New York State Department of Environmental Conservation
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Feasibility Study

Former Paulsen-Holbrook Site
Town of Guilderland, New York
Site #401046

Work Assignment # D-004439-21

December 2009

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1. Introduction

The New York State Department of Environmental Conservation (NYSDEC) issued a Work Assignment for a Remedial Investigation and Feasibility Study of the Former Paulsen-Holbrook Site (site) located in the Town of Guilderland, New York (Figure 1). Malcolm Pirnie, Inc. (Malcolm Pirnie) has prepared this Feasibility Study (FS) to evaluate remedial alternatives for metals in soil and groundwater at the site. The purpose of this report is to:

- Identify and screen remedial technologies to address soil and groundwater containing arsenic, chromium, and/or copper at concentrations exceeding 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objectives, 6 NYCRR Part 375 Commercial Soil Cleanup Objectives, or NYSDEC Class GA Groundwater Standards; and

- Evaluate potential remedial alternatives based on seven evaluation criteria.

After approval of this FS, the NYSDEC will issue a Proposed Remedial Action Plan (PRAP) which is open to public comment. Following the public comment period, the NYSDEC will issue a Record of Decision (ROD) for the site.

This FS was completed in accordance with NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10), NYSDEC DER program policy for Presumptive/Proven Remedial Technologies (DER-15), and other appropriate NYSDEC and United States Environmental Protection Agency (USEPA) guidance.

1.1. Site Description

The site is located at 54 Railroad Avenue in the Town of Guilderland, Albany County, New York (Figure 1). The approximately 0.5-acre site is situated in an industrial and commercial area bounded by Railroad Avenue to the north, a raised railroad bed operated by Amtrak and CSX Transportation to the south, and commercial properties to the east and west (Figure 2). Patroon Creek is located to the south of the site and flows to the east-southeast. The site is relatively flat and is largely covered by asphalt and buildings. There is a fence surrounding the property with access controlled by a locking gate entrance off of Railroad Avenue. However, there is an approximately 50-foot section of the fence along the western edge of the property that has been damaged and remains open. The property has been largely unoccupied since at least 2002.

1.1.1. Site Physical Setting

The topography is moderately flat and generally slopes towards the southeast. Soils in the vicinity of the site are primarily mapped as lacustrine sand (Figure 3) deposits generally associated with large bodies of water, typically a near shore deposit or near a sand source (Cadwell et. al. 1986). These deposits are typically well sorted, stratified, and generally consist of quartz sand with a variable thickness ranging from 6.5 to 65 feet (Cadwell et. al. 1986). Soils encountered during the Remedial Investigation were generally fine to medium sand with some silt. Brown dense clay was encountered in two borings: PH-SB-01 (from 11 feet below ground surface [bgs] to 15 feet bgs, the bottom of this boring) and PH-SB-54 (from 12.8 feet bgs to 13.4 feet bgs). As shown in Figure 4, bedrock beneath the overburden is the Normanskill shale of the Lorraine, Trenton, and Black River Groups (Fisher et. al. 1970).

1.1.2. Groundwater

Groundwater elevations at the site range from 238.79 feet (AMSL) to 234.43 feet (AMSL). As summarized in Table 1, the depth to the water table ranges from approximately 11 feet bgs to 14 feet bgs. Groundwater in the vicinity of the site flows generally to the south, south-east toward Patroon Creek (Figure 5). This groundwater flow direction is based on water levels measured from the 14 existing on-site and two off-site shallow groundwater monitoring wells, as well as the newly installed deep on-site groundwater monitoring well. Results from groundwater sampling are discussed in Section 3.2 of this Report.

1.1.3. Surface Water

There is a discharge pipe located at the south eastern corner of the property, which was flowing and had formed a small ponded area during the field investigation. The drainage pipe is shown on Plate 1. Based on the locations of storm sewer manholes at the site, it is believed that this pipe is a discharge point for the site storm water drainage system. Patroon Creek is located approximately 600 feet to the south of the site and flows to the east-southeast.

1.2. Site History

Various companies who occupied the property operated a wood treatment operation at this location from the early 1950s until sometime before 1978. Wood was treated by pressure treating with chromated copper arsenate (CCA), which is a solution of chromic acid, cupric oxide, and arsenic pentoxide, in a large pressure vessel located in a containment building at the south-central portion of the property. After treatment, batches of lumber were removed from the pressure vessel and allowed to air dry on the site. An estimated (based on the size of the pressure vessel) 2,000 to 3,000 gallon spill of CCA occurred at the site in 1965 when the pressure vessel was opened before the CCA solution had been pumped out. Soil and groundwater contamination resulting from the spill and, potentially, daily operations associated with treated wood storage after removal from the CCA tank, are present at the site. Contaminants of concern in the soil and groundwater include arsenic, chromium, and copper.

The property has been previously investigated under the NYSDEC Voluntary Cleanup Program. The NYSDEC settled with the responsible parties in March 2007 and the site was subsequently referred to the State Inactive Hazardous Waste Disposal Site Program.

2. Remedial Investigation Summary

2.1. Soil

The primary contaminants at the site, metals, were present in soil samples at concentrations greater than the 6 NYCRR Part 375 Unrestricted Use and Commercial Use Soil Cleanup Objectives (SCOs). Soil sampling locations are shown on Plate 1. The location and depth of metals in soil is consistent with the historic wood treatment operations at the site. Of the metals that were detected in soil samples, arsenic, chromium, and copper are the primary metals of concern.

The primary area of concern is the former CCA lumber treating area, located in the south-western portion of the site (Figure 2). Soil containing chromium and copper at concentrations that exceeded SCOs is present mainly from zero to five feet bgs. Soil containing arsenic at concentrations that exceeded SCOs is present mainly from zero to five feet bgs. However, borings drilled in the former CCA lumber treating area and the area down-gradient of the former CCA lumber treating area, had soil containing arsenic that exceeded SCOs from ground surface to the final depth of the borings (15 feet bgs). The area down-gradient of the former CCA lumber treating area appears to have been affected by runoff. Soil containing arsenic concentrations that exceeded SCOs was measured with an x-ray fluorescence analyzer (XRF) from ground surface to the final depth of the boring (40 feet bgs) in boring PH-MW-01.

Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), and pesticides in soil do not appear to be a concern for this site as they were not detected in samples at concentrations greater than Unrestricted Use or Commercial Use SCOs.

2.2. Groundwater

Metals are also present in groundwater at the site as well as in an off-site plume at concentrations greater than the NYSDEC Class GA Groundwater Standards. The primary contaminants of concern in groundwater samples are arsenic and chromium, and to a lesser extent, copper and antimony. The vertical and horizontal extent of groundwater containing arsenic and chromium has not been fully defined. Groundwater flows to the south-southeast toward Patroon Creek.

Monitoring well locations are shown on Plate 1. Groundwater samples collected from monitoring wells in and down-gradient of the former CCA lumber treating area exceeded

NYSDEC Class GA Standards for at least one of the following metals: antimony, arsenic, chromium, copper, manganese, and zinc. The highest dissolved phase arsenic concentration (21,900 μg/l) was detected in the groundwater sample collected from monitoring well, ML-2R, which is in the former CCA lumber treating area. Results from the groundwater sample collected from the deep monitoring well, PH-MW-01, exceeded NYSDEC Class GA Standards for arsenic, chromium, manganese, and sodium. The off-site monitoring wells, ML-15 and ML-16, do not appear to be affected by the metals of concern at the site; however, these wells may not be directly down-gradient of the area of concern.

VOCs, SVOCs, PCBs, and pesticides in groundwater do not appear to be a concern for this site as they were not detected in samples at concentrations greater than NYSDEC Class GA Standards.

2.3. Surface Water/Sediment

Locations of surface water and sediment samples collected from Patroon Creek are provided on Figure 6. Surface water and sediment samples collected from Patroon Creek did not indicate site related contaminants of concern. The sediment sample collected from the discharge pipe just off the site property (Plate 1) exceeded Unrestricted Use SCOs for arsenic, chromium, copper, mercury, and zinc.

2.4. Conceptual Site Model

With the conclusion of RI sampling, the current Conceptual Site Model is as follows:

Historical uses of the property for a wood treatment facility resulted in the release of metals into soil and groundwater. Wood was treated by pressure treating with chromated copper arsenate (CCA) in a large pressure vessel in a containment building located at the south-central portion of the property. After treatment, batches of lumber were removed from the pressure vessel and allowed to air dry on the site. An estimated (based on the size of the pressure vessel) 2,000 to 3,000 gallon spill of CCA occurred at the site in 1965 when the pressure vessel was opened before the CCA solution had been pumped out. Soil and groundwater contamination resulting from the spill and, potentially, daily operations associated with treated wood storage after removal from the CCA tank, are present at the site. The primary contaminants of concern in the soil include arsenic, chromium, and copper. The primary contaminants of concern detected in groundwater samples are arsenic and chromium, and to a lesser extent, copper and antimony.

Soil containing metals at concentrations greater than Unrestricted Use and Commercial Use SCOs is present in two areas: the former CCA wood treating area, and the area down-gradient of the former CCA wood treating area following surface topography, which is consistent with historic uses of the site. Soil containing arsenic at concentrations greater than Unrestricted and Commercial Use SCOs from zero to two feet bgs is present at additional areas of the site including: the area to the north of the former CCA lumber treating area and the area west of the former CCA lumber treating area.

The highest concentrations of arsenic (9,541 parts per million [ppm]), chromium (8,571 ppm), and copper (23,976 ppm) measured with the XRF were detected in the two to three feet bgs samples from borings PH-SB-50 and PH-SB-51. Table 2 (below) summarizes the estimated volume of soil containing arsenic at concentrations greater than the listed potential cleanup objectives. These volumes were calculated based on the arsenic concentrations measured with the XRF during the Remedial Investigation and an assumed density of approximately 3,200 pounds per cubic yard (lbs/yd^3).

Table 2. Summary of Arsenic-Containing Soil Volumes and Mass

Potential Cleanup Objective (CO) (ppm)	Estimated Soil Volume Greater Than CO (yd^3)	Estimated Soil Mass Greater Than CO (tons)
13 (Unrestricted Use SCO)	6,525	10,440
16 (Commercial Use SCO)	6,150	9,840
50	5,250	8,400
100	4,400	7,040
250	1,425	2,280
500	500	800

Affected groundwater (with concentrations of arsenic, chromium, and/or copper greater than Class GA Groundwater Standards) is present in the former CCA wood treating area, which appears to be the source of a groundwater plume that is migrating off-site to the south-southeast. The direction of groundwater flow across the site is generally toward the south-southeast. The average depth to water at the site is approximately 13 feet bgs.

3. Exposure/Risk Assessment

A qualitative exposure assessment was performed using the data collected during the RI. The qualitative exposure assessment consists of characterizing the exposure setting, identifying potential exposure pathways, and evaluating contaminant fate and transport. An exposure pathway describes the means by which an individual may be exposed to contaminants originating from the site. An exposure pathway has five elements: (1) a contaminant source; (2) contaminant release and transport mechanism; (3) a point of exposure; (4) a route of exposure; and (5) a receptor population.

3.1. Exposure Pathways

3.1.1. Soil

On-site surface soils characterized during the remedial investigation contained arsenic, chromium, and copper at concentrations greater than the Unrestricted Use and Commercial Use SCOs. The site is closed and not open to the public. Therefore, a possible exposure pathway is limited to contact with the impacted surface soils by site workers or trespassers.

Subsurface soil, as characterized during the remedial investigation, contains elevated concentrations of arsenic, chromium, and copper. These subsurface soils do not presently have an exposure point or route, as they are present at depth and groundwater flowing beneath the site is not used as a drinking water source. However, contact with the impacted soils by construction and/or utility workers represents a possible future exposure pathway.

3.1.2. Groundwater

Groundwater at the site contains metals at concentrations greater than the NYSDEC Class GA Standards. Arsenic, chromium, and copper have been mobilized, via south-southeast groundwater flow. The extent of groundwater contamination for arsenic and chromium has not been fully defined. The metals-impacted groundwater presently has no exposure point or route, as groundwater in the vicinity of the site is not used as a drinking water source and does not appear to discharge to surface water locally. However, as with subsurface soil, contact with impacted groundwater by construction and/or utility workers represents a possible future exposure pathway.

3.1.3. Surface Water

Off-site surface water samples collected from Patroon Creek (Figure 6) during the remedial investigation did not contain arsenic, chromium, or copper at concentrations greater than NYSDEC Class C Type A(C) Standards. Therefore, an exposure point or route does not presently exist in this stretch of Patroon Creek.

3.1.4. Sediment

Off-site sediment samples collected from Patroon Creek during the remedial investigation did not contain arsenic, chromium, or copper at concentrations greater than the Unrestricted Use and Commercial Use SCOs. Therefore, an exposure point or route does not presently exist in these sediments in Patroon Creek.

The sediment sample collected from the discharge pipe just off the site property exceeded Unrestricted Use SCOs for arsenic, chromium, copper, mercury, and zinc. Contact with the impacted sediment by utility workers, trespassers, or railroad employees, represents a possible exposure pathway.

4. Remedial Action Objectives and Evaluation Criteria

The remedial goal for the Former Paulsen-Holbrook Site will be the restoration of the site to pre-release conditions, to the extent feasible, given the existing and anticipated land use. At this time, the end use of the property is unknown, but the site resides in a predominantly commercial area. Accordingly, the remedial action objectives (RAOs) discussed in this section were developed based upon a similar end-use of the site.

According to Title 40 Code of Federal Regulations (CFR) Part 261, under the Resource Conservation and Recovery Act (RCRA) "wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes that use inorganic preservatives containing arsenic and chromium" are considered a listed hazardous waste (F035). Per the NYSDEC, soil containing arsenic or chromium as a result of direct contact with CCA fluid waste is considered hazardous waste for the purposes of this evaluation.

4.1. Remedial Action Objectives

The results of the remedial investigation indicate that exposure to surface soil, subsurface soil, and groundwater containing metal constituents is the potential exposure pathway for the Former Paulsen-Holbrook Site. The RAOs for the site are:

4.1.1. Soil

- Prevent direct contact with contaminated soil, including soil in surface water runoff areas.
- Prevent migration of contaminants which would result in further groundwater contamination.
- Remove the source of soil contamination.

4.1.2. Groundwater

- Restore, to the extent practical, the groundwater to pre-release conditions.
- Remove, to the extent practical, the source of groundwater contamination.
- Prevent the discharge of contaminants to surface water.

Generally, these RAOs may be achieved by minimizing the:

- Migratory potential of the contaminants;
- Potential for human exposure to contaminated media; and

- Magnitude and extent of contamination in the affected media.

