minimal Consolidation of Waste	$ 2,334,000
12	PCB Hot Spot Removal 50 PPM or Greater	$ 524,000
17	Unnamed Tributary Sediment Removal	$ 410,000
	Direct Cost Subtotal	$ 3,604,000
INDIRECT CAPITAL COSTS		
	Project Management (@ 5 Percent)	$ 181,000
	Remedial Design (@ 8 Percent)	$ 288,000
	Construction Management (@ 6 Percent)	$ 216,000
	Contingency (@ 20 Percent)	$ 721,000
	Indirect Cost Subtotal	$ 1,406,000
TOTAL CAPITAL COSTS		**$ 5,010,000**
Long-Term Annual Costs*		
22	Periodic Institutional Control Inspections and Reporting (Years 1 through 30)	$ 9,000
22.1	Cap Mowing	$ 5,000
21.1	Long-Term Monitoring & Reporting (Years 1 through 5)	$ 13,000
21.2	Long-Term Monitoring & Reporting (Years 6 through 30)	$ 6,000
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$ 395,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$ 5,405,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$ 5,645,000**

NOTES:
Costs have been rounded to the nearest thousand.
* - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs assume annual inspection and reporting.

Prepared by: JDW 04/05/2019
Checked by: MJS 04/09/2019

Table 7.6: Cost Summary for Alternative 4
Consolidated Cap System with Excavation and Off-Site Disposal of PCB Hotspots Exceeding 25 mg/kg

Item No.	Item Description	COST
DIRECT CAPITAL COSTS		
1	Pre-Design for Consolidated Cover System	$ 57,000
7	Mobilization, Site Preparation and Demobilization	$ 279,000
9.4	Consolidate and Install Impermeable Cap Installation	$ 4,426,000
13	PCB Hot Spot Removal 25 PPM or Greater	$ 1,680,000
17	OU-4 Sediment Off-Site Disposal	$ 410,000
	Direct Cost Subtotal	$ 6,852,000
INDIRECT CAPITAL COSTS		
	Project Management (@ 5 Percent)	$ 343,000
	Remedial Design (@ 8 Percent)	$ 548,000
	Construction Management (@ 6 Percent)	$ 411,000
	Contingency (@ 20 Percent)	$ 1,370,000
	Indirect Cost Subtotal	$ 2,672,000
TOTAL CAPITAL COSTS		**$ 9,524,000**
Long-Term Annual Costs*		
22	Periodic Institutional Control Inspections and Reporting (Years 1 through 30)	$ 9,000
21.1	Long-Term Monitoring & Reporting (Years 1 through 5)	$ 13,000
21.2	Long-Term Monitoring & Reporting (Years 6 through 30)	$ 6,000
22.1	Cap Mowing	$ 5,000
PRESENT WORTH OF ANNUAL AND PERIODIC COSTS (30 yrs)		**$ 395,000**
TOTAL PRESENT WORTH OF ALTERNATIVE (30 yrs)		**$ 9,919,000**
TOTAL NON-DISCOUNTED COST OF ALTERNATIVE (30 yrs)		**$ 10,159,000**

NOTES:
Costs have been rounded to the nearest thousand.
* - Costs include additional 10 percent for technical support and 25 percent contingency for unforeseen project complexities, including insurance, taxes, and licensing costs. Costs assume annual inspection and reporting.

Prepared by: JDW 04/05/2019
Checked by: MJS 04/09/2019

APPENDICES

APPENDIX A

GEOLOGIC CROSS SECTIONS

SURVEYOR'S DESCRIPTION

ALL THAT TRACT OR PARCEL OF LAND, situate in the Town of Colonie, County of Albany and State of New York more particularly described as follows:

BEGINNING at a point on the existing centerline of Spring Street Road at its intersection with the division line between the lands now or formerly of Lewis Growick (Bk.3057 Pg.76) on the east and the lands now or formerly of REALCO Inc. (Bk.2639 Pg.66) on the west, said point being South 81°57' East a distance of 1748± feet from the centerline intersection of Spring Street Road and E. Hills Boulevard;

Thence along said division line the following two (2) courses and distances:

1) North 04° 28' 54" East, passing through a found 1" iron pipe at 24.85 feet and a found angle iron at 644.65 feet, a total distance of 859.30 feet to a point;
2) South 80° 03' 56" East, passing through a found 1" iron pipe at 375.98 feet and 545.63 feet a total distance of 603.21 feet to a point at its intersection with the westerly boundary of the lands now or formerly of Niagara Mohawk Corporation (Bk.1303 Pg.263);

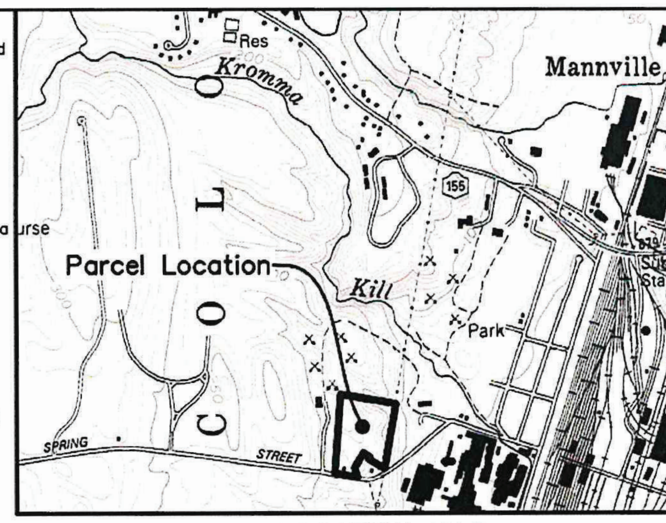
Thence South 10° 05' 27" East along the division line between the herein described parcel on the west and the said lands now or formerly of Niagara Mohawk Corporation (Bk.1303 Page 263) on the east, a distance of 712.12 feet to a point;

Thence along the division line between the herein described parcel on the north and the lands now or formerly of Mark Toren (Bk.2758 Pg.336) on the south the following five (5) courses and distances:

1) North 58° 15' 29" West along the center of a proposed street, a distance of 201.12 feet to a point;
2) North 30° 39' 44" East through said proposed street, a distance of 25.00 feet to a point, said point being 10.83 feet southwesterly from a found 1" iron pin;
3) North 58° 15' 29" West along the northerly side of said proposed street, passing through a found 1" iron pin at 9.90 feet, a total distance of 80.00 feet to a found 1" iron pipe;
4) South 30° 39' 44" West, a distance of 189.41 feet to a found 1" iron pipe;
5) South 18° 56' 44" East, a distance of 103.81 feet to a point on the existing centerline of Spring Street Road;