4.2. Applicable Standards, Criteria, and Guidance (SCGs)

6 NYCRR Part 375 requires that SCGs are identified and that remedial actions conform with SCGs unless "good cause exists why conformity should be dispensed with." Standards and Criteria are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, or location. Guidance includes non-promulgated criteria and guidelines that are not legal requirements; however, the site's remedial program should be designed with consideration given to guidance that, based on professional judgment, is determined to be applicable to the site.

The principal SCGs for the site are listed below:

General:

- 6 NYCRR Part 375 – Environmental Remediation Programs, including the Inactive Hazardous Waste Disposal Site Remedial Program
- 6 NYCRR Part 371 – Identification and Listing of Hazardous Wastes
- 40 CFR Part 260 – Environmental Protection Agency Federal Regulations for Hazardous Waste Management

Soil:

- 6 NYCRR Part 375 – Unrestricted Use Soil Cleanup Objectives (SCOs)
- 6 NYCRR Part 375 – Commercial Use Soil Cleanup Objectives (SCOs)
- 6 NYCRR Part 376 – Land Disposal Restrictions
- NYSDEC Division of Solid and Hazardous Materials TAGM 3028 "Contained-in" Criteria for Environmental Media (8/97)

Water:

- 6 NYCRR Part 700-705, Water Quality Regulations for Surface Water and Groundwater
- NYSDEC Division of Water TOGS 1.1.1 – Ambient Water Quality Standards and Groundwater Effluent Limitations

4.3. Evaluation Criteria

In accordance with Draft DER-10 Technical Guidance for Site Investigation and Remediation (DER-10) (NYSDEC, 2002), the remedial measure alternatives developed in this Feasibility Study will be screened based on an evaluation of the following criteria:

- Overall Protection of Human Health and the Environment;
- Compliance with Standards, Criteria, and Guidance (SCGs);
- Long-term Effectiveness and Permanence;
- Reduction of Toxicity, Mobility, and Volume;
- Short-term Effectiveness;
- Implementability; and
- Cost.

The community acceptance criteria will be evaluated during the review of the Proposed Remedial Action Plan (PRAP) for the site. If cleanup to pre-disposal conditions is determined to be infeasible, the current, intended, and reasonably anticipated future land use may be used in evaluating remedial alternatives.

4.3.1. Overall Protection of Human Health and the Environment

This criterion serves as a final check to assess whether each alternative meets the requirements that are protective of human health and the environment. The overall assessment of protection is based on a composite of factors assessed under other evaluation criteria; especially long-term effectiveness and performance, short-term effectiveness; and compliance with SCGs. The evaluation focuses on how a specific alternative achieves protection over time and how site risks are reduced. The analysis includes how each source of contamination is to be eliminated, reduced, or controlled for each alternative.

4.3.2. Compliance with SCGs

This evaluation criterion assesses how each alternative complies with 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objectives, 6 NYCRR Part 375 Commercial Soil Cleanup Objectives, and NYSDEC Class GA Standards.

4.3.3. Long-term Effectiveness and Permanence

This evaluation criterion addresses the results of a remedial action in terms of its permanence and quantity/nature of waste or residual remaining at the site after response objectives have been met. The primary focus of this evaluation is the extent and effectiveness of the controls that may be required to manage the waste or residual remaining at the site and operating system necessary for the remedy to remain effective. The factors being evaluated include the permanence of the remedial alternative, magnitude of the remaining risk, adequacy of controls used to manage residual waste, and reliability of controls used to manage residual waste.

4.3.4. Reduction of Toxicity, Mobility, and Volume

This evaluation criterion assesses the remedial alternative’s use of the technologies that permanently and significantly reduce toxicity, mobility, or volume of the hazardous wastes as their principal element. The NYSDEC's policy is to give preference to alternatives that eliminate any significant threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in the contaminants mobility, or reduction of the total volume of contaminated media. This evaluation includes: the amount of the hazardous materials that would be destroyed or treated, the degree of expected reduction in toxicity, mobility, or volume measured as a percentage, the degree in which the treatment would be irreversible, and the type and quantity of treatment residuals that would remain following treatment.

4.3.5. Short-term Effectiveness

This evaluation criterion assesses the effects of the alternative during the construction and implementation phase. Alternatives are evaluated with respect to the effects on human health and the environment during implementation of the remedial action. The aspects evaluated include: protection of the community during remedial actions, environmental impacts as a results of remedial actions, time until the remedial response objectives are achieved, and protection of workers during the remedial action.

4.3.6. Implementability

This criterion addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during its implementation. The evaluation includes: feasibility of construction and operation; the reliability of the technology; the ease of undertaking additional remedial action; monitoring considerations; activities needed to coordinate with other offices or agencies; availability of adequate off-site treatment, storage, and disposal services; availability of equipment; and the availability of services and materials.

4.3.7. Cost

Cost estimates are prepared and evaluated for each alternative. The cost estimates include capital costs, operation and maintenance (O&M) costs, and future capital costs. A cost sensitivity analysis is performed which includes the following factors: the effective life of the remedial action, the O&M costs, the duration of the cleanup, the volume of contaminated material, other design parameters, and the discount rate. Cost estimates developed at the detailed analysis of alternatives phase of a feasibility study generally have an exposed accuracy range of -30 to +50 percent (USEPA, 2000).

4.3.8. Community Acceptance

Following submission of this report and the generation of the Proposed Remedial Action Plan (PRAP) by the NYSDEC, a summary of the proposed remedial action will be sent to the project's contact list, which will include the date, time, and location of the public meeting, and announcement of the 30-day period for submission of written comments from the public. A Responsiveness Summary will be prepared to address public comments on the PRAP. After the submission of Responsiveness Summary, a final remedy will be selected and publicized in a Record of Decision (ROD). If the final remedy differs significantly from the proposed remedy, public notices will include descriptions of the differences and the reason for the changes.

5. Identification and Screening of Technologies

5.1. General Response Actions

NYSDEC Program Policy DER-15: *Presumptive /Proven Remedial Technologies*, provides generally accepted presumptive remedies for various site media which comply with 6 NYCRR section 375-1.8. Presumptive remedies for metals contaminated site media are presented in Section 5 of the DER-15 Guidance document. The purpose of the presumptive remedy approach is to streamline the remedy selection process by providing remedies which have been proven to be both feasible and cost-effective for specific site types and/or contaminants. In accordance with Section 4.2(a)3 of the NYSDEC Program Policy Draft DER-10: *Technical Guidance for Site Investigation and Remediation*, the use of presumptive remedies eliminates the need to screen the selected technologies and to proceed directly to the evaluation of the presumptive alternatives.

In accordance with the DER-10 Guidance document, Section 4.2(a)3, General Response Actions (GRAs) have been identified which may be effective remedies for the remediation of soil and/or groundwater at the site. In this section, medium-specific GRAs are identified and potentially applicable technology types and process options for each GRA are evaluated based on the evaluation criteria discussed in Section 5. In general, the GRAs which are applicable to the affected media at the Former Paulsen-Holbrook Site include the no action response, institutional controls, immobilization (stabilization), excavation/off-site removal, extraction/ex-situ technologies, and in-situ treatment technologies.

- **No Action** - A no action response, required by the DER-10 for the Feasibility Study (FS) process, provides a baseline for comparison with other alternatives.

- **Institutional Controls** - Institutional controls are applied when active remedial measures do not achieve cleanup limits. Potential human exposure is reduced by limiting public access to site contaminants. Institutional controls such as environmental easements can also apply through an extended remediation period, or to sites where cleanups are completed up to feasible levels but still leave residual contamination greater than background levels.

- **In-situ Treatment** - In-situ treatment for soil and groundwater uses various technologies including chemical injections and reactive materials. In-situ treatment is effective in treating source areas of contamination but can be prohibitively expensive for treatment of large areas of groundwater contamination.

- **Removal Measures -** Removal measures provide for the removal of contaminants or contaminated materials from their existing location for treatment (on-site or off-site) or disposal. Groundwater extraction systems are typically used to remove groundwater and are combined with various ex-situ treatment technologies including chemical precipitation and ion exchange/absorption. The effluent treated water is often returned to the subsurface through injection wells, released to surface water bodies, or released to the local Publicly-Owned Treatment Works (POTW).

- **Containment/Barrier** - Containment for groundwater includes remedial measures that contain or isolate contaminants on-site. Containment prevents migration of contaminants from the site and attempts to prevent direct human and ecological exposure to contaminated media. Examples of containment technologies are grout slurry walls, sheet piling, hydraulic control by pumping, and reactive barriers. Containment technologies are often combined with other treatment technologies to remove contamination.

5.2. Identification and Screening of Soil Technologies

Soil containing concentrations of arsenic, chromium, and copper greater than Unrestricted and Commercial Use SCOs is present in two areas: the former CCA wood treating area, and the area down-gradient of the former CCA wood treating area following surface topography, which is consistent with historic uses of the site. Soil containing arsenic concentrations greater than Unrestricted and Commercial Use SCOs from zero to two feet bgs is present at additional areas of the site including: the area to the north of the former CCA lumber treating area and the area west of the former CCA lumber treating area.

5.2.1. No Action

The "no action" GRA, by definition, involves no institutional controls, environmental monitoring, or remedial action, and therefore, includes no technological barriers. This GRA defines the minimum steps that would be taken at the site in the absence of any type of action directed at the existing contamination. In accordance with DER-10, the no action alternative will be retained for alternatives development.

5.2.2. Institutional Controls

Institutional controls are not technologies, but rather, are legal actions that reduce or prevent exposure of the human population to the contaminated soil and/or groundwater (e.g., deed restrictions, fencing/signs, health advisories). Institutional controls can be used as a stand-alone alternative or can be used in conjunction with other technologies to achieve RAOs. Because impacted soil at the site has created a groundwater plume that has likely migrated off-site, institutional controls would ideally include restrictions on groundwater use in the area of the off-site plume. Because some of the soil impacted by metals is relatively deep (at least 40 feet bgs), institutional controls could be effective in preventing human exposure to soil. Therefore, institutional controls will be retained for further consideration in conjunction with other technologies.

5.2.3. Ex-Situ Technologies

Ex-situ technologies would involve the excavation of contaminated soil with subsequent treatment or disposal. Ex-situ treatment technologies include capping, solidification and stabilization (immobilization), vitrification, and soil washing.

5.2.3.1. Capping

Capping systems prevent dermal contact of surface soil by installing an impermeable barrier. The cap also prevents infiltration of water through contaminated soil, potentially inhibiting further release of contaminants to groundwater. Capping is considered potentially applicable to the site and will be retained for alternatives development.

5.2.3.2. Excavation/Off-site Disposal

Excavation is a useful remedial option when the location of the source of contamination is known or if there is a well delineated contaminated area. The concentrations of metals in the impacted areas, including the source area of the former CCA lumber treating area, have been delineated by XRF measurements in soil cores. The extent of impacted soil off-site is not well defined; however, the railroad track would serve to constrain the excavation. According to DER-15, excavation is a presumptive remedial technology for metals contamination and, therefore, will be retained for alternatives development.

5.2.3.3. Solidification and Stabilization-Immobilization

Solidification and stabilization techniques, also known as immobilization, are used to reduce the mobility of metals in soil. Solidification and stabilization techniques can be performed ex-situ or in-situ. Ex-situ solidification and stabilization techniques involve mixing reagents, such as Portland cement, lime, fly ash, cement kiln dust, or polymers with soil to create a slurry, which with time cures into a solid. Additional oxidizing or reducing reagents are selected based on soil characteristics and metal contaminants present. Excavated soil that has been solidified and stabilized with techniques described above generally can meet the regulatory threshold of 5 milligrams per liter (mg/l) leachable metals as measured by TCLP. However, since some of the waste at this site is considered a listed hazardous waste (see Section 4), such treatment would not result in a non-hazardous waste classification. There are many factors that can affect the solidification and stabilization performance including: the valence state of arsenic, pH and redox potential of the soil, presence of organic material, other inorganic soil characteristics, and mixing.

It is therefore necessary to evaluate soil characteristics and assess applications for comparability before choosing solidification and stabilization techniques. Long term monitoring is necessary to ensure that contaminants have not been re-mobilized. Limited data are available regarding the long-term stability of arsenic contaminated soil that was treated with solidification and stabilization techniques (USEPA 2002). A disadvantage of solidification and stabilization techniques is that although the mobility of metals may be reduced by changing it to a less soluble form, metals are not removed from the soil. Consequently, long-term effectiveness of solidification and stabilization processes may be impacted if soil conditions cause the stabilized arsenic to change to more soluble and mobile forms. According to DER-15, solidification and stabilization techniques are a presumptive remedial technology for metals contamination. However, once contaminated soil containing a listed hazardous waste is excavated, it is considered to have been "generated." If the "generated" waste was placed back in the excavation, the site would be classified as a RCRA treatment, storage, and disposal (TSD) facility and the cost associated with permitting, monitoring, and reporting activities would be prohibitive. Therefore, this technology will not be retained for alternatives development.

5.2.3.4. Vitrification

Vitrification processes are solidification methods that employ heat up to 1,200° C to reduce the mobility of metals by incorporating them into a vitreous mass. Vitrification processes can be performed ex-situ or in-situ. Heating devices employed for ex-situ vitrification processes include plasma torches and electric arc furnaces. There are several factors that affect the vitrification performance including: presence of volatile metals, presence of halogenated organic compounds, particle size, metals content, and organic content. Disadvantages to vitrification processes include the potential for a substantial increase in waste volume and large amounts of energy necessary to achieve vitrification temperatures. In addition, the high temperatures may cause arsenic, cadmium, and mercury to volatilize, resulting in the off-gases to require further treatment to remove hazardous constituents. Based on the above disadvantages, both ex-situ and in-situ vitrification technologies will not be considered further as a remedial option for the Former Paulsen-Holbrook Site.

5.2.3.5. Soil Washing

Soil washing is an ex-situ treatment that concentrates contaminants through separation methods. This technology takes advantage of some contaminant transport mechanisms including the preferential for some contaminants to adsorb onto finer particles. After the particles are separated by size and homogenized the soil is suspended in a wash solution. The fine particles remain in suspension, enabling their removal. The coarser soil generally requires no further treatment; however, the wash water from the process is concentrated and must be treated. Factors that can affect soil washing techniques include multiple contaminants and temperature. Heterogeneous contaminant compositions might require the use of multiple sequential washing processes to remove contaminants

(USEPA, 1997). Complex mixtures of anionic and cationic metals do not favor soil washing because solubility maximums based on pH and reduction-oxidation (redox) conditions differ. Because there are a variety of metals of concern at the Former Paulsen-Holbrook site, some of which that typically exist in nature as cations and some of which typically exist in nature as oxyanions, soil washing will not be considered further as a remedial option for the site.

5.2.4. In-Situ Treatment Technologies

In-situ treatment uses physical or biological processes to remove or degrade contaminants in place. In-situ treatment technologies of contaminated soil include solidification and stabilization (immobilization), and in situ soil flushing.

5.2.4.1. Solidification and Stabilization-Immobilization

As described in the previous section, solidification and stabilization techniques, also known as immobilization can be used in-situ or ex-situ to reduce the mobility of arsenic and other metals in soil. In-situ solidification and stabilization techniques include injecting solutions of chemical precipitants, pH adjustment agents, and/or chemical oxidants as well as a cement-based agent into the soil. The depth of contaminants may limit in-situ solidification and stabilization techniques. A disadvantage to this technology is that future use of the site and environmental conditions may erode the materials used to stabilize contaminants, thus affecting their capacity to immobilize contaminants. There are many factors that can affect the solidification and stabilization performance including: the valence state of arsenic, pH and redox potential of the soil, the presence of organics, other inorganic soil characteristics, and mixing.

It is therefore necessary to evaluate soil characteristics and assess applications for long term comparability before choosing solidification and stabilization techniques. Long term monitoring is necessary to ensure that contaminants have not been re-mobilized. Limited data are available regarding the long-term stability of arsenic contaminated soil that was treated with solidification and stabilization techniques (USEPA, 2002). According to DER-15, solidification and stabilization techniques are a presumptive remedial technology for metals contamination and will therefore be retained for alternatives development. However, as mentioned previously, use of this technology will not result in a non-hazardous waste determination. In addition, due to increased volumes associated with this technology, it is assumed that approximately 10 percent of the impacted soil will be disposed of off-site to maintain the site's existing grade.

5.2.4.2. Soil Flushing

Soil flushing techniques involve injecting water with a solution of chemicals, organic solvents, or surfactants, into affected soil so that the contaminants become mobilized by dissolution or emulsification. After passing through contaminated soil, the contaminant-bearing flushing solution is collected in down-gradient wells or trenches, for removal, treatment, or reinjection. Disadvantages of soil flushing include: flushing additives may leave small residuals in the soil or groundwater and should be evaluated on a site-specific basis, and additives must be recovered from the underlying aquifer. Additionally, there is the potential of washing the contaminant beyond the capture zone and the introduction of surfactants to the subsurface. The technology should be used only where flushed contaminants and soil-flushing fluid can be contained and recaptured. Based on the disadvantages listed above soil flushing will not be considered further as a remedial option for the site.

5.2.5. Summary

A summary of the potential soil remedial technology screening is provided below in Table 3.

Table 3. Summary of Soil Remedial Technology Screening

Technology	Retained?	Reason(s)
No Action	Yes	• In accordance with DER-10
Institutional Controls	Yes	• Would reduce potential human exposure pathway. • In accordance with DER-10
Ex-Situ Technologies		
Capping	Yes	• Would prevent dermal contact of surface soil.
		• Would minimize infiltration of water through contaminated soil.
Excavation/Off-site Disposal	Yes	• Would remove contaminated soil from the site. • In accordance with DER-15.
Solidification and Stabilization-Immobilization	No	• Would result in the "generation" and on-site disposal of hazardous waste.
Vitrification	No	• Potential for a substantial increase in waste volume. • Requires large amounts of energy. • Limited number of vendors.
Soil Washing	No	• Heterogeneous contaminant compositions.
In-Situ Treatment Technologies		
Solidification/Stabilization-Immobilization	Yes	• Would reduce the mobility of metals in the soil. • In accordance with DER-15.
Soil Washing	No	• Introduction of surfactants to the subsurface that could mobilize contaminants.

5.3. Identification and Screening of Groundwater Technologies

GRAs for groundwater are limited to areas exceeding the NYSDEC Class GA Standards, which are predominantly in the former CCA lumber treating area and the area down-gradient of the former CCA lumber treating area. Groundwater affected with arsenic and chromium has not been delineated beyond the site property.

5.3.1. No Action

The no action GRA, as described in section 5.2.1 will be retained for alternatives development.

5.3.2. Institutional Controls

Preventing the use of groundwater could be effective in preventing human exposure to contaminated groundwater. Long-term groundwater monitoring can also be included in institutional controls to detect contaminant migration toward potential receptors. Long-term monitoring is distinct from natural attenuation in that it does not attempt to demonstrate that the contaminants are being degraded and/or that they will be attenuated before reaching a potential receptor. Institutional controls, as described in Section 5.2.2 will be retained for alternatives development, in conjunction with other technologies.

5.3.3. Extraction/Ex-Situ Technologies

Extraction of contaminated groundwater would be accomplished by altering the existing hydraulic gradients through pumping. The groundwater extraction options are coupled with various treatment technologies to remove the contamination from the water prior to discharge. Extraction options include vertical well groundwater extraction and treatment methods. Treatment methods for groundwater include chemical precipitation, ion exchange/adsorption, and membrane filtration.

5.3.3.1. Groundwater Extraction and Treatment

This technology includes the installation of at least one vertical groundwater recovery well equipped with a pump in or down-gradient from the area of contaminated groundwater, and a surface treatment technology prior to discharge. The number of wells is a function of the possible pumping rate and aquifer characteristics. The capture zone of the wells should, at a minimum, encompass the area of contaminated groundwater or the most contaminated portion of the aquifer. According to DER-15, extraction and treatment is a presumptive remedial technology for metals contamination in groundwater. However, groundwater extraction technologies are typically only used to prevent exposure to a groundwater receptor. Since there are no known receptors for groundwater, extraction and treatment of groundwater will not be retained for alternatives development.

5.3.3.2. Chemical Precipitation

Chemical precipitation uses chemicals to precipitate dissolved contaminants into an insoluble form after the water has been extracted to the surface. Metal ions generally precipitate out as hydroxides, sulfides, or carbonates, and then are removed as solids through clarification and filtration. Chemical precipitation generally involves the addition of oxidizing or reducing agents and pH adjustment. Site-specific treatability tests are necessary to evaluate precipitation chemicals, pre-treatment steps, and post-treatment requirements of the effluent and sludge residuals. According to DER-15, chemical precipitation is a presumptive remedial technology for metals contamination in groundwater. However, since groundwater extraction is not being retained, use of precipitation will not be considered further.

5.3.3.3. Ion Exchange/Adsorption

Ion exchange/adsorption removes metal contaminants by passing contaminated groundwater through a granular solid or other porous material, such as an impregnated resin. Contaminants are removed from the aqueous phase (groundwater) in an exchange with relatively innocuous ions (e.g., NaCl) held by the ion exchange material. When most of the exchange sites of the media become filled, the exchange resin can be regenerated. According to DER-15, ion exchange is a presumptive remedial technology for metals contamination in groundwater. However, since groundwater extraction is not being retained, use of ion exchange/adsorption will not be considered further.

5.3.4. In-Situ Treatment Technologies

In-situ treatments use chemical, physical, and/or biological processes to remove or degrade contaminants in place. In-situ treatment of metals contaminated groundwater could be accomplished utilizing chemical supplement technology or permeable reactive barrier technology.

5.3.4.1. Chemical Supplement

Chemical supplement technology involves injecting a slurry of chemicals, such as integrated carbon and zero-valent iron (ZVI) into the subsurface to change the reduction-oxidation potential (Eh) and pH of the groundwater facilitating precipitation and/or adsorption of arsenic and other metals. Laboratory data suggest that once precipitated, further changes in Eh and pH would not remobilize arsenic (Adventus Group, 2009). This alternative will reduce metals concentration in groundwater and will therefore, be retained for alternatives development.

5.3.4.2. Permeable Reactive Barriers

Permeable reactive barriers (PRBs) are vertical zones of material containing reactive medium that are installed perpendicular to the groundwater flow direction to passively intercept a contaminant plume. PRBs allow groundwater to pass through, while the medium removes contaminants by precipitation, degradation, adsorption, or ion exchange. The most common treatment medium in PRBs for arsenic is zero-valent iron (Wilkin et. al. 2008). Advantages of using PRBs include limited operations and maintenance (O&M) costs, no aboveground equipment is required except for monitoring devices, and they produce less waste than active remediation because contaminants are immobilized or altered in the subsurface. Disadvantages of using PRBs include that remediation may take relatively long periods of time and the long-term effectiveness of PRBs for arsenic treatment has not been demonstrated (EPA, 2002). Using PRB technology is not considered to be potentially feasible for treatment of the site due to depth of the contaminants (at least 40 feet bgs).

5.3.4.3. Phytoremediation

Phytoremediation uses plants to degrade, extract, contain, or immobilize contaminants in soil, sediment, or groundwater. Phytoremediation applications used for treating arsenic include phytoextraction and phytostabilization. Phytoextraction is the uptake of contaminants by plant roots and the accumulation of contaminants into plant shoots and leaves. Phytostabilization immobilizes contaminants at the interface of roots and soil by the production of chemical compounds by plants. Advantages of phytoremediation include that soil excavation is not necessary. Disadvantages of phytoremediation include long-term maintenance of vegetation and soil to prevent re-release of contaminants, plant uptake of metals to aboveground portions of the plant may introduce them into the food chain if the plant is consumed, and products could bioaccumulate in animals that ingest plants. Due to disadvantages listed above, phytoremediation will not be considered further as a remedial option for the site. Additionally, phytoremediation is not considered to be potentially feasible due to the depth of contaminants (at least 40 feet bgs) and therefore, will not be retained for alternatives development.

A summary of the potential groundwater remedial technology screening is provided below in Table 4.

Table 4. Summary of Groundwater Remedial Technology Screening

Technology	Retained?	Reason(s)
No Action	Yes	• In accordance with DER-10.
Institutional Controls	Yes	• Prohibition of the use of groundwater, and contingencies for handling contaminated groundwater will prevent exposure. • In accordance with DER-10.
Ex-Situ Technologies		
Groundwater Extraction and Treatment	No	• No source treatment (indefinite operational period). • No known receptors for groundwater.
Chemical Precipitation	No	• Requires groundwater extraction.
Ion Exchange/ Adsorption	No	• Requires groundwater extraction.
In-Situ Treatment Technologies		
Chemical Supplement	Yes	• Facilitates precipitation and adsorption of dissolved metals into an insoluble form.
Permeable Reactive Barriers	No	• Not feasible due to depth of contaminants.
Phytoremediation	No	• Long-term maintenance of vegetation and soil. • Potential for bioaccumulation in animals that ingest plants. • Not feasible due to depth of contaminants in groundwater.

5.4. Remedial Alternatives

Based upon the site characteristics, the General Response Actions, and technology screening presented above, the following remedial alternatives were considered to be potentially applicable for source area soil and groundwater treatment at the site:

Alternative 1:	No Action
Alternative 2:	Institutional Controls + Long-Term Monitoring
Alternative 3:	Capping + Institutional Controls + Long-Term Monitoring
Alternative 4:	Excavation to Unrestricted Use SCOs + Long-Term Monitoring + Institutional Controls
Alternative 5:	Excavation to Unrestricted Use SCOs + In-situ Groundwater Remediation + Long-Term Monitoring + Institutional Controls
Alternative 6A:	In-Situ Soil Stabilization + Long-Term Monitoring + Institutional Controls
Alternative 6B:	In-situ Groundwater Remediation + In-Situ Soil Stabilization + Long-Term Monitoring + Institutional Controls

6. Remedial Alternatives Analysis

The selection and development of the remedial alternatives was conducted in accordance with NYSDEC Division of Environmental Remediation (DER) policy, DER-15: Presumptive/Proven Remedial Technologies. The presumptive remedy approach is to select remedies that have already been proven to be both feasible and cost effective so as to make the remedy selection quicker. In accordance with Section 1 of DER-15, no action, institutional controls, capping, and excavation alternatives are evaluated in this section along with select presumptive remedies for groundwater contaminated with metals.

The remedial alternatives selected for evaluation in this Section achieve remediation of groundwater by treatment of groundwater in the source area or removal of the contaminants in the source material. For this Feasibility Study, it is assumed that the plume is stable due to the length of time that has passed since the known spill that occurred in 1965.

This Section presents an analysis of the potential remedial alternatives for remediation of the Former Paulsen-Holbrook Site in accordance with the criteria described in Section 4.3.

6.1. Remedial Alternatives Evaluation

6.1.1. Alternative 1: No Action

6.1.1.1. Description

The no action alternative will serve as the baseline representing the minimum steps to be taken for remediation of the area.

6.1.1.2. Overall protection of public health and the environment

The No Action alternative would not be protective of public health and the environment. Soil and groundwater impacted by metals would be left at the site and within the plume that has likely migrated off-site. Contaminated soil at the site exists both at the surface and at greater depths (at least up to 40 feet bgs). Water users in the area of the site are supplied with public drinking water; therefore, potential future exposure to contaminated groundwater would be to construction/excavation activities at the site or adjacent property. This exposure pathway could be reduced through the use of appropriate health and safety protocols during any such work.

6.1.1.3. Compliance with SCGs

The No Action alternative would not meet the SCGs over the long term as the contaminants have been present at the site for more than 40 years and still exceed SCGs.

6.1.1.4. Long-Term Effectiveness and Permanence

The No Action alternative would not be effective in the long-term as the contaminants have been present at the site for more than 40 years and still exceed SCGs.

6.1.1.5. Reduction of Toxicity, Mobility, or Volume with Treatment

The No Action alternative would not reduce the toxicity, mobility, or volume of the contaminants.

6.1.1.6. Short-Term Effectiveness

Community Protection

The No Action alternative would not be protective of the community because the soil and groundwater impacted by metals would remain on-site.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures that should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would not reduce environmental impacts as the contaminants have been present at the site for more than 40 years and still exceed SCGs.

Time Required to Implement

The No Action alternative would not require any time to implement.

6.1.1.7. Implementability

The No Action alternative can be easily implemented.

6.1.1.8. Cost

The No Action Alternative would not require any additional costs to implement.

6.1.2. Alternative 2: Institutional Controls and Long-Term Monitoring

6.1.2.1. Description

Alternative 2 would include all of the elements of the No Action alternative, plus the implementation of restrictions on the access to on-site soil, and the use of groundwater at the site and in the area of the likely off-site plume. Land restrictions would include deed restrictions to minimize exposure to potentially contaminated soil. Groundwater use restrictions would include deed restrictions to prevent future use of the groundwater and control activities at the site in accordance with the NYSDEC requirements.

This alternative would not actively reduce contaminant concentrations. However, this alternative would be effective in minimizing exposure to subsurface soil and groundwater contaminants. Because contamination would remain both on- and likely off-site, a Site Management Plan (SMP) would be required that would provide specific requirements for site development and use, including annual site inspections. A long-term monitoring program would be implemented at the site to evaluate the extent of contaminant migration and attenuation, and would include the installation of two off-site groundwater monitoring well clusters (each containing a shallow and deep monitoring well) down-gradient from the source area. Semi-annual groundwater monitoring of the existing groundwater monitoring well network would be part of the long-term groundwater monitoring program.