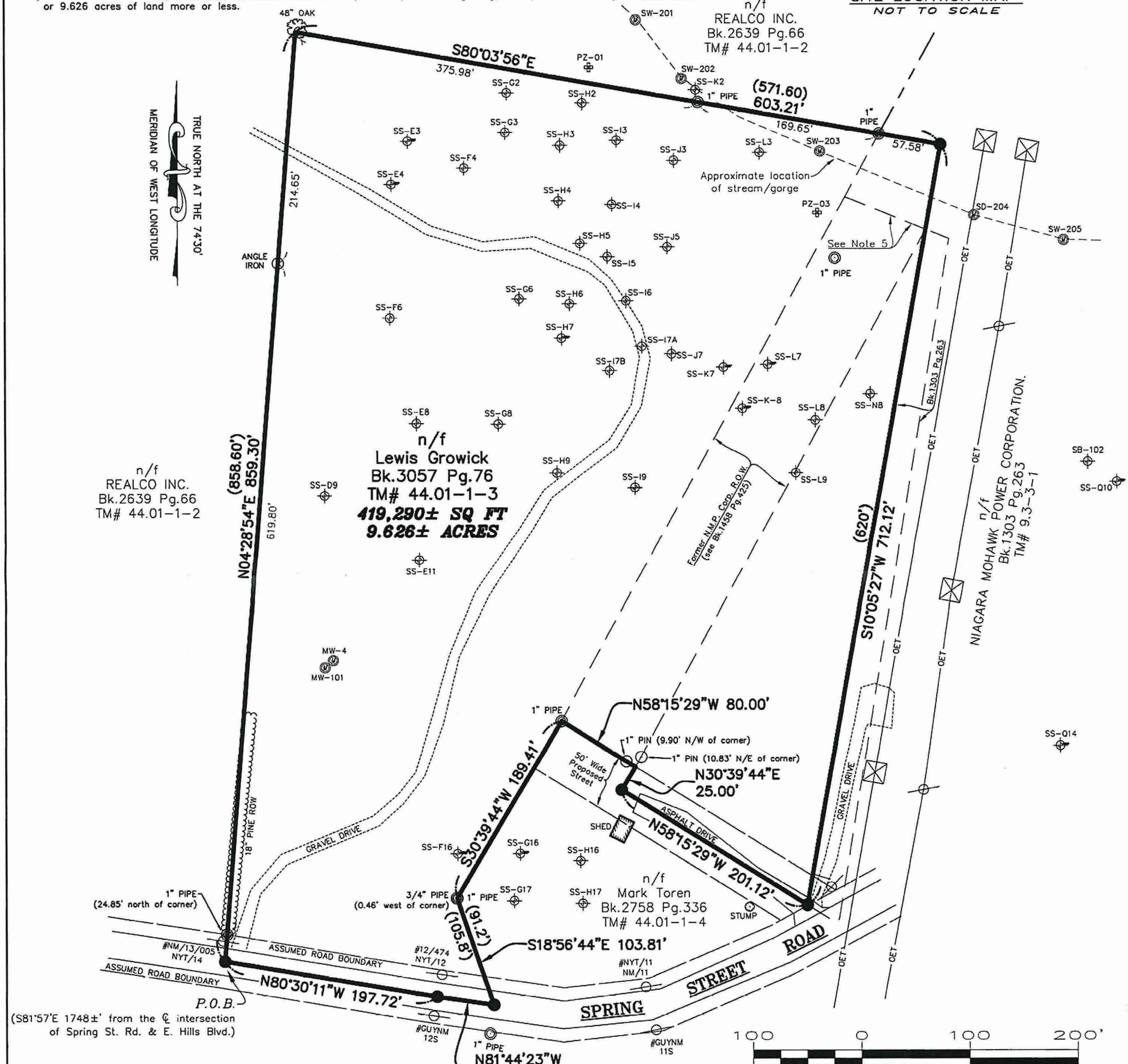
Thence along said existing centerline of Spring Street Road the Following two (2) courses and distances:

1) North 81° 44' 23" West, a distance of 52.87 feet to a point;
2) North 80° 30' 11" West, a distance of 197.72 feet to the point or place of beginning, said parcel containing 419,290 square feet or 9.626 acres of land more or less.



SITE LOCATION MAP

NOT TO SCALE



Legend

- SUBJECT PROPERTY
- PROPERTY LINE
- COMPUTED POINT (NOT SET)
- 1" PIN — IRON FOUND (TYPE & SIZE AS NOTED)
- 1" PIPE — PIPE FOUND (TYPE & SIZE AS NOTED)
- OET — OVERHEAD UTILITY LINE
- NYT/12 — UTILITY POLE
- MW-101 — MONITORING WELL
- SS-10 — BORING
- PZ-02 — SAMPLE LOCATION
- UTILITY TOWER

Notes

1. PREMISES SOURCE OF TITLE:
   a. Lands conveyed by David J. Friedfel, as Commisioner of the Albany County Department of Management and Budget (Grantor) to Lewis Growick (Grantee) by a deed dated January 17th 2013 and filed in the Albany County Clerk's office on January 25th 2013 in book 3057 of deeds at page 76.
2. The location of the utility lines if shown is pursuant to information supplied by others. There is no guarantee that all existing utilities, whether functional or abandoned within the project area are shown on this drawing.
3. Horizontal datum is referenced to the New York State Plane Coordinate System (NYSPCS) East Zone NAD 83.
4. This survey was prepared without the benefit of an abstract of title and is subject to any additional facts an up to date abstract may disclose.
5. Property line per Niagara Mohawk Power Corporation deeds and maps recorded in the Albany County Clerk's Office at book 1303 of deeds at page 263 and book 1458 of deeds at page 425.
6) No existing wetland mapping found for the subject parcel of property based on information obtained through the U.S. Fish and Wildlife Service's national wetlands inventory and the New York State Department of Environmental Conservation agencies fresh water wetlands obtained through the Cornell University Geospatial Information Repository (CUGIR).