6.1.2.2. Overall protection of public health and the environment

Alternative 2 would not be protective of public health and the environment. Soil and groundwater impacted by metals would be left at the site and within the plume that has likely migrated off-site. Contaminated soil at the site exists both at the surface and at greater depths (at least up to 40 feet bgs). Water users in the area of the site are supplied with public drinking water. Therefore, potential future exposure to contaminated groundwater would be to construction/excavation activities at the site or adjacent property. This exposure pathway could be mitigated through the use of appropriate health and safety protocols during any such work.

6.1.2.3. Compliance with SCGs

Alternative 2 would not meet the SCGs over the long term as the contaminants have been present at the site for more than 40 years and still exceed SCGs.

6.1.2.4. Long-Term Effectiveness and Permanence

Alternative 2 would not be effective in the long-term as the contaminants have been present at the site for more than 40 years and still exceed SCGs.

6.1.2.5. Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 2 would not reduce the toxicity or mobility of the contaminants.

6.1.2.6. Short-Term Effectiveness

Community Protection

Alternative 2 would not be protective to the community if the property was reopened to the public, since the soil and groundwater impacted by metals would remain on-site.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would not reduce environmental impacts.

Time Required to Implement

This alternative would likely require less than one year to implement.

6.1.2.7. Implementability

Alternative 2 could be easily implemented using readily available technologies.

6.1.2.8. Cost

The capital, O&M and present worth costs for Alternative 2 are presented in Table 5. A 30 year monitoring period was chosen for this alternative.

- **Capital Costs**: The probable capital cost to construct and implement Alternative 2 is approximately $70,800.
- **O&M Costs**: The probable annual operations, monitoring and maintenance cost for Alternative 2 is $30,000.
- **Present Worth Cost**: Over a 30 year monitoring period, the probable net present worth for this alternative is approximately $532,000. This was calculated using a 5% annual discount rate.

6.1.3. Alternative 3: Capping + Institutional Controls + Long-Term Monitoring

6.1.3.1. Description

Alternative 3 would include all of the elements of Alternative 2, plus the following items:

- Removal of drums likely containing investigation derived waste (IDW) from previous investigations;
- Demolition of two buildings in the vicinity of the wood treating facility (Figure 7);
- Excavation of the top two feet of soil that contains arsenic at concentrations greater than 6 NYCRR Unrestricted Use SCOs (Figure 7);
- Off-site disposal of excavated soil in accordance with applicable federal, state, and local regulations;
- Backfilling of excavation with 0.5 foot of clean fill;
- Installation of an engineered cap on top of clean fill consisting of: geotextile fabric, one foot of item four crushed stone, and 0.5 foot asphalt top course (Figure 7);
- Installation of two off-site monitoring well clusters (each cluster containing one shallow and one deep monitoring well) down-gradient of the source area; and
- Post-excavation groundwater monitoring and annual cap inspections/maintenance.

6.1.3.2. Overall protection of public health and the environment

Alternative 3 would be more protective of public health and the environment than the No Action alternative because the removal of surface soil coupled with an engineered asphalt cap would eliminate the exposure pathway for contaminants in the surface soil. Alternative 3 does not address subsurface soil or groundwater contamination; however, institutional controls would be used to reduce exposure pathways in the subsurface soil and groundwater.

6.1.3.3. Compliance with SCGs

Alternative 3 may meet the SCGs over the long term by removing some of the source material and by reducing infiltration of precipitation through contaminated soil.

6.1.3.4. Long-Term Effectiveness and Permanence

Alternative 3 may be effective in the long-term through removal of some of the source material and by reducing infiltration of precipitation through contaminated soil.

6.1.3.5. Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 3 would not reduce the toxicity of the contaminants, but would reduce the contaminant mass in the soil over the short-term through partial source removal. This alternative may reduce the mobility of the contaminants by reducing infiltration of precipitation through contaminated soil.

6.1.3.6. Short-Term Effectiveness

Community Protection

This alternative would be protective of the community during the short-term since the contaminants in the surface soil would be removed, exposure to subsurface soil would be controlled, and groundwater use restrictions would reduce exposure to groundwater in the area of the site.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative may over time reduce environmental impacts by reducing infiltration of precipitation through contaminated soil. However, a majority of the source contaminants would remain in place at the site.

Time Required to Implement

The time required to implement this alternative is approximately one year.

6.1.3.7. Implementability

Alternative 3 could be implemented using readily available technologies.

6.1.3.8. Cost

The capital, O&M, and present worth costs for Alternative 3 are presented in Table 6. A 10 year groundwater monitoring period was chosen for the analysis to provide sufficient time to evaluate the stability of the groundwater plume downgradient of the site.

- **Capital Costs:** The probable capital cost to construct and implement this alternative is approximately $1,721,200.
- **O&M Costs:** The probable annual operations, monitoring, and maintenance cost for this alternative is $30,000.
- **Present Worth Cost:** Over a 10 year monitoring period, the probable net present worth for this alternative is approximately $1,953,000.

6.1.4. Alternative 4: Excavation to 6 NYCRR Part 375 Unrestricted Use SCOs + Long-Term Monitoring + Institutional Controls

6.1.4.1. Description

Alternative 4 would include all of the elements of the Institutional Controls alternative, plus the following items:

- Removal of drums likely containing IDW from previous investigations;
- Demolition of two buildings in the vicinity of the wood treating facility (Figure 7);
- Excavation of approximately 6,500 yd^3 of soil that contains arsenic at concentrations greater than Unrestricted Use SCOs up to the depth of the water table, (approximately 13 feet bgs);
- Off-site disposal of excavated soil in accordance with applicable federal, state, and local regulations;
- Backfilling of excavation with clean fill following confirmation sampling that indicates that impacted soil has been removed;
- Replacement of selected monitoring wells destroyed while excavating and the installation of two off-site monitoring well clusters (each containing one shallow and one deep monitoring well) down-gradient of the source area; and
- Post-excavation groundwater monitoring.

6.1.4.2. Overall protection of public health and the environment

Alternative 4 would be more protective of public health and the environment than the No Action alternative because removal of the soil would eliminate source area contaminants. This alternative removes unsaturated source material, but does not address the groundwater plume that likely extends off-site. However, adjacent properties are served by municipal water.

6.1.4.3. Compliance with SCGs

Alternative 4 would meet the SCGs for soil above the water table and may meet the SCGs for groundwater over the long term by removing the source material.

6.1.4.4. Long-Term Effectiveness and Permanence

Alternative 4 may be effective in the long-term through removal of source material.

6.1.4.5. Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 4 would not reduce the toxicity or mobility of the contaminants, but would reduce the contaminant mass in the soil through source removal.

6.1.4.6. Short-Term Effectiveness

Community Protection

This alternative may be protective of the community during the short-term since the contaminants in the surface soil would be removed and groundwater use restrictions would reduce exposure to groundwater in the area of the site.

Worker Protection

Implementation of this alternative would be undertaken using standard procedures for worker protection including the establishment of a health and safety plan which would incorporate the appropriate protective measures which should be undertaken during any subsurface activities in the affected area.

Environmental Impacts

Implementation of this alternative would over time reduce environmental impacts through the removal of soil source areas and thereby, the removal of the source of groundwater contamination.

Time Required to Implement

The time required to implement this alternative is approximately one year.

6.1.4.7. Implementability

Alternative 4 could be implemented using readily available technologies.

6.1.4.8. Cost

The capital, O&M, and present worth costs for Alternative 4 are presented in Table 7. A 10 year groundwater monitoring period was chosen for the analysis to provide sufficient time to evaluate the stability of the groundwater plume downgradient of the site.

- **Capital Costs:** The probable capital cost to construct and implement this alternative is approximately $3,591,300.
- **O&M Costs:** The probable annual operations, monitoring, and maintenance cost for this alternative is $30,000.
- **Present Worth Cost:** Over a 10 year monitoring period, the probable net present worth for this alternative is approximately $3,823,000.

6.1.5. Alternative 5: Excavation to 6 NYCRR Part 375 Unrestricted Use SCOs + In-situ Groundwater Remediation + Long-Term Monitoring + Institutional Controls

6.1.5.1. Description

Alternative 5 would include all of the elements of Alternative 4, plus the following items:

- A pilot test, including installation of injection wells, to evaluate the applicability of reductive co-precipitation and adsorption of dissolved arsenic, chromium, and copper species via injections of carbon, zero-valent iron, and a source of sulfate. The applicability of this technology would be evaluated based on bench-scale testing of groundwater samples collected from a monitoring well network;

- Injection of carbon, zero-valent iron, and a source of sulfate as primary source area treatment through injection wells (Figure 7);

- Pre- and Post-injection groundwater sampling; and

- Groundwater monitoring.

6.1.5.2. Overall protection of public health and the environment

Alternative 5 would be more protective of human health and the environment than the No Action alternative because of source removal coupled with the uses of carbon, zero-valent iron, and a source of sulfate would result in the treatment of contaminants in the subsurface, thereby reducing the potential for exposure pathways.

6.1.5.3. Compliance with SCGs

Alternative 5 would meet the SCGs in a relatively short period by removing source material and treating the contaminants in the subsurface.

6.1.5.4. Long-Term Effectiveness and Permanence

Removal of source material coupled with the use of carbon, zero-valent iron, and a source of sulfate would treat the contaminants in the subsurface and would, therefore, be effective over the long-term.

6.1.5.5. Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 5 would reduce the volume of chromium, arsenic, and copper by removal of contaminated soil. Alternative 5 would reduce the toxicity of chromium, by reducing dissolved chromium species from hexavalent chromium [Cr(VI)] to trivalent chromium [Cr(III)]. Additionally, this alternative would immobilize dissolved chromium by precipitating stable iron minerals and adsorbing to iron oxides.

Alternative 5 would initially increase the toxicity of arsenic by reducing dissolved arsenic species from arsenate [As(V)] to arsenite [As(III)], but would then rapidly immobilize the contaminants, by precipitating stable sulfides. The immobilization of dissolved arsenic takes place in two steps, first the arsenic oxyanions would be quickly adsorbed onto the iron oxyhydroxide phases. Then arsenic oxyanions would be reduced and co-precipitate with sulfide and additional iron phases formed.

6.1.5.6. Short-Term Effectiveness

Community Protection

Alternative 5 would be protective of the community during the short-term since the contaminants in the surface soil would be removed. Additionally, it is anticipated that the use of carbon, zero-valent iron, and a source of sulfate would rapidly treat the contaminants in the groundwater.

Worker Protection

Utility workers would be protected under Alternative 5 since the use of carbon, zero-valent iron, and a source of sulfate would result in the treatment of contaminants in the subsurface.

Environmental Impacts

Implementation of this alternative would benefit the environment through the removal of source material and treatment of contaminants in the subsurface.

Time Required to Implement

The time required to implement this alternative is approximately two years.

6.1.5.7. Implementability

Removal of contaminated soil could be implemented using readily available technologies. Performing injections and routine groundwater sampling and monitoring activities are actions that can also be readily implemented at the site.

6.1.5.8. Cost

The capital, O&M and present worth costs for Alternative 5 are presented in Table 8. A five year monitoring period was chosen for this alternative to verify steady state conditions and to provide sufficient time to monitor the effectiveness of the groundwater source remediation.

- **Capital Costs**: The probable capital cost to construct and implement this alternative is $3,860,500.

- **O&M Costs**: The probable annual operations, monitoring and maintenance cost for this alternative is $30,000.

- **Present Worth Cost**: Over a five year monitoring period, the probable net present worth for this alternative is approximately $3,990,000. This was calculated using a 5% annual discount rate.

6.1.6. Alternative 6A: In-Situ Soil Stabilization/Solidification + Long-Term Monitoring + Institutional Controls

6.1.6.1. Description

Alternative 6A would include all of the elements of Alternative 2, plus the following items:

- Bench scale treatability testing of soil samples, to evaluate the valence state of metals and other geochemical parameters of soil at the site, assess which compounds (i.e. portland cement, ferrous iron salt, and/or other compounds) to use to achieve soil stabilization, and to evaluate the post-treatment geotechnical characteristics of the treated soil;

- Removal of drums likely containing IDW from previous investigations;

- Demolition of two buildings in the vicinity of the wood treating facility (Figure 7);

- Off-site disposal of approximately 10 percent of the total volume of treated soil (due to volume increase resulting from treatment) as F035 hazardous waste in accordance with applicable federal, state, and local regulations;

- Mixing of soil with compounds, as determined from bench scale testing, to achieve stabilization and solidification of the contaminated soil. The soil treated in this alternative includes contaminated soil above and below the water table to a maximum depth of 40 feet below ground surface;

- Pre- and Post-mixing groundwater sampling;

- Replacement of selected monitoring wells destroyed while using in-situ stabilization/solidification techniques and the installation of two off-site monitoring well clusters (each containing one shallow and one deep monitoring well) down-gradient of the source area; and

- Groundwater monitoring.

6.1.6.2. Overall protection of public health and the environment

Alternative 6A would be more protective of human health and the environment than the No Action alternative because the use of stabilization/solidification techniques would result in the treatment of contaminants in the subsurface, thereby reducing the potential for exposure pathways. This alternative does not address the groundwater plume that likely extends off-site. However, water users in the area of the site are supplied with public drinking water; therefore, potential future exposure to contaminated groundwater would be to construction/excavation activities at the site or adjacent property.

6.1.6.3. Compliance with SCGs

Alternative 6A would meet the SCGs for soil in a relatively short period by the use of stabilization/solidification techniques, which would treat the contaminants in the subsurface soil. However, the affected soil would still be classified as a class F035 hazardous waste. Alternative 6A may meet the SCGs for groundwater over the long term by stabilizing metals in the source area.

6.1.6.4. Long-Term Effectiveness and Permanence

The stabilization/solidification techniques would treat the contaminants in the subsurface soil and would, therefore, likely be effective over the long-term.

6.1.6.5. Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 6A would reduce the mobility of the metals in the subsurface through incorporation into the cement matrix using stabilization/solidification techniques. Alternative 6A would also reduce the toxicity of the contaminants as the metals will not leach from the treated soil at concentrations greater than the TCLP standard for arsenic and chromium (5 mg/l).

6.1.6.6. Short-Term Effectiveness

Community Protection

Alternative 6A would be protective of the community during the short-term since stabilization/solidification techniques would result in the immediate treatment of contaminants in the subsurface.

Worker Protection

Utility workers would be protected under Alternative 6A since stabilization/solidification techniques would result in the treatment of contaminants in the subsurface.

Environmental Impacts

Implementation of this alternative would benefit the environment through the treatment of contaminants in the subsurface.

<u>Time Required to Implement</u>

The time required to implement this alternative is approximately two years.

6.1.6.7. Implementability

In-situ stabilization/solidification and routine groundwater sampling and monitoring activities are actions that can be readily implemented at the site.

6.1.6.8. Cost

The capital, O&M and present worth costs for Alternative 6A are presented in Table 9. A five year monitoring period was chosen for this alternative to verify steady state conditions and to provide sufficient time to monitor the effectiveness of the soil source remediation.

- **Capital Costs**: The probable capital cost to construct and implement this alternative is $2,340,400.
- **O&M Costs**: The probable annual operations, monitoring and maintenance cost for this alternative is $30,000.
- **Present Worth Cost**: Over a five year monitoring period, the probable net present worth for this alternative is approximately $2,470,000. This was calculated using a 5% annual discount rate.

6.1.7. Alternative 6B: In-Situ Soil Stabilization/Solidification (to the water table) + In-situ Groundwater Remediation + Long-Term Monitoring + Institutional Controls

6.1.7.1. Description

Alternative 6B would include all of the elements of Alternative 2, plus the following items:

- Bench scale treatability testing of soil samples, to evaluate the valence state of metals and other geochemical parameters of soil at the site, assess which compounds (i.e. portland cement, ferrous iron salt, and/or other compounds) to use to achieve soil stabilization, and to evaluate the post-treatment geotechnical characteristics of the treated soil;
- Removal of drums likely containing IDW from previous investigations;
- Demolition of two buildings in the vicinity of the wood treating facility (Figure 7);

- A pilot test, including installation of injection wells, to evaluate the applicability of reductive co-precipitation and adsorption of dissolved arsenic species via injections of carbon, zero-valent iron, and a source of sulfate. The applicability of this technology would then be evaluated based on groundwater samples collected from a monitoring well network;
- Injection of carbon, zero-valent iron, and a source of sulfate as source material treatment through injection wells (Figure 7);
- Pre- and Post-injection groundwater sampling;
- Off-site disposal of approximately 10 percent of the total volume of treated soil (due to volume increase from treatment) as F035 hazardous waste in accordance with applicable federal, state, and local regulations;
- Mixing of soil with compounds, as determined from bench scale testing, to achieve stabilization and solidification of the contaminated soil. The soil treated in this alternative includes contaminated soil above the water table (maximum depth of 13 feet below ground surface);
- Replacement of selected monitoring wells destroyed while using in-situ stabilization/solidification techniques and installation of two off-site monitoring well clusters (each containing one shallow and one deep monitoring well) down-gradient of the source area;
- Groundwater monitoring;

6.1.7.2. Overall protection of public health and the environment

Alternative 6B would be more protective of human health and the environment than the No Action alternative because the use of stabilization/solidification techniques coupled with the use of carbon, zero-valent iron, and a source of sulfate would result in the treatment of contaminants in the subsurface, thereby reducing the potential for exposure pathways.

6.1.7.3. Compliance with SCGs

Alternative 6B would meet the SCGs in a relatively short period by using stabilization/solidification techniques and treating the contaminants in the saturated subsurface.

6.1.7.4. Long-Term Effectiveness and Permanence

The stabilization/solidification techniques coupled with the use of carbon, zero-valent iron, and a source of sulfate would treat the contaminants in the subsurface and would, therefore, be effective over the long-term.

6.1.7.5. Reduction of Toxicity, Mobility, or Volume with Treatment

Alternative 6B would reduce the mobility of the metals in the unsaturated soil through incorporation into the cement matrix using stabilization/solidification techniques, and would also reduce the toxicity of the contaminants as the metals will not leach from the treated soil at concentrations greater than the TCLP standard for arsenic and chromium (5 mg/l). This alternative would reduce the mobility and toxicity of metals in the saturated soil by precipitating stable sulfides.

6.1.7.6. Short-Term Effectiveness

Community Protection

Alternative 6B would be protective of the community during the short-term since stabilization/solidification techniques and the use of carbon, zero-valent iron, and a source of sulfate would result in the immediate treatment of contaminants in the subsurface.

Worker Protection

Utility workers would be protected under Alternative 6B since stabilization/solidification techniques and the use of carbon, zero-valent iron, and a source of sulfate would result in the treatment of contaminants in the subsurface.

Environmental Impacts

Implementation of this alternative would benefit the environment through the treatment of contaminants in the subsurface.

Time Required to Implement

The time required to implement this alternative is approximately two years.

6.1.7.7. Implementability

Performing in-situ stabilization/solidification, groundwater injections, routine groundwater sampling, and monitoring activities are actions that can be readily implemented at the site.

6.1.7.8. Cost

The capital, O&M and present worth costs for Alternative 6B are presented in Table 10. A five year monitoring period was chosen for this alternative to verify steady state conditions and to provide sufficient time to monitor the effectiveness of the soil and groundwater source remediation.

- **Capital Costs**: The probable capital cost to construct and implement this alternative is $1,852,400.

- **O&M Costs**: The probable annual operations, monitoring and maintenance cost for this alternative is $30,000.

- **Present Worth Cost**: Over a five year monitoring period, the probable net present worth for this alternative is approximately $1,982,000. This was calculated using a 5% annual discount rate.

6.2. Comparative Analysis

6.2.1. Overview

The RAOs for the Former Paulsen-Holbrook Site are concerned with the prevention of contact with contaminated soil and groundwater and the remediation of the affected media to pre-release conditions or the Unrestricted Use SCOs and NYSDEC Class GA Standards for soil and groundwater, respectively. The alternatives presented for the site provide varying levels of remedial actions.

Alternative 1, the No Action alternative, defines the minimum steps to be taken for remediation of the site. This alternative alone would not meet the RAOs over the long-term. Alternative 2, the Institutional Controls plus Long-Term Monitoring alternative, is similar to the No Action alternative, but would include deed restrictions, activity/use limitations for soil and groundwater, and groundwater monitoring to document plume configuration over time. All the remaining alternatives include the components of the No Action and Institutional Controls plus Long-Term Monitoring alternatives. Alternative 3, Capping with excavation, would likely meet the RAOs for soil over the short-term at the site itself, and may address the RAOs for groundwater by reducing infiltration of precipitation through contaminated soil. Alternative 4, Excavation, would likely meet the RAOs for soil over the short-term, and may address the RAOs for groundwater by removing the source of contaminants. Alternatives 5, 6A, and 6B (Excavation plus In-Situ Groundwater Remediation, In-Situ Soil Stabilization/Solidification, and In-Situ Groundwater Remediation plus In-Situ Soil Stabilization/Solidification, respectively) would likely meet the RAOs for soil and groundwater.

6.2.2. Overall Protection of Public Health

Alternative 1 would not be protective of human health and the environment, as the contaminated soil would remain in place and the groundwater would be left untreated. If the site remains closed to the public, routes of exposure are limited to construction workers, utility workers, and trespassers. Exposure to construction and utility workers can be controlled through the implementation of health and safety protocols for work in the area.

Alternative 2 provides a similar level of protection to Alternative 1 except that property and groundwater use would be restricted and the potential exposure pathways would be monitored over time. Therefore, Alternative 2 would be protective of human health and the environment by providing control of potential exposure pathways.

Alternatives 3 and 4 would be more protective than Alternatives 1 and 2 because direct contact with on-site source material would be eliminated through capping, excavation, and waste removal.

Alternative 5, 6A, and 6B would be protective of human health because each method would provide the protective measures of Alternatives 3 and 4 in addition to the treatment of contaminants below the water table, thereby reducing construction/utility worker exposure pathways.

6.2.3. Compliance with SCGs

Alternatives 1 and 2 would not meet the SCGs. Alternatives 3 and 4 may meet the SCGs with time. Alternatives 5, 6A, and 6B are capable of meeting SCGs in less time.

6.2.4. Long-Term Effectiveness and Permanence

Alternative 1 would not be effective in the long-term. Alternative 2 would be more effective than Alternative 1 through control of exposure pathways. Alternatives 3, 4, 5, 6A, and 6B would be effective in the long-term. However, Alternatives 4 and 5 which include soil removal, would be more permanent than Alternatives 6A, and 6B which consists of stabilization/solidification technologies. Alternative 5 would be the most effective in the long-term, and most permanent, because contaminated soil would be excavated and groundwater in the source area would be treated.

6.2.5. Reduction of Toxicity, Mobility, or Volume with Treatment

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume of the contaminants. Alternative 3 would reduce the contaminant volume by removal of two feet of contaminated soil, and the mobility of contaminants by preventing infiltration of precipitation through contaminated soil in the capped areas.

Alternatives 4 and 5 would more effectively reduce contaminant volume and mobility through removal of contaminated soil to the water table (approximately 13 feet bgs). Alternative 5 would reduce the mobility of contaminants to a greater extent than Alternative 4 by also treating the saturated soil in the source area in-situ.

Alternative 6A and 6B would reduce the mobility and toxicity of the contaminants through the use of stabilization/solidification techniques, which would incorporate the contaminants into the cement matrix from which they would not leach. Alternative 6B would further reduce the mobility and toxicity of contaminants in the saturated soil through in-situ treatment. Alternatives 6A and 6B would also slightly reduce the contaminant volume by removal of 10 percent of the volume of soil treated.

6.2.6. Short-Term Effectiveness

Alternative 1 would not be effective in the short-term. Alternative 2 would be more effective than Alternative 1 through control of exposure pathways. Alternatives 3 and 4 would be most effective in the short term. Alternatives 5, 6A, and 6B would be effective in the short-term, but may take longer to implement than Alternatives 3 and 4 because pilot and bench scale tests would be necessary.

6.2.7. Implementability

Each of the alternatives could be readily implemented using regionally available resources.

6.2.8. Cost

A comparison of the costs for each alternative is provided in Table 11. The ranking of each of the alternatives, in order of estimated cost (from lowest to highest) is shown below.

1. Alternative 1 – No Action;
2. Alternative 2 – Institutional Controls + Long-Term Monitoring;
3. Alternative 3 – Capping + Institutional Controls + Long-Term Monitoring;
4. Alternative 6B – In-Situ Groundwater Remediation + In-Situ Soil Stabilization/Solidification + Long-Term Monitoring + Institutional Controls;
5. Alternative 6A – In-Situ Stabilization/Solidification + Long-Term Monitoring + Institutional Controls;
6. Alternative 4 – Excavation to Unrestricted Use SCOs + Long-Term Monitoring + Institutional Controls; and
7. Alternative 5 – Excavation to Unrestricted Use SCOs + In-Situ Groundwater Remediation + Long-Term Monitoring + Institutional Controls.

7. References

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New York State Department of Environmental Conservation

Feasibility Study Report

Figures

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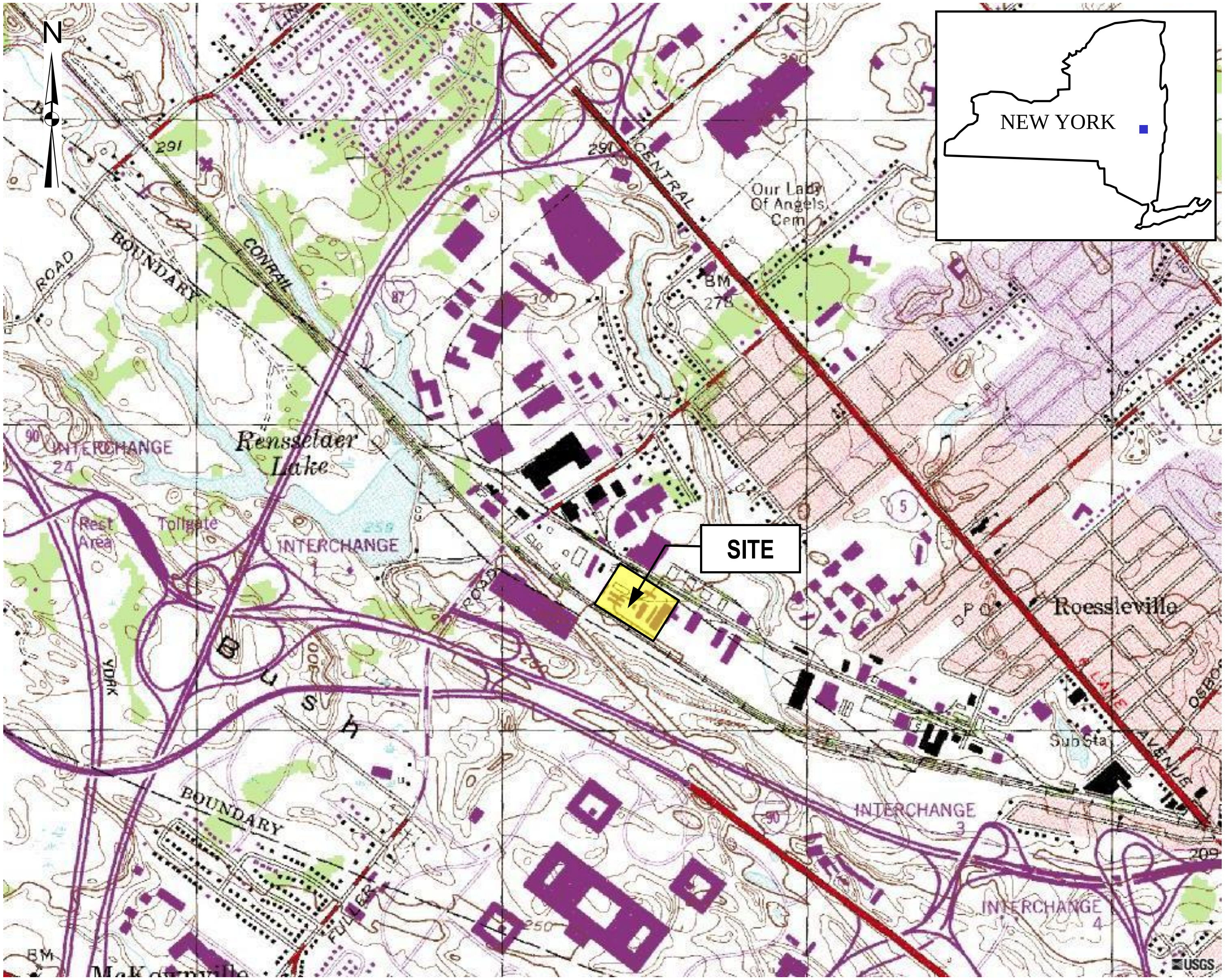
MALCOLM PIRNIE



0 1500 3000 6000

APPROXIMATE SCALE IN FEET

Source: USGS 7.5 minute Topographic Map
Albany, NY. 1994

MALCOLM PIRNIE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
FORMER PAULSEN-HOLBROOK SITE (# 401046)
TOWN OF GUILDERLAND, ALBANY COUNTY, NEW YORK
FEASIBILITY STUDY