I HEREBY CERTIFY TO:

1) The People of the State of New York acting through its commissioner of the Department of Environmental Conservation

"Certifications indicated hereon signify that this survey was prepared in accordance with the existing code of practice for land surveys adopted by the New York State Association of Professional Land Surveyors. Said certifications shall run only to the person for whom the survey is prepared, and on their behalf to the title company, governmental agency, lending institution listed hereon, and to the assignees, of the lending institution. Certifications are not transferable to additional institutions or subsequent owners"

STATE OF NEW YORK · AMMON A. BUSH · 050344 · LICENSED LAND SURVEYOR

DATE: 12/11/17

AMMON A. BUSH, LAND SURVEYOR
LS NO. 050344

SHEET NO. 1 of 1

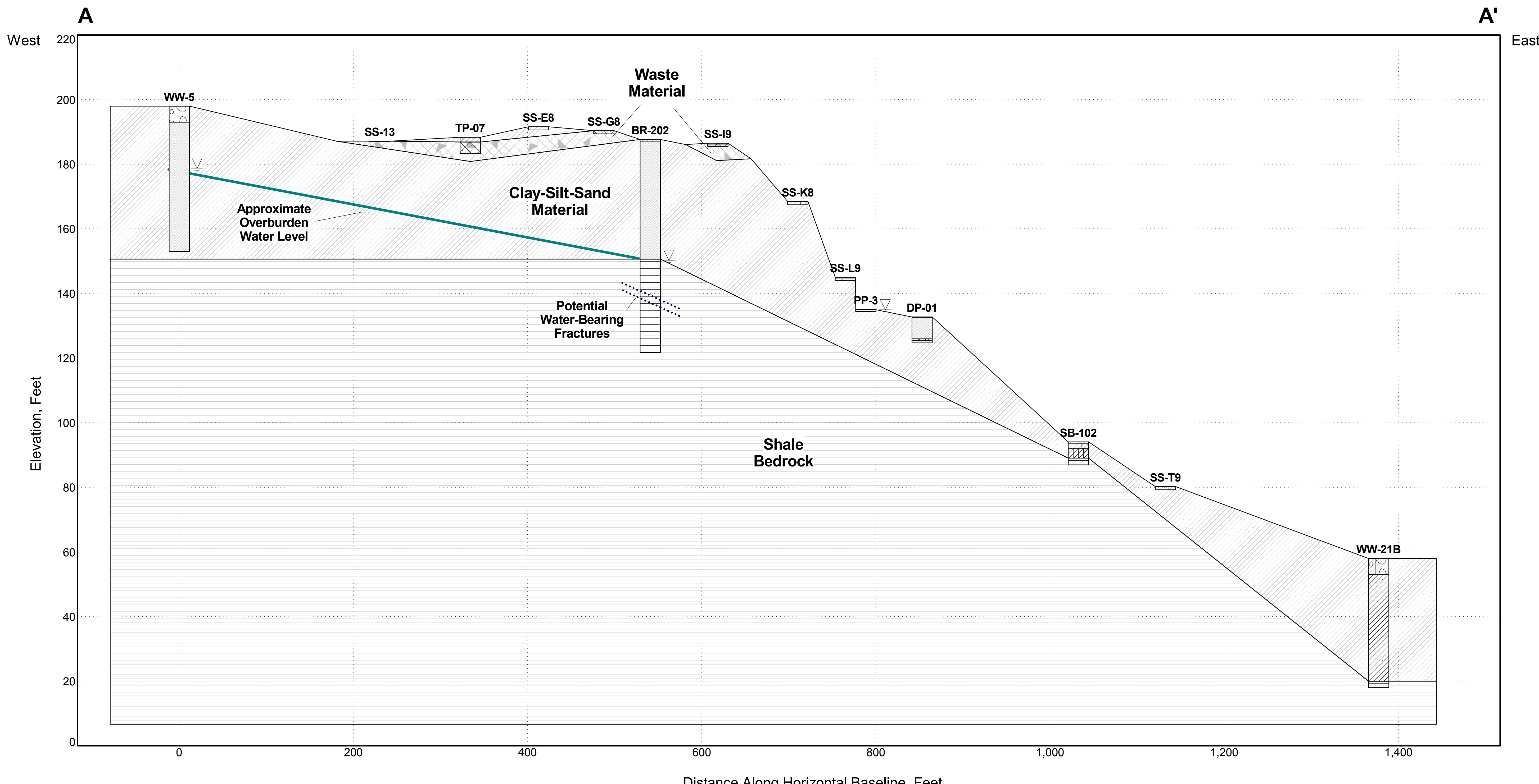
Boundary Survey
Lands of
Lewis Growick
located at
152 Spring Street Road
Town of Colonie, Albany Co., NY

		NO.	REMARKS	DATE
SURVEY COMPLETED:	9/15/2017	6		
MAP COMPLETED:	10/27/2017	5		
DRAWN BY:	MST	4		
CHECKED BY:	TRM	3		
SCE PROJECT NUMBER:	15152.03	2		
SCALE:	1" = 100'	1	Additional Boring Locations	12/7/17
DRAWING. NAME:	1515203_Bdy_A.dwg	NO.	REMARKS	DATE

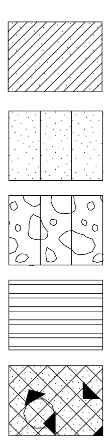
SHUMAKER
CONSULTING ENGINEERING & LAND SURVEYING D.P.C.
143 COURT STREET, BINGHAMTON, NY 13901
PHONE 607-798-8081

APPENDIX B

HYDRAULIC CONDUCTIVITY RESULTS



LEGEND:



CL CLAY OR CLAY-LIKE MATERIAL, SILTY CLAY OR SANDY CLAY

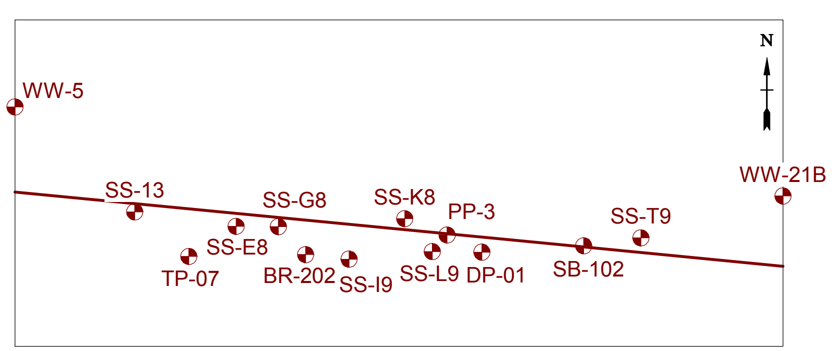
SM SAND, SILTY SAND, SAND-SILT MIXTURES

GM GRAVEL, SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES

BR SHALE BEDROCK

WF WASTE FILL

SITE MAP:



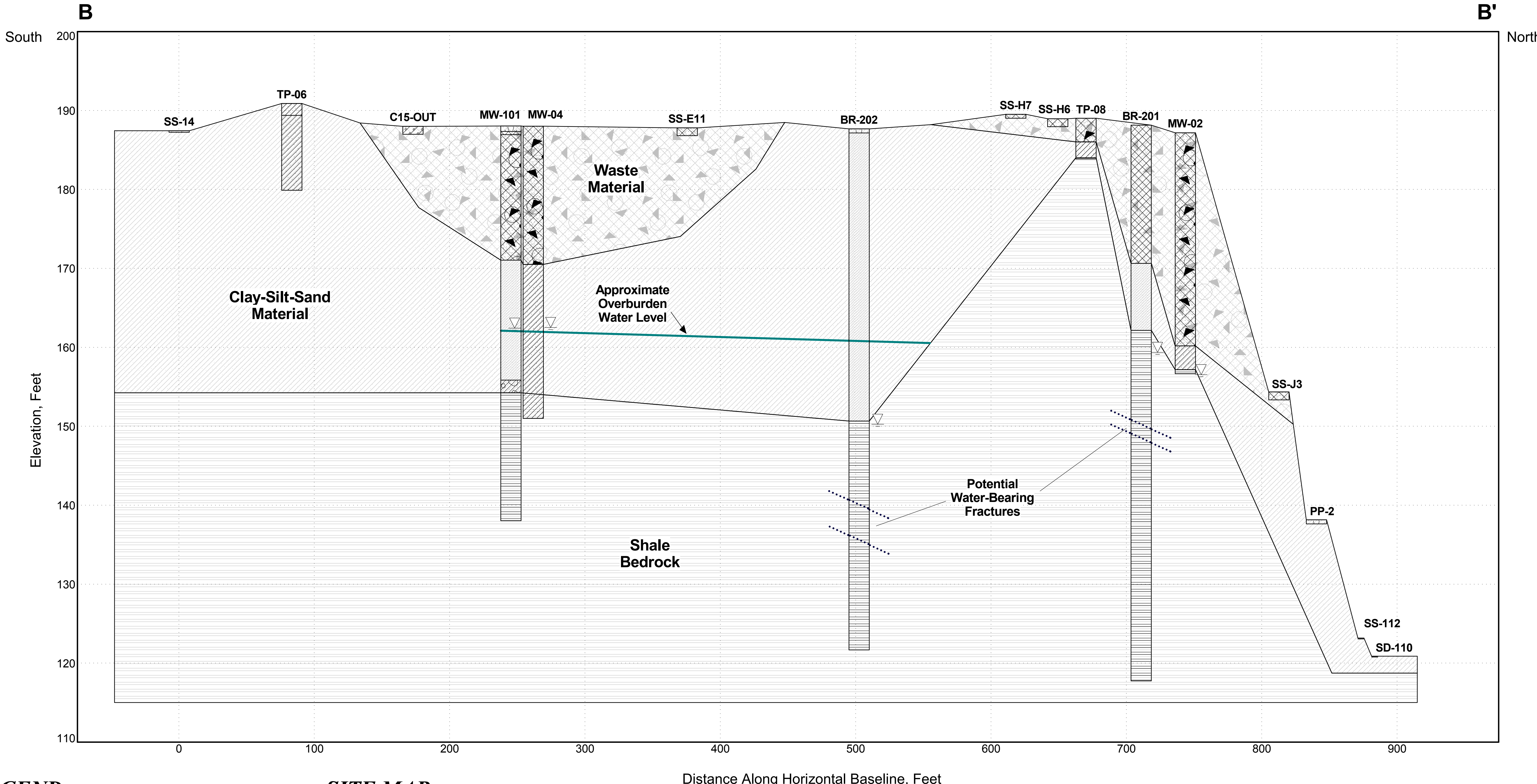
THIS PROFILE IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Prepared/Date By: KSavage 12/3/18
Checked/Date By: NVogan 12/4/18

SUBSURFACE PROFILE

PROJECT:	Former Bearoff RIFS
PROJECT No.:	3611171207
SECTION:	A - A'
FIGURE:	A4.2

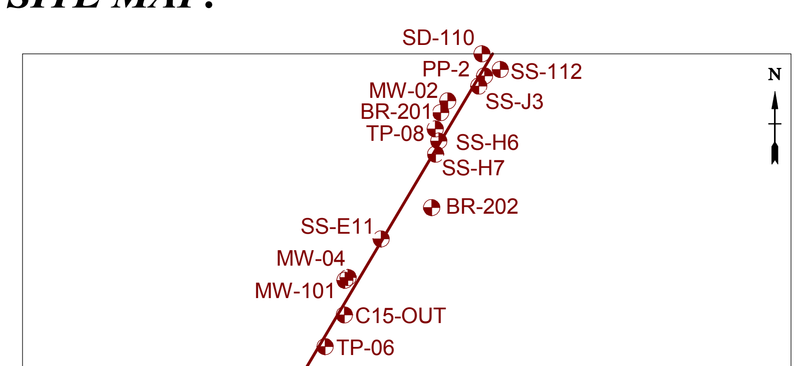
MACTEC Engineering & Consulting, PC



LEGEND:

CL	CLAY OR CLAY-LIKE MATERIAL, SILTY CLAY OR SANDY CLAY
SM	SAND, SILTY SAND, SAND-SILT MIXTURES
GM	GRAVEL, SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
BR	SHALE BEDROCK
WF	WASTE FILL

SITE MAP:



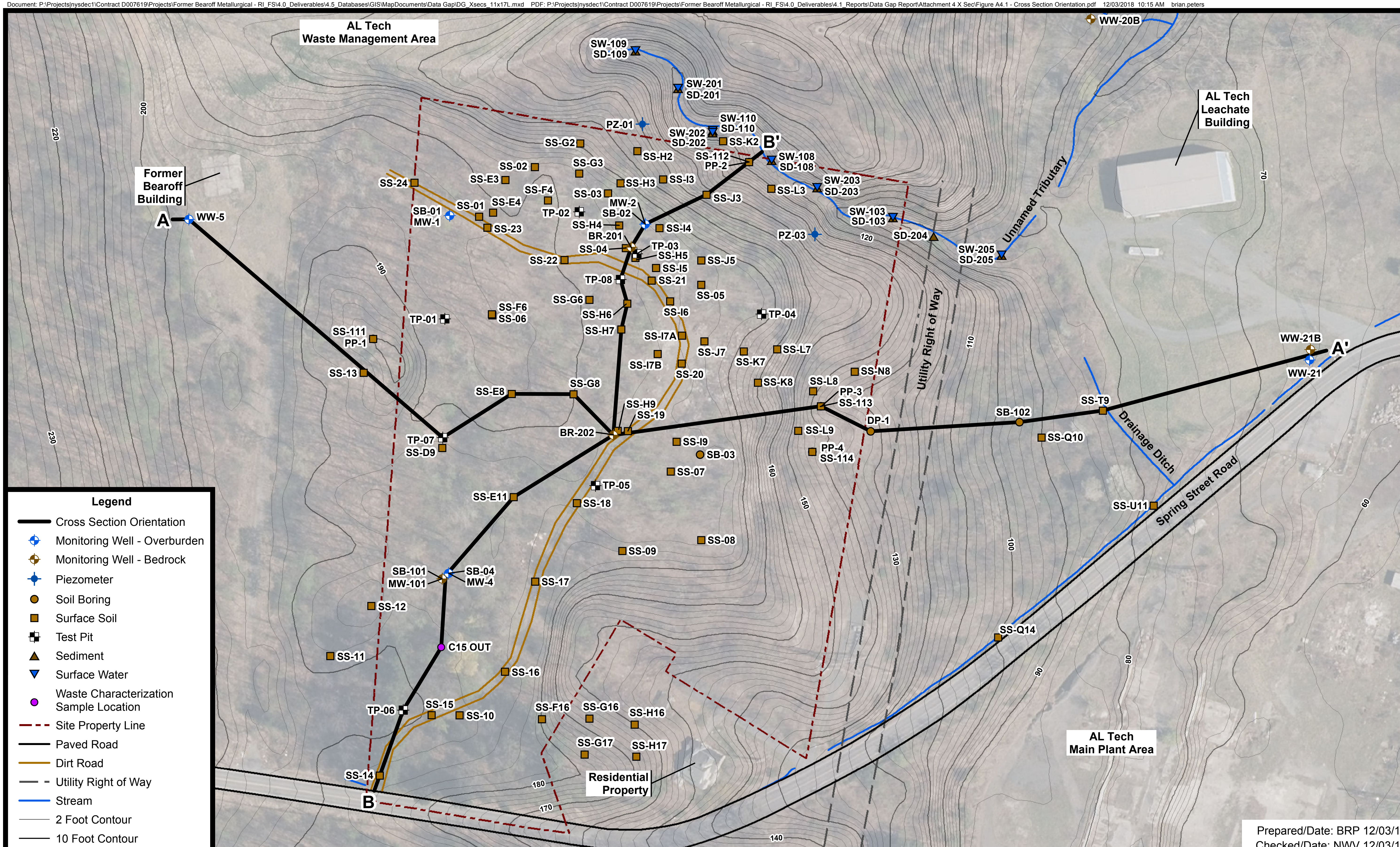
THIS PROFILE IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATIONS. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Prepared/Date By: KSavage 12/3/18
Checked/Date By: NVogan 12/4/18

SUBSURFACE PROFILE

PROJECT: Former Bearoff RIFS
PROJECT No.: 3611171207
SECTION: B - B'
FIGURE: A4.3

MACTEC Engineering & Consulting, PC



N
0 55 110 Feet

Albany County color digital orthoimagery (2014) obtained from New York State GIS Clearinghouse at: http://www.nysgis.state.ny.us

NYSDEC Site # 401069
Former Bearoff Metallurgical
Colonie, New York

MACTEC

Cross Section Orientation

Project 3611171207

Figure A4.1

APPENDIX C

DETAILED COST ANALYSIS BACKUP

Appendix C
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
		PRE-DESIGN / PILOT TESTING FOR ALL ALTERNATIVES					
1	*Alt. 3, 4*	***Pre-Design Investigation for Site-Wide Cover System***				***$ 57,000***	
		Topographical Survey					
		Two People, 10 Days	5	Days	$ 3,000.00	$ 15,000	Includes 10 hrs each person per day, per diem, surveying equipment
		Soil Sampling (Geotech for excavation support, delineation, disposal paramaters)					
		Drill Rig mob/demob	1	LS	$ 1,000.00	$ 1,000	
		Drill Rig & Crew (Drive/Wash)	1	Week	$ 15,000.00	$ 15,000	Drive & Wash Crew for the Geotech Samples , some Enviro samples can also be collected.
		Field Technician	15	Days	$ 1,000.00	$ 15,000	One for one week, then 2 for one week. Total of 15 days.
		Sampling Equipment	2	Weeks	$ 200.00	$ 400	
		Soil Analysis - Geotechnical	10	Each	$ 500.00	$ 5,000	
		Soil Analysis Delineation (Metals / PCBs)	20	Each	$ 80.00	$ 1,600	
		Drill Waste Disposal	20	Tons	$ 200.00	$ 4,000	includes roll-off rental
2	*Alt. 2*	***Pre-Design Investigation for Site-Wide Soil Excavation***				***$ 150,525***	
		Topographical Survey					
		Two People, 10 Days	5	Days	$ 3,000.00	$ 15,000	Includes 10 hrs each person per day, per diem, surveying equipment
		Soil Sampling (Geotech for excavation support, delineation, disposal paramaters)					
		Drill Rig mob/demob	1	LS	$ 1,000.00	$ 1,000	
		Drill Rig & Crew (Drive/Wash)	1	Week	$ 15,000.00	$ 15,000	Drive & Wash Crew for the Geotech Samples, some Enviro samples can also be collected.
		Geoprobe mob/demob	1	LS	$ 525.00	$ 525	
		Geoprobe Rig & Crew	3	Weeks	$ 9,000.00	$ 27,000	One Geoprobe Rig for 3 weeks for delineation and disposal sampling
		Field Technician	25	Days	$ 1,000.00	$ 25,000	One for one week, then 2 for 2 weeks. Total of 25 days.
		Sampling Equipment	3	Weeks	$ 200.00	$ 600	
		Soil Analysis - Geotechnical	20	Each	$ 500.00	$ 10,000	
		Soil Analysis Delineation (Metals / PCBs)	40	Each	$ 80.00	$ 3,200	
		Soil Analysis Precharacterization	59	Each	$ 800.00	$ 47,200	One composite sample for every 1,000 CY to be disposed.
		Drill Waste Disposal	30	Tons	$ 200.00	$ 6,000	includes roll-off rental
		FULL SCALE IMPLEMENTATION FOR ALL ALTERNATIVES					
7	*Alt. 3, 4*	***Mobilization / Site Prep***				***$ 278,404***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 7,500.00	$ 7,500	
		Health & Safety Plan	1	LS	$ 5,000.00	$ 5,000	
		QA/QC Plan	1	LS	$ 5,000.00	$ 5,000	
		As-Built Survey	1	LS	$ 6,000.00	$ 6,000	Labor plus equipment
		Equipment Mobilization/Demobilization	1	LS	$ 15,000.00	$ 15,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	8	MO	$ 2,000.00	$ 16,000	
		Portable Toilets	8	MO	$ 360.00	$ 2,880	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Silt Fence 3 ft High	10	Rolls	$ 51.75	$ 518	
		Stockpile Area(s)	2	LS	$ 1,500.00	$ 3,000	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	12	WK	$ 420.00	$ 5,040	
		Clearing and Grubbing					
		Cut and Clear Trees over Entire Work Area	47,149	SY	$ 3.00	$ 141,447	
		Demobilization	1	LS	$ 35,000.00	$ 35,000	
		Payment and Performance Bonds				$ 2,508	
		Subcontractor Profit				$ 25,081	
8	*Alt. 2*	***Mobilization / Site Prep***				***$ 320,273***	
		MOBILIZATION					
		Work Plans, Schedules and Permits					
		Detailed Construction Plan	1	LS	$ 12,500.00	$ 12,500	
		Health & Safety Plan	1	LS	$ 7,000.00	$ 7,000	
		QA/QC Plan	1	LS	$ 7,000.00	$ 7,000	
		As-Built Survey	1	LS	$ 10,000.00	$ 10,000	Labor plus equipment
		Equipment Mobilization/Demobilization	1	LS	$ 35,000.00	$ 35,000	
		Temporary Facilities and Controls					
		Temporary Storage Trailer 16' x 8'	10	MO	$ 2,000.00	$ 20,000	
		Portable Toilets	10	MO	$ 360.00	$ 3,600	
		Rented chain link, 6' high, to 1,000'	1,000	LF	$ 4.13	$ 4,130	
		Silt Fence 3 ft High	10	Rolls	$ 51.75	$ 518	
		Stockpile Area(s)	2	LS	$ 1,500.00	$ 3,000	
		Decontamination Area	1	LS	$ 4,300.00	$ 4,300	
		Dumpster, weekly rental, 1 dump/week	12	WK	$ 420.00	$ 5,040	
		Clearing and Grubbing					
		Cut and Clear Trees over Entire Work Area	47,149	SY	$ 3.00	$ 141,447	
		Demobilization	1	LS	$ 35,000.00	$ 35,000	
		Payment and Performance Bonds				$ 2,885	
		Subcontractor Profit				$ 28,853	
9.3	*Alt. 3*	***Impermeable Cap Installation - Minimal Consolidation of Waste***				***$ 2,333,156***	
		Excavation / Consolidation of Material					
		Soil excavation and loading	20,370	CY	$ 30.00	$ 611,086	Excavate off cliff areas, difficult area, increase costs from regular excavation.
		Transport & grade within cover area	20,370	CY	$ 5.00	$ 101,848	Does not have to move far
		Impermeable Cover					
		General grading	39,416	SY	$ 5.00	$ 197,079	
		Imported Soil approval/certification	3	EA	$ 1,500.00	$ 4,500	one per 10,000 CY of fill or one per each soil type
		Sand/Cushion Layer	6,569	CY	$ 30.00	$ 197,079	Approximate 6-inches thick
		40 mil HDPE geomembrane	41,387	SY	$ 3.25	$ 134,506	HDPE Liner, 10% larger than area to extend past and key into ground.
		Import, place, and compact clay layer	6,569	CY	$ 45.00	$ 295,618	Approximate 6-inches thick
		Import and place drainage layer - sand	6,569	CY	$ 30.00	$ 197,079	Approximate 6-inches thick
		Import, place, and compact topsoil	6,569	CY	$ 35.00	$ 229,925	6" topsoil
		Seed and mulch	43,357	SY	$ 3.00	$ 130,072	
		Bank Stabilization (riprap)	30	TON	$ 105.00	$ 3,150	
		Payment and Performance Bonds				$ 21,019	
		Subcontractor Profit				$ 210,194	
9.4	*Alt. 4*	***Impermeable Cap Installation - Consolidate and Cap***				***$ 4,425,271***	
		Excavation / Consolidation of Material					
		Soil excavation and loading	54,160	CY	$ 30.00	$ 1,624,788	Excavate off cliff areas, difficult area, increase costs from regular excavation.
		Transport & grade within cover area	54,160	CY	$ 10.00	$ 541,596	Move to smaller consolidation area
		Impermeable Cover					
		General grading	14,355	SY	$ 5.00	$ 71,776	
		Imported Soil approval/certification	3	EA	$ 1,500.00	$ 4,500	one per 10,000 CY of fill or one per each soil type
		Sand/Cushion Layer	2,393	CY	$ 45.00	$ 107,665	Approximate 6-inches thick
		40 mil HDPE geomembrane	15,791	SY	$ 3.25	$ 51,320	HDPE Liner, 5% larger than area to extend past and key into ground.
		Import, place, and compact clay layer	2,393	CY	$ 45.00	$ 107,665	Approximate 6-inches thick
		Import and place drainage layer - sand	2,393	SY	$ 2.90	$ 6,938	Approximate 6-inches thick
		Import, place, and compact topsoil	2,393	CY	$ 45.00	$ 107,665	6" topsoil
		Seed and mulch	15,791	SY	$ 3.00	$ 47,372	
		Bank Stabilization (riprap)	15	TON	$ 105.00	$ 1,575	
		Restore Area Outside of Cover System					
		Import, place, and compact clean soil	33,053	CY	$ 30.00	$ 991,600	Assume 1 foot general fill, gentle grade to undisturbed areas
		Import, place, and compact topsoil	4,132	CY	$ 45.00	$ 185,925	6" topsoil
		Seed / mulch and Plantings	27,269	SY	$ 5.00	$ 136,345	
		Payment and Performance Bonds				$ 39,867	
		Subcontractor Profit				$ 398,673	
11	*Alt. 2*	***Site-Wide Excavation Implementation***				***$ 12,195,668***	
		EXCAVATION					
		Soil Excavation and Backfill					
		Soil excavation and loading	70,680	CY	$ 20.00	$ 1,413,600	with 20 contingency added to quantity identified via Tecplot (320,000 CY)
		Transportation and Disposal, Non-Hazardous	108,811	TON	$ 61.00	$ 6,637,465	Approximately 93% of soil non-hazardous, based on below assumption of hazardous
		Transportation and Disposal, Hazardous	7,811	TON	$ 181.00	$ 1,413,809	PCBs >50 mg/kg(TSCA) plus 5% of site-wide soil assumed hazardous. 10% bulking, CY*1.5 to tons
		Confirmatory Testing, soil SVOCs, PCBs, metals	680	EA	$ 75.00	$ 51,000	Assume 25 X 25 grid confirmatory sampling
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Import, place, and compact backfill	47,149	LCY	$ 30.00	$ 1,414,468	Average 3 feet thickness
		Import, place, and compact topsoil	7,858	LCY	$ 35.00	$ 275,035	Average 0.5 foot thickness. Less backfill/topsoil than excavated. Work into existing topography
		Seed / mulch / plantings	43,220	SY	$ 5.00	$ 216,099	10% in addition to excavation area to account for limits of work
		Bank Stabilization (riprap)	120	TON	$ 1,250.00	$ 150,000	
		Dewatering Excavation Areas	1	LS	$ 20,000.00	$ 20,000	
		Assemble Temporary Water Treatment System					
		Pumps/piping/fittings/connections	1	LS	$ 10,000.00	$ 10,000	
		Filter Bag Unit Mob/Demob	1	LS	$ 10,000.00	$ 10,000	
		Filter Bag Unit Rental	8	Month	$ 3,000.00	$ 24,000	
		GAC Vessel Rental	8	Month	$ 10,000.00	$ 80,000	2 vessels
		Frac Tank	8	Month	$ 802.50	$ 6,420	2 tanks / 4 months
		Frac Tank Delivery & Pick-up	4	Each	$ 200.00	$ 800	
		Heavy Const Skilled Laborer	64	hr	$ 50.00	$ 3,200	
		Equipment Operator	16	hr	$ 60.00	$ 960	
		Operate Temporary Water Treatment System					
		Bag Filters	32	EA	$ 8.00	$ 256	
		GAC	6,000	lb	$ 5.00	$ 30,000	initial and estimated changeouts, 2 vessels with 250-lb capacity
		Discharge compliance analytical - GW for PCBs, m	16	EA	$ 250.00	$ 4,000	Weekly discharge compliance sampling
		Miscellaneous maintenance	1	EA	$ 10,000.00	$ 10,000	
		Treatment System Operator	160	hr	$ 60.00	$ 9,600	Assume 10 hrs/week.
		Payment and Performance Bonds				$ 37,337	Performance Bond does not include cost of T&D or oversight
		Subcontractor Profit				$ 373,369	Subcontractor Profit does not include cost of T&D or Oversight