SITE LOCATION

FIGURE 1

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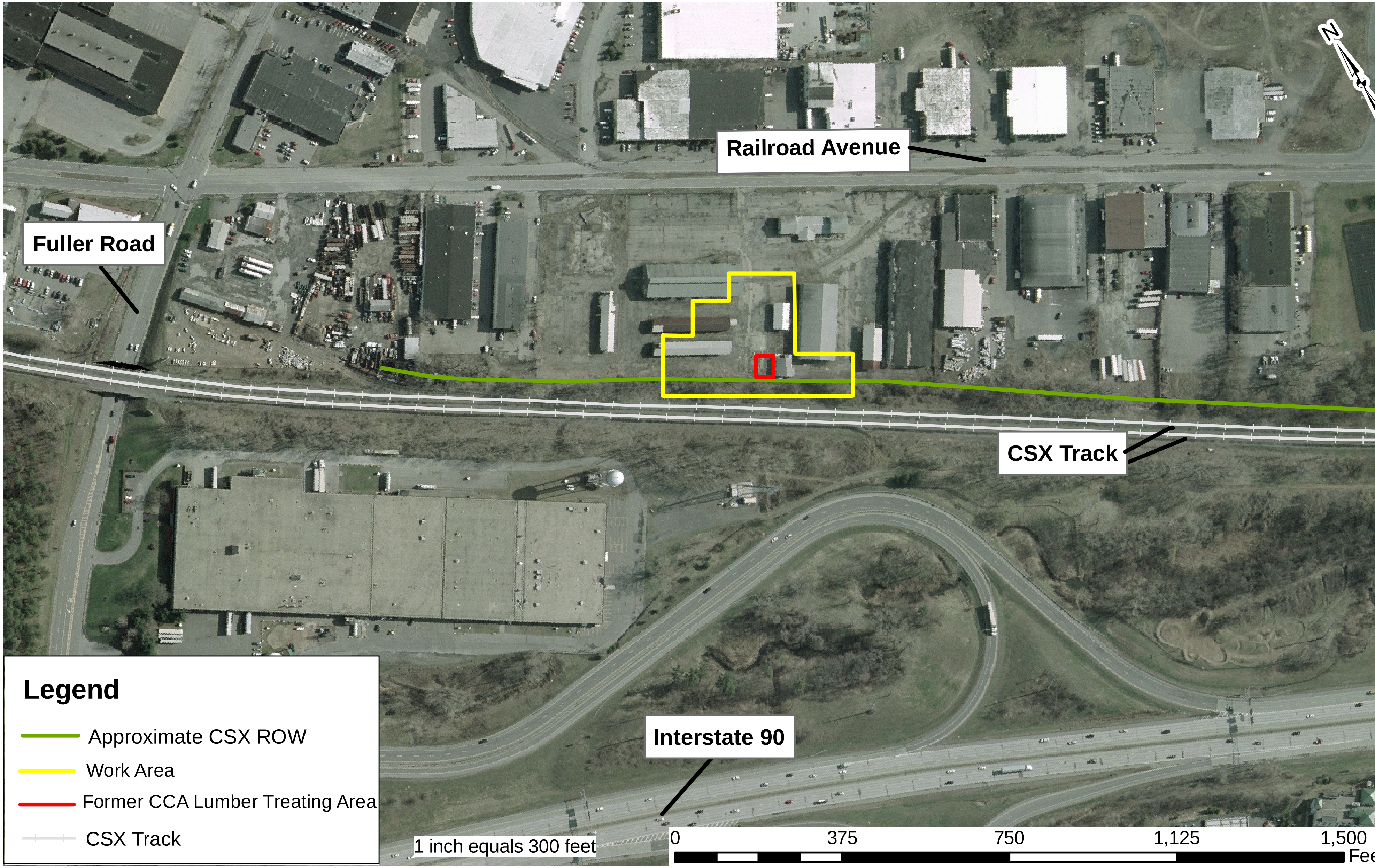

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
FORMER PAULSEN HOLBROOK SITE (#401046)
TOWN OF GUILDERLAND, ALBANY COUNTY, NEW YORK STATE

FEASIBILITY STUDY

WORK AREA

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FIGURE 2

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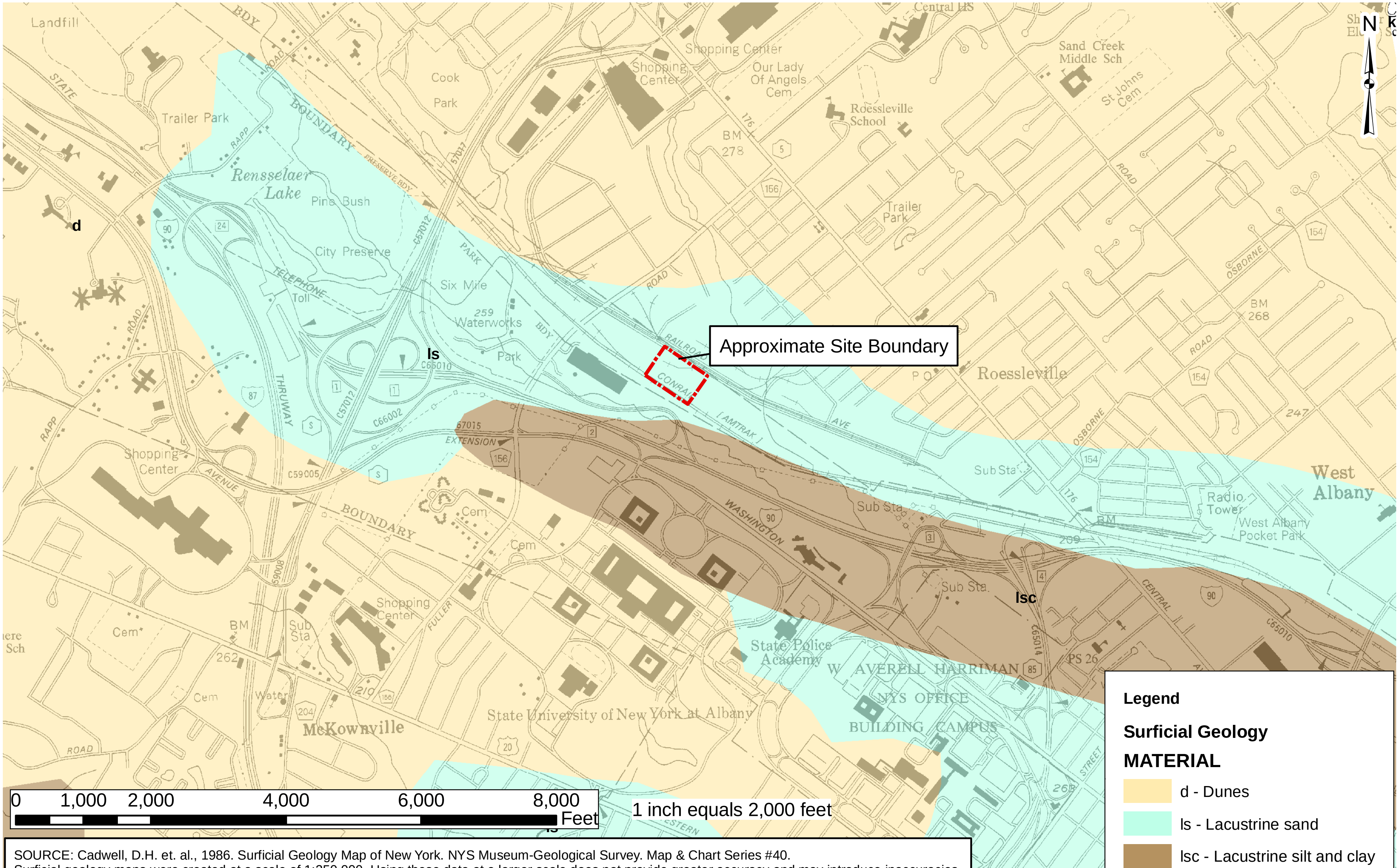

SOURCE: Cadwell, D.H. et. al., 1986. Surficial Geology Map of New York. NYS Museum-Geological Survey. Map & Chart Series #40.
Surficial geology maps were created at a scale of 1:250,000. Using these data at a larger scale does not provide greater accuracy and may introduce inaccuracies.

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
FORMER PAULSEN-HOLBROOK SITE (# 401046)
TOWN OF GUILDERLAND, ALBANY COUNTY, NEW YORK

FEASIBILITY STUDY

SURFICIAL GEOLOGY MAP

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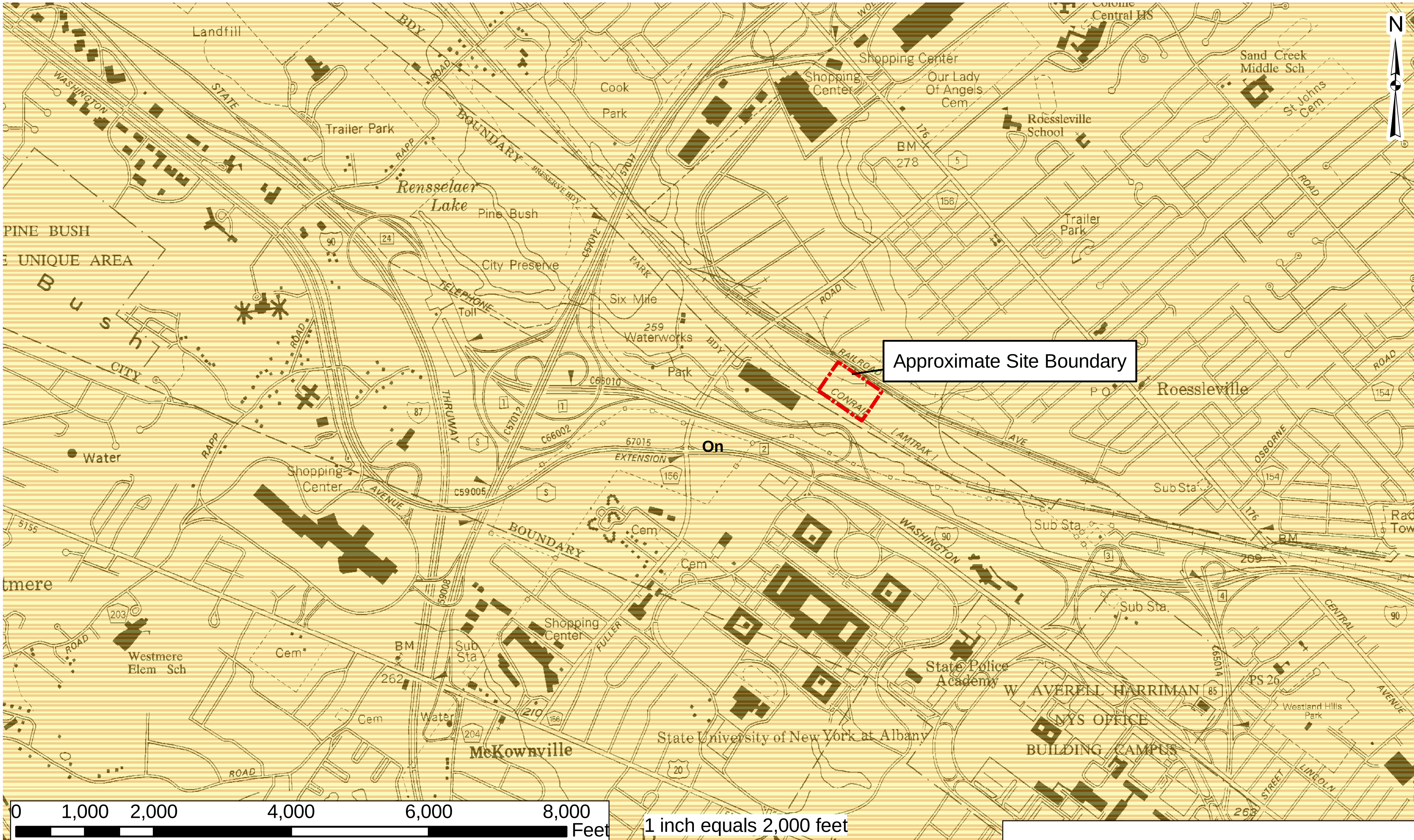
FIGURE 3

M:\GISMOD\0266376\bedrock_geo.mxd



SOURCES: NYS Department of Transportation, Albany Quadrangle, Scale 1:24,000, 1993.
Fisher, D.W. et. al., 1970. New York State Museum and Science Service, Map and Chart Series No. 15, Hudson Mohawk Sheet.
Surficial geology maps were created at a scale of 1:250,000. Using these data at a larger scale does not provide greater accuracy and may introduce inaccuracies.

Legend

On - Normanskill shale, minor mudstone, sandstone.

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
FORMER PAULSEN-HOLBROOK SITE (# 401046)
TOWN OF GUILDERLAND, ALBANY COUNTY, NEW YORK

FEASIBILITY STUDY

BEDROCK GEOLOGY MAP

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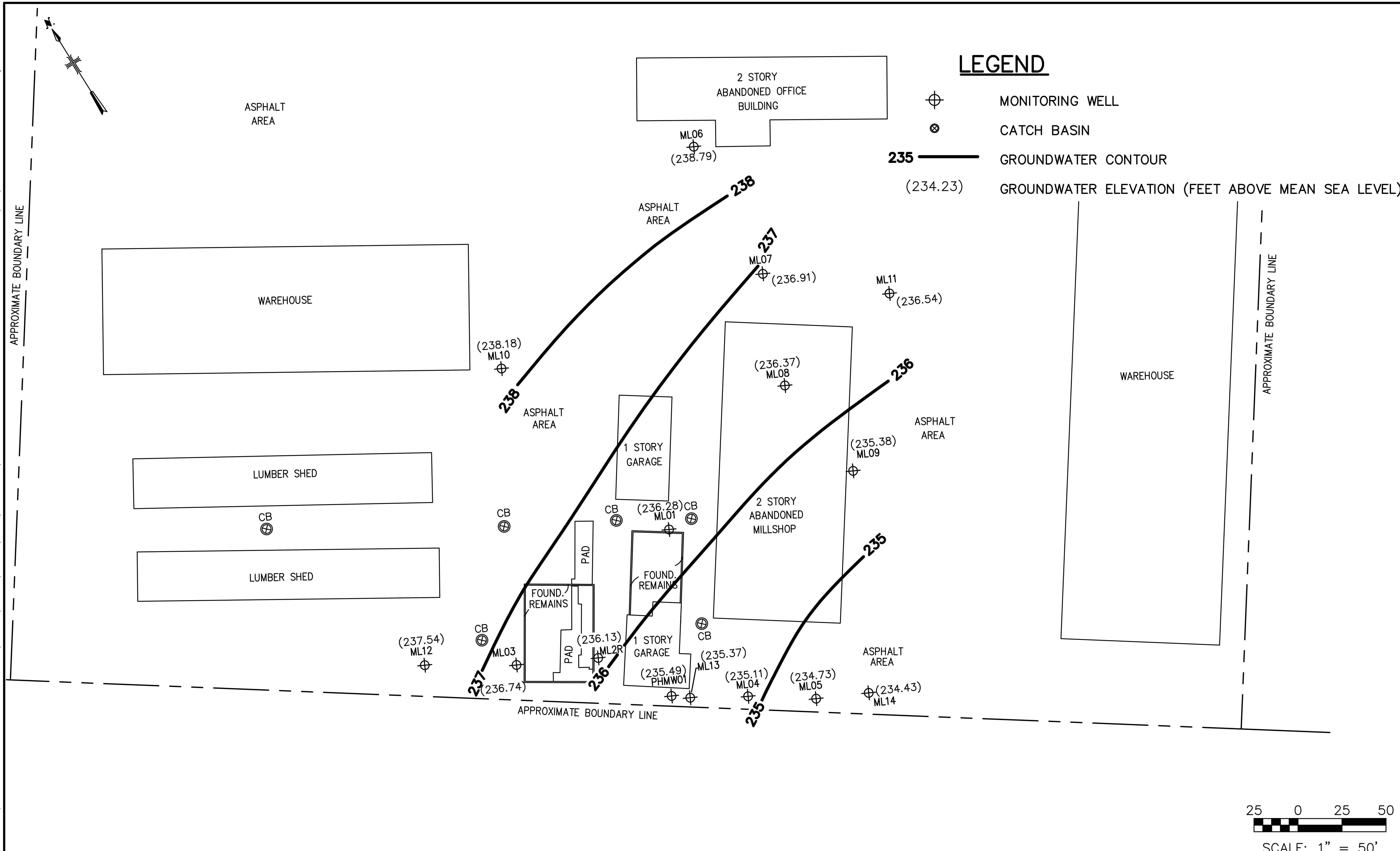
FIGURE 4



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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
GUILDERLAND, NEW YORK

FORMER PAULSEN-HOLBROOK SITE (#401046)
WORK ASSIGNMENT # D-00439-21

POTENTIOMETRIC MAP
(NOVEMBER 21, 2008)
SCALE: 1"=50'

MALCOLM PIRNIE, INC.
MARCH 2009
FIGURE 5

XREFS:I:\ACAD\PROJ\0266\376\PROJLIB\Basemap.dwg IMAGES:None
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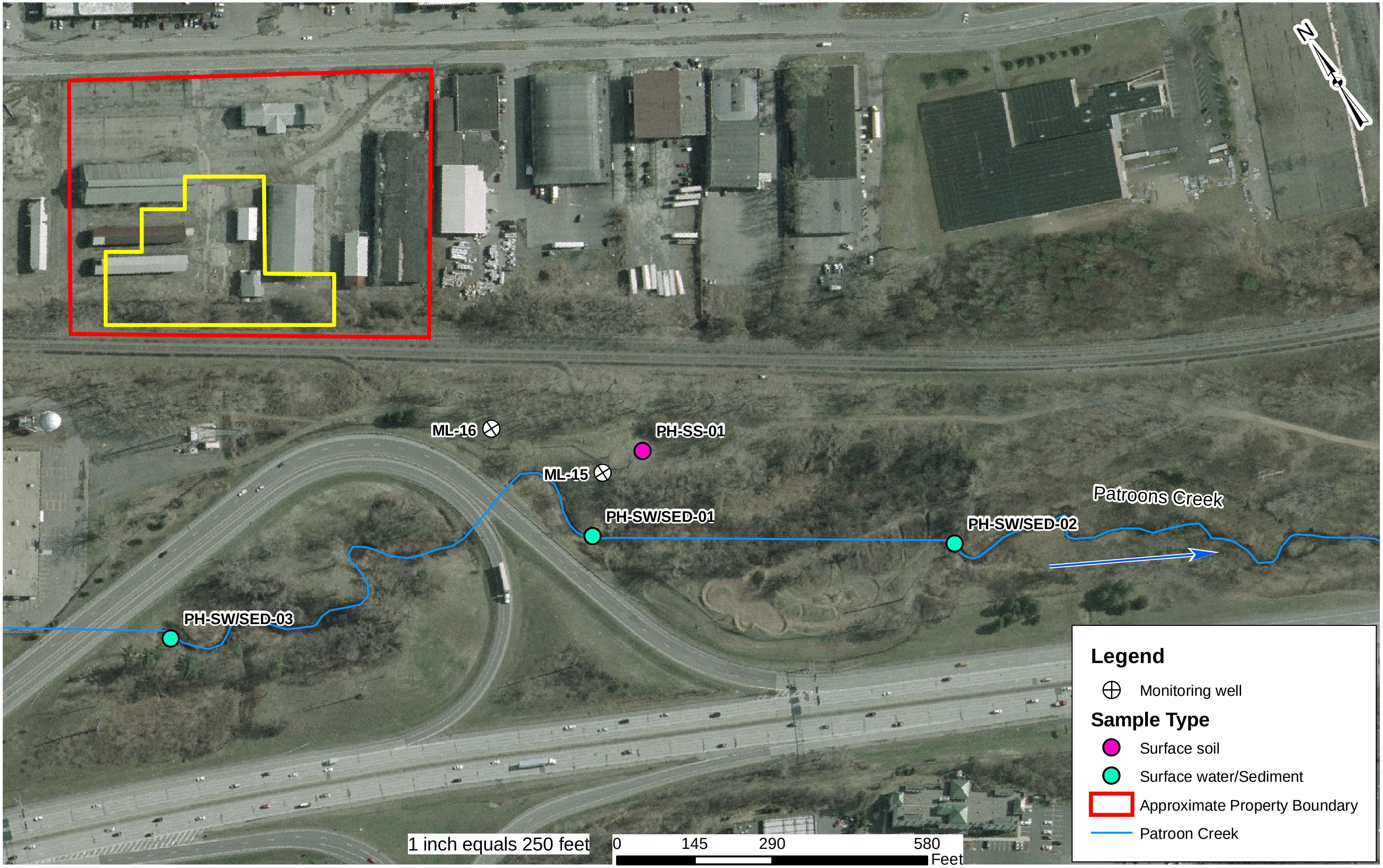

SOURCE: NYSDOP High Resolution Imagery, 2004. NYS GIS Clearing House.

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
FORMER PAULSON - HOLBROOK SITE (# 401046)
TOWN OF GUILDERLAND, ALBANY, NEW YORK
FEASIBILITY STUDY

SURAFCE WATER AND SEDIMENT SAMPLING LOCATIONS

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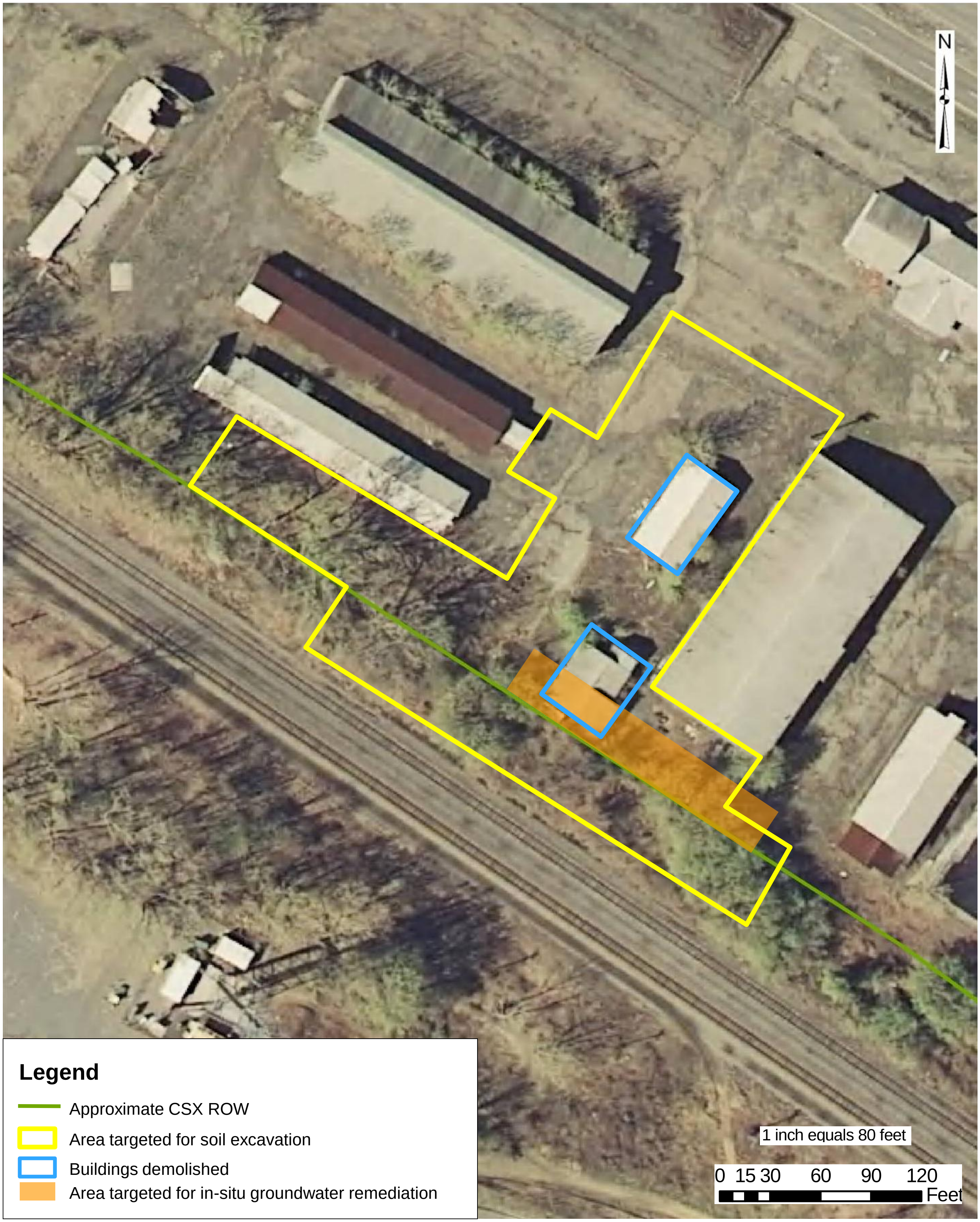
FIGURE 6



SOURCE: NYSDOP High resolution imagery, 2007; NYSGIS Clearing House

MALCOLM PIRNIE	NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION FORMER PAULSON-HOLBROOK SITE (#401046) TOWN OF GUILDERLAND, ALBANY COUNTY, NEW YORK **OVERVIEW OF REMEDIAL ALTERNATIVES**	**DECEMBER 2009** **FIGURE 7**

New York State Department of Environmental Conservation

Feasibility Study Report

Tables

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MALCOLM PIRNIE

Table 1. Summary of Groundwater Elevations
Former Paulsen-Holbrook Site (# 401046)
Gulderland, New York

MONITORING WELL ID	NORTHING	EASTING	TOP OF CASING ELEVATION (FEET)	DEPTH TO WATER (FEET)	GROUNDWATER ELEVATION (FEET)
ON-SITE MONITORING WELLS					
PH-MW-01	1407459.918	674271.5521	249.28	13.79	235.49
ML-01	14074549.67	674271.6047	248.89	12.61	236.28
ML-2R	1407419.475	674198.9544	249.08	12.95	236.13
ML-03	1407440.749	674157.3019	249.34	12.60	236.74
ML-04	1407355.515	674259.3045	247.54	12.43	235.11
ML-05	1407333.724	674291.1166	246.83	12.10	234.73
ML-06	1407636.414	674399.0165	249.76	10.97	238.79
ML-07	1407554.564	674393.9344	249.16	12.25	236.91
ML-08	1407493.920	674370.8600	249.27	12.90	236.37
ML-09	1407432.264	674377.9266	247.80	12.42	235.38
ML-10	1407587.710	674239.7905	251.13	12.95	238.18
ML-11	1407506.925	674449.1413	248.03	11.49	236.54
ML-12	1407468.454	674113.3429	249.97	12.43	237.54
ML-13	1407372.415	674230.8058	248.88	13.51	235.37
ML-14	1407320.825	674318.6869	246.47	12.04	234.43
OFF-SITE MONITORING					
ML-15	1406749.428	674595.4719	241.94	17.57	224.37
ML-16	1406932.304	674465.1574	238.67	6.40	232.27

NOTE:
Horizontal Datum NAD 1983/96 NYSPCS East Zone Feet; Vertical Datum NAVD 1988

TABLE 5
Remedial Alternative Cost Summary

Alternative 2
Institutional Controls + Long-Term Monitoring

OPINION OF PROBABLE COST

Site:	Former Paulsen-Holbrook Site
Location:	Guilderland, New York
Phase:	Feasibility Study (-30% to +50%)
Base Year:	2009
Date:	November 2009

Description: Alternative 2 consists of institutional controls and long-term groundwater monitoring (LTM) using the existing well network with the addition of two down-gradient well clusters. Capital costs are incurred in Year 1. O&M costs are incurred in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Additional Groundwater Monitoring Well Installation					
Mobilization	1	lump sum	$2,500	$2,500	
Overburden Well Installation (including drilling, well supplies, protective covering, and development)	2	1	$4,000	$8,000	
Soil Cuttings Disposal	3	drums	$400	$1,200	Assumes soil cuttings as hazardous
Removal of Drums from Previous Investigations					
Transportation & Disposal (F035 haz. waste)	10	drums	$400	$4,000	
SUBTOTAL				$40,700	
Contingency	20%			$8,140	
SUBTOTAL				$48,840	
Design/Project Management*	30%			$14,652	
Remedial Oversight/Reporting*	15%			$7,326	
TOTAL CAPITAL COST				**$70,800**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling & Analysis	2	YR	$10,000	$20,000	Semi-annual sampling - 10 wells
Data Evaluation and Reporting	2	YR	$5,000	$10,000	
SUBTOTAL				$30,000	
TOTAL ANNUAL O&M COST				**$30,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$70,800	$70,800	1.00	$70,800	
Annual OM&M	1-30	$900,000	$30,000	15.37	$461,174	
					$531,974	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$532,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 6
Remedial Alternative Cost Summary

Alternative 3
Capping + Long-Term Monitoring + Institutional Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2009
Date: November 2009