Appendix C
Detailed Cost Backup for All Alternatives

Cost Item No.	Applicable Alternative	Description	Quantity	Unit	Unit Cost	Total Cost	Notes
12	Alt. 3	PCB Hotspot Removal >50 ppm				$ 523,731	
		MOBILIZATION				$ -	Mobilization Items covered under Capping Alternative
		PCB HOTSPOT EXCAVATION					
		Surface Soil Excavation and Backfill					
		Soil excavation and loading	1200	CY	$ 20.00	$ 24,000	5 feet deep trhought 50 ppm contour, 20% contingency
		Transportation and Disposal, Hazardous	1980	TON	$ 181.00	$ 358,380	PCBs >50 mg/kg(TSCA), 10% bulking, CY*1.5 to tons
		Precharacterication Sampling	3	Each	$ 800.00	$ 2,400	One per 500 CY
		Confirmatory Testing, soil SVOCs, PCBs, metals	60	EA	$ 80.00	$ 4,800	Assume 10' by 10' confirmatory sampling
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Import, place, and compact backfill	1200	LCY	$ 65.00	$ 78,000	backfill only, topsoil, seed, and mulch included in capping cost
		Payment and Performance Bonds				$ 4,718	
		Subcontractor Profit				$ 47,183	
13	Alt. 4	PCB Hot Spot Removal >25 ppm				$ 1,679,894	
						$ -	Mobilization Items Covered under Capping
		PCB HOTSPOT EXCAVATION					
		Surface Soil Excavation and Backfill					
		Soil excavation and loading	6720	CY	$ 20.00	$ 134,400	6.5 feet deep throughougt 25 ppm contour, 20% contingency
		Transportation and Disposal, Exceeds TSCA	1980	TON	$ 181.00	$ 358,380	PCBs >50 mg/kg(TSCA), 10% bulking, CY*1.5 to tons
		Transportation and Disposal, non-haz	9108	TON	$ 61.00	$ 555,588	
		Confirmatory Testing, soil SVOCs, PCBs, metals	200	EA	$ 80.00	$ 16,000	Assume 10' by 10' confirmatory sampling
		Precharacterization Sampling	10	Each	$ 800.00	$ 8,000	One per 500 CY
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Import, place, and compact backfill	6720	LCY	$ 65.00	$ 436,800	backfill only, topsoil, seed, and mulch included in capping cost
		Payment and Performance Bonds				$ 15,134	
		Subcontractor Profit				$ 151,342	
17	Alt. 2,3,4	Unnamed Tributary Sediment - Excavation and Off-site Disposal				$ 409,945	
		General Excavation					Equipment may change pending subcontractor means and methods, may include vacuum excavation.
		Heavy Const Skilled Laborer	600	hr	$ 50.00	$ 30,000	3 laborers, 4 weeks, 10 hr days
		Equipment Operator	600	hr	$ 60.00	$ 36,000	3 operators, 4 weeks, 10 hr days
		Track Excavator	400	hr	$ 100.00	$ 40,000	2 excavators
		Loader	200	hr	$ 100.00	$ 20,000	
		Articulating Truck	200	hr	$ 100.00	$ 20,000	
		Dump Truck Driver	200	hr	$ 50.00	$ 10,000	
		Kiln Dust	200	tons	$ 25.00	$ 5,000	
		Composite Samples for Characterization	3	each	$ 800.00	$ 2,400	For full disposal characterization
		Unnamed Tributary Sediment - Excavation, Transportation, and Off-site Disposal					
		Clear and Grub	6106	SY	$ 3.00	$ 18,317	Clear & Grub 4 times the area to be remediated, for access, lay-down, etc.
		Build Temporary access roads/ramps	1	LS	$ 45,000.00	$ 45,000	Area is difficult to access.
		Off-Site transportation and Disposal, Non-haz	1409	TON	$ 61.00	$ 85,972	20% contingencey, 10% added for bulking, 1.5 tons/cy. Plus weight of kiln dust.
		Confirmatory Testing, soil SVOCs, PCBs, metals	25	EA	$ 80.00	$ 2,000	1 every 30 feet
		Imported Soil approval/certification	1	LS	$ 4,250.00	$ 4,250	
		Import, place, and compact backfill	305	LCY	$ 65.00	$ 19,851	Assume 1/2 the material removed will be replaced
		Seed/Mulch/Plantings	6106	SY	$ 5.00	$ 30,529	
		Payment and Performance Bonds				$ 3,693	
		Subcontractor Profit				$ 36,932	
21	Alt. 3, 4	Annual - Long-term Monitoring & Reporting					
21.1		Long-Term Monitoring (Years 1 through 5)				$ 8,992	
		Surface Water Sampling (3 locations Semi-annually)					
		Labor and Per Diem	2	Days	$ 2,000.00	$ 4,000	1 person, 1 day 2x year
		Monitoring well sampling equipment	2	ea/wk	$ 219.00	$ 438	1 day 2 x year
		Lab Analysis - Multiple Analyses	7	EA	$ 222.00	$ 1,554	3 samples 2xyear plus duplicate
		Montoring Report	2	LS	$ 1,500.00	$ 3,000	
21.2		Long-Term Monitoring (Years 6 through 30)					
		Surface Water Sampling (3 locations annually)				$ 4,352	
		Labor and Per Diem	1	Days	$ 2,000.00	$ 2,000	Two people, 3 days
		Monitor well sampling equipment	1	each/day	$ 75.00	$ 75	
		Lab Analysis - Multiple Analysis Water	3.5	EA	$ 222.00	$ 777	3 samples plus dup every other year
		Annual Report	1	LS	$ 1,500.00	$ 1,500	
22	Alt. 3, 4	Periodic Cost - Institutional Control Inspections/Reporting - Cap Options				$ 6,500	
		Inspection - field tech and mobilization	1	LS	$ 1,500.00	$ 1,500	
		Report	1	LS	$ 5,000.00	$ 5,000	Will require evaluating in year 5 to see if needed to replace again in year 6
22.1	Alt. 3 and 4	Mowing / Lawn Care	3.00	EA	$ 1,000.00	$ 3,000	3/year mowing

APPENDIX C - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 3

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Periodic Inspections and Reporting (Years 1-30)	$ 9,000	30	0.036	NA	NA	NA	NA	$ 270,000.00	$ 163,000.00
Cap Mowing	$ 5,000	30	0.036	NA	NA	NA	NA	$ 150,000.00	$ 91,000.00
Long-Term Monitoring (Years 1 through 5)	$ 13,000	5	0.036	NA	NA	NA	NA	$ 65,000.00	$ 59,000.00
Long-Term Monitoring (Years 6 through 30)	$ 6,000	25	0.036	NA	NA	NA	NA	$ 150,000.00	$82,000.00

Note:
Discount rate of 3.6% was used, as published by the Office of Management and Budget (OMB) in December 2018

Prepared by: JDW 04/05/2019
Checked by: MJS 04/09/2019

APPENDIX C - PRESENT VALUE OF PERIODIC COSTS ALTERNATIVE 4

Year	Cost	Number of Annual Periods	Annual Discount Rate	Number of 3-Year Periods	3-Year Discount Rate	Number of 10-Year Periods	10-Year Discount Rate	Total Non-Discounted Cost	Present Value Cost
Periodic Inspections and Reporting (Years 1-30)	$ 9,000	30	0.036	NA	NA	NA	NA	$ 270,000.00	$ 163,000.00
Long-Term Monitoring (Years 1 through 5)	$ 13,000	5	0.036	NA	NA	NA	NA	$ 65,000.00	$ 59,000.00
Long-Term Monitoring (Years 6 through 30)	$ 6,000	25	0.036	NA	NA	NA	NA	$ 150,000.00	$82,000.00
Cap Mowing	$ 5,000	30	0.036	NA	NA	NA	NA	$ 150,000.00	$ 91,000.00

Note:
Discount rate of 3.6% was used, as published by the Office of Management and Budget (OMB) in December 2018.

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	Areas/Volumes - Without Contingency				
Description of Remedial Area	**Area (SF)**	**Area (acres)**	**Assumed Depth (ft)**	**Volume (CF)**	**Volume (CY)**
Site-Wide Excavation Area (includes area sloughed over banks)	**353,617**	8.1	4.5	1,591,000	58,900
Non-Consolidated Cover System Area (above area minus area sloughed over banks) - **ALT 3**	**268,744**	6.2	NA	NA	NA
Sloughed Areas to add to above Non-Consolidated Area - **ALT 3**	**84,873**	1.9	4.5	382,000	14,100
Consolidated Cover System Area (approximately follows 1 ppm PCB contour) - **ALT 4**	**82,819**	1.9	NA	NA	NA
Area to excavate/move for consolidated Cover - **ALT 4**	**270,798**	6.2	4.5	1,219,000	45,100
PCB Hot Spots >50 ppm	5,291	0.1	5.0	26,000	1,000
PCB Hot Spots >25 ppm (in addition to above)	15,097	0.3		125,000	4,600
- Lateral Extents in Addition to 50 ppm area:	9,806		10.0	98,060	3,632
- Additional Depth within 50 ppm area:	5,291		5.0	26,455	980
Class C Sediment	13,738		1.0	13,738	509

Calculating Areas/Volumes for Various Materials and Activities Associated with Remedial Alternatives

Alternative 2 - Site-Wide Excavation				
Site-wide area	39,291 SY	47,149 SY	includes 20% contingency	
Site-wide Volume	58,900 CY		From TecPlot based on sampling data, Average 4.5 feet deep.	
Site-wide Volume with 20% contingency	70,680 CY			
After bulking	77,748 CY			
CY to Ton	1.5 Ton/CY			
Total Soil in Tons	116,622 Tons			
Assume ~93% non-haz (see below)	108,811 Tons			
Assume 5% haz + 50 ppm PCB Area	7,811 Tons		Assume soil from >50ppm plus 5% of site-wide soil is Hazardous.	
Average Depth	4.5 ft			
Depth topsoil	0.5 ft			
Depth Clean Fill	3.0 ft		Assume less backfill than what was removed, use grading to work into topography	
Volume Backfill	47,149 CY		includes 20% contingency	
Volume Topsoil (6")	7,858 CY		includes 20% contingency	
Alternative-3: Cover System Area	354,742 SF	39,416 SY	20% contingency and 10% to account for gentle mound after adding sloughed soil	
Area/Volume to be Excavated / Consolidated	101,848 SF	20,370 CY	Assume 4.5 foot thickness on average, with 20% contingency	
Alternative 4: Consolidated Cover System Area	129,198 SF	14,355 SY	add 30% for sloped surfaces (Tall Mound) and includes 20% contingency	
Area/Volume to be Excvated / Consolidated	324,958 SF	54,160 CY	Assume 4.5 foot thickness on average, with 20% contingency	
			Assum 4.5 foot thickness on average	0
Alternatives 2, 3 and 4:				
Soil with PCBs greater than 50 ppm				
> 50 ppm w contingency	1200 CY			
>50 ppm w bulking	1320 CY			
Tons of soil >50 ppm	1980 tons			
Soil with PCBs greater than 25 ppm				
>25 ppm w contingency	5520 CY		Additional 5 feet below the >50ppm excavation and additional area around it.	
>25 ppm w bulking	6072 CY			
Tons of soil >50 ppm	9108 tons			
Unnamed Tributary Sediments				
Class C sediment with contingency	611 Cy	20% contingency		
Area to be restored around the tributary	54952 SF	6,106 SY	Assume twice the area remediated will require restoration (vegetation)	

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