Description: Alternative 3 consists of Alternative 2 (Institutional Controls + LTM) plus excavating the top two feet of affected soil, replacing soil removed with clean fill and then using an engineered 6-inch asphalt cap (38,300 sq. ft) with appropriate sub grades. Capital costs are incurred in Year 1. O&M costs are incurred in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Work					
Mobilization	1	lump sum	$60,000	$60,000	
Site Preparation & Staging	1	1	$5,000	$5,000	
Demolition of Two Buildings	43,000	CF	$0.5	$19,780	Assumes 12' high bldgs.
Demolition of Two Buildings Slabs	3,600	drum	$4	$14,400	Assumes 6" concrete slab with mesh reinforcing .
Loading, Transportation & Disposal of C &D (non-haz.)	83	Tons	$125	$10,375	Assumes most C&D classified as Non-Hazardous waste
Loading, Transportation & Disposal of C &D (F035)	100	Tons	$225	$22,500	Assumes slab of bldgs. considered hazardous waste (F035)
SUBTOTAL				$157,055	
Removal of Drums from Previous Investigations					
Transportation & Disposal (F035 haz. waste)	10	drums	$400	$4,000	
SUBTOTAL				$4,000	
Excavation of Top Two-feet of Hazardous Soil					
Site Preparation & Staging	1	1	$2,500	$2,500	
Excavation	2,840	CY	$6	$17,210	Assumes excavation of top two feet of soil.
Loading, Transportation & Disposal of Soil	2,160	Tons	$225	$486,000	Assumes soil as hazardous waste (F035).
Loading, Transportation & Disposal of Soil	2,440	Tons	$125	$305,000	Assumes soil as non-hazardous waste.
Furnish & Deliver General Fill	710	CY	$15	$10,650	Assumes 6" of backfill.
Spreading and Compact General Fill	710	CY	$5	$3,550	
SUBTOTAL				$824,910	
Capping					
Geotextile Fabric	4,260	SY	$1	$4,984	
Crushed Stone (12")	1,410	ECY	$36	$50,619	Assumes 12" of Item 4 Crushed Stone (Embankment Cubic Yard).
Top Course Asphalt Cap	710	CY	$120	$85,115	Assumes 6" of Top Course Asphalt Cap.
SUBTOTAL				$140,718	
Additional Groundwater Monitoring Well Installation					
Mobilization	1	lump sum	$2,500	$2,500	
Overburden Well Installation (including drilling, well supplies, protective covering, and development)	2	1	$4,000	$8,000	
Soil Cuttings Disposal	3	drums	$400	$1,200	Assumes soil cuttings as Hazardous waste (F035).
SUBTOTAL				$11,700	
SUBTOTAL				$1,138,383	
Contingency	20%			$227,677	
SUBTOTAL				$1,366,060	
Design/Project Management*	18%			$245,891	
Remedial Oversight/Reporting*	8%			$109,285	
TOTAL CAPITAL COST				**$1,721,200**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling & Analysis	2	YR	$10,000	$20,000	Semi-annual sampling - 10 wells
Data Evaluation and Reporting	2	YR	$5,000	$10,000	
SUBTOTAL				$30,000	
TOTAL ANNUAL O&M COST				**$30,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$1,721,200	$1,721,200	1.00	$1,721,200	
Annual OM&M	1-10	$300,000	$30,000	7.72	$231,652	
					$1,952,852	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$1,953,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 7
Remedial Alternative Cost Summary

Alternative 4
Excavation to meet 6 NYCRR Unrestricted Use SCOs + Long-Term Monitoring + Plus Institutional Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2009
Date: November 2009

Description: Alternative 4 consists of Alternative 2 (Institutional Controls + LTM) plus soil excavation to meet 6NYCRR Unrestricted Use SCOs with maximum excavation depth to the water table and backfill, source area drum/debris removal, and long-term monitoring. Capital costs are incurred in Year 1. O&M costs occur in Years 1-10.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Work					
Mobilization	1	lump sum	$60,000	$60,000	
Site Preparation & Staging	1	1	$5,000	$5,000	
Demolition of Two Buildings	43,000	CF	$0.5	$19,780	Assumes 12' bldgs.
Demolition of Two Buildings Slabs	3,600	drum	$4	$14,400	Assumes 6" concrete slab with mesh reinforcing .
Loading, Transportation & Disposal of C &D (non haz.)	83	Tons	$125	$10,375	Assumes most C&D classified as non-haz.
Loading, Transportation & Disposal of C &D (F035)	100	Tons	$225	$22,500	Assumes slab of bldgs. considered hazardous waste (F035)
SUBTOTAL				$157,055	
Removal of Drums from Previous Investigations					
Transportation & Disposal (F035 haz. waste)	10	drums	$400	$4,000	
SUBTOTAL				$4,000	
Excavation of Hazardous Soil					
Excavation	6,530	CY	$6	$39,572	Assumes maximum depth of 13'.
Confirmation Sampling	30	EA	$150	$4,500	
Loading, Transportation & Disposal (F035 haz. waste)	7,320	Tons	$225	$1,647,000	
Loading, Transportation & Disposal (non-haz. waste)	3,260	Tons	$125	$407,500	Excavation area based on arsenic distribution.
SUBTOTAL				$2,098,572	
Backfill & Site Restoration					
Backfill Costs (incl. Load and Haul)	10,580	Tons	$15	$158,700	
Backfill & Compaction	10,580	Tons	$5	$52,900	
SUBTOTAL				$211,600	
New and Replacement Monitoring Wells					
Mobilization	1	lump sum	$2,500	$2,500	
Overburden Well Installation (including drilling, well supplies, protective covering, and development)	10	1	$4,000	$40,000	Replace PH-MW-01, ML-2R, ML-03, ML-04, ML-10, ML-14 , Add two off-site clusters
Soil Cuttings Disposal	3	drums	$400	$1,200	Assumes soil cuttings as haz. waste (F035).
SUBTOTAL				$43,700	
SUBTOTAL				$2,514,900	
Contingency	20%			$502,980	
SUBTOTAL				$3,017,880	
Design/Project Management*	13%			$392,324	
Remedial Oversight/Reporting*	6%			$181,073	
TOTAL CAPITAL COST				**$3,591,300**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling & Analysis	2	YR	$10,000	$20,000	Semi-annual sampling - 10 wells
Data Evaluation and Reporting	2	YR	$5,000	$10,000	
SUBTOTAL				$30,000	
TOTAL ANNUAL O&M COST				**$30,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$3,591,300	$3,591,300	1.00	$3,591,300	
Annual OM&M	1-10	$300,000	$30,000	7.72	$231,652	
					$3,822,952	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$3,823,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 8
Remedial Alternative Cost Summary

Alternative 5
Excavation + In-Situ Groundwater Source Remediation + LTM + Institutional Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2009
Date: November 2009

Description: Alternative 5 consists of Alternative 4 (Excavation + Institutional Controls + LTM), plus source and plume area in-situ groundwater treatment using chemical reduction. Capital costs are incurred in Year 1. O&M costs occur in Years 1-5.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Combined ZVI Field Pilot Testing	1	LS	$18,500	$18,500	Based on quote from Adventus using EHC-M.
Source Area Chemical Reduction Injection Includes chemicals and site personnel	1	event	$129,000	$129,000	Based on quote from Adventus using EHC-M.
Geoprobe points for injections					
Mobilization Fee	1	LS	$1,000	$1,000	Assumes 38 Geoprobe Points for Injections & 4 injection points/day
Includes drilling and mixing injection material	10	day	$4,000.00	$40,000	
SUBTOTAL				$188,500	
Contingency	20%			$37,700	
SUBTOTAL				$226,200	
Design/Project Management*	13%			$29,406	
Remedial Oversight/Reporting*	6%			$13,572	
Alternative 4 Excavation Costs	1	LS	$3,591,300	$3,591,300	See Alternative 4 for details
TOTAL CAPITAL COST				**$3,860,500**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling & Analysis	2	YR	$10,000	$20,000	Semi-annual sampling - 10 wells
Data Evaluation and Reporting	2	YR	$5,000	$10,000	
SUBTOTAL				$30,000	
TOTAL ANNUAL O&M COST				**$30,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$3,860,500	$3,860,500	1.00	$3,860,500	
Annual OM&M	1-5	$150,000	$30,000	4.33	$129,884	
.					$3,990,384	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$3,990,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 9
Remedial Alternative Cost Summary

Alternative 6A
In-Situ Soil Stabilization/Solidification + Long-Term Monitoring + Institutional Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2009
Date: November 2009

Description: Alternative 6A consists Alternative 2 (Institutional Controls + LTM) plus in-situ soil stabilization/solidification of soil that exceeds 6NYCRR Unrestricted Use SCOs. This alternative includes waste below the water table, to a maximum depth of 40' bgs. Capital costs are incurred in Year 1. O&M costs occur in Years 1-5.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Work					
Mobilization	1	lump sum	$10,000	$10,000	
Site Preparation & Staging	1	1	$5,000	$5,000	
Demolition of Two Buildings	43,000	CF	$0.5	$19,780	Assumes 12' bldgs.
Demolition of Two Buildings Slabs	3,600	SF	$4	$14,400	Assumes 6" concrete slab with mesh reinforcing.
Loading, Transportation & Disposal of C &D (non-haz.)	83	drum	$125	$10,375	Assumes most C&D classified as non-haz.
Loading, Transportation & Disposal of C &D (F035)	100	Tons	$225	$22,500	Assumes slab foundation is classified as haz. (F035)
SUBTOTAL				$107,055	
Removal of Drums from Previous Investigations					
Transportation & Disposal (F035 haz. waste)	10	drums	$400	$4,000	
SUBTOTAL				$4,000	
Soil Stabilization/Solidification					
Mobilization, site preparation, % demobilization	1	lump sum	$250,000	$250,000	
Bench Scale Treatability Testing	1	lump sum	$15,000	$15,000	Assumes treatability testing on 2 samples.
Excavation of soil, mixing, & addition of iron, chemical oxidants and cement slurry.	12,820	CY	$60	$769,200	
Loading, Transportation & Disposal (F035 haz. waste)	2,000	Tons	$225	$450,000	Assumes 10% of volume (~2,000 tons equivalent mass) removed as F035 hazardous waste.
SUBTOTAL				$1,484,200	
New and Replacement Monitoring Wells					
Mobilization	1	lump sum	$2,500	$2,500	
Overburden Well Installation (including drilling, well supplies, protective covering, and development)	10	1	$4,000	$40,000	Replace PH-MW-01, ML-2R, ML-03, ML-04, ML-10, ML-14 , Add two off-site clusters
Soil Cuttings Disposal	3	drums	$400	$1,200	
SUBTOTAL				$43,700	
SUBTOTAL				$1,638,955	
Contingency	20%			$327,791	
SUBTOTAL				$1,966,746	
Design/Project Management*	13%			$255,677	
Remedial Oversight/Reporting*	6%			$118,005	
TOTAL CAPITAL COST				**$2,340,400**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling & Analysis	2	YR	$10,000	$20,000	Semi-annual sampling - 10 wells
Data Evaluation and Reporting	2	YR	$5,000	$10,000	
SUBTOTAL				$30,000	
TOTAL ANNUAL O&M COST				**$30,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$2,340,400	$2,340,400	1.00	$2,340,400	
Annual OM&M	1-5	$150,000	$30,000	4.33	$129,884	
					$2,470,284	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$2,470,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 10
Remedial Alternative Cost Summary

Alternative 6B
In-Situ Soil Stabilization/Solidification + Long-Term Monitoring + Institutional Controls

OPINION OF PROBABLE COST

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2009
Date: November 2009

Description: Alternative 6B consists Alternative 2 (Institutional Controls + LTM) plus in-situ soil stabilization/solidification of soil that exceeds 6NYCRR Unrestricted Use SCOs with maximum excavation depth to the water table plus in-situ groundwater treatment using chemical reduction. Capital costs are incurred in Year 1. O&M costs occur in Years 1-5.

CAPITAL COSTS:

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Institutional Controls Legal/Administrative Costs	1	lump sum	$25,000	$25,000	
Site Work					
Mobilization	1	lump sum	$10,000	$10,000	
Site Preparation & Staging	1	1	$5,000	$5,000	
Demolition of Two Buildings	43,000	CF	$0.5	$19,780	Assumes 12' bldgs.
Demolition of Two Buildings Slabs	3,600	SF	$4	$14,400	Assumes 6" concrete slab with mesh reinforcing.
Loading, Transportation & Disposal of C &D (non haz.)	83	drum	$125	$10,375	Assumes most C&D classified as non-haz.
Loading, Transportation & Disposal of C &D (F035)	100	Tons	$225	$22,500	Assumes slab foundation is classified as haz. (F035)
SUBTOTAL				$107,055	
Removal of Drums from Previous Investigations					
Transportation & Disposal (F035 haz. waste)	10	drums	$400	$4,000	
SUBTOTAL				$4,000	
Soil Stabilization/Solidification					
Mobilization, site preparation, % demobilization	1	lump sum	$250,000	$250,000	
Bench Scale Treatability Testing	1	lump sum	$15,000	$15,000	Assumes treatability testing on 2 samples.
Excavation of soil, mixing, & addition of iron, chemical oxidants and cement slurry.	6,530	CY	$60	$391,800	
Loading, Transportation & Disposal (F035 haz. waste)	1,000	Tons	$225	$225,000	Assumes 10% of volume (~1,000 tons equivalent mass) removed as F035 hazardous waste.
SUBTOTAL				$881,800	
In-Situ Groundwater Treatment					
Combined ZVI Field Pilot Testing	1	LS	$18,500	$18,500	Based on quote from Adventus using EHC-M.
Source Area Chemical Reduction Injection	1	event	$129,000	$129,000	Based on quote from Adventus using EHC-M.
Includes chemicals and site personnel					
Geoprobe points for injections					
Mobilization Fee	1	LS	$1,000	$1,000	Assumes 38 Geoprobe points for injections & 4 injection points/day
Includes drilling and mixing injection material	10	day	$4,000.00	$40,000	
SUBTOTAL				$188,500	
New and Replacement Monitoring Wells					
Mobilization	1	lump sum	$2,500	$2,500	
Overburden Well Installation (including drilling, well supplies, protective covering, and development)	10	1	$4,000	$40,000	Replace PH-MW-01, ML-2R, ML-03, ML-04, ML-10, ML-14 , Add two off-site clusters
Soil Cuttings Disposal	3	drums	$400	$1,200	
SUBTOTAL				$43,700	
SUBTOTAL				$1,225,100	
Contingency	20%			$245,020	
SUBTOTAL				$1,470,120	
Design/Project Management*	18%			$264,622	
Remedial Oversight/Reporting*	8%			$117,610	
TOTAL CAPITAL COST				**$1,852,400**	

OPERATION, MAINTENANCE, AND MONITORING (OM&M) COSTS

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL	NOTES:
Site Monitoring					
Groundwater Sampling & Analysis	2	YR	$10,000	$20,000	Semi-annual sampling - 10 wells
Data Evaluation and Reporting	2	YR	$5,000	$10,000	
SUBTOTAL				$30,000	
TOTAL ANNUAL O&M COST				**$30,000**	

PRESENT VALUE ANALYSIS:

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR (5%)	PRESENT VALUE	NOTES:
Capital	1	$1,852,400	$1,852,400	1.00	$1,852,400	
Annual OM&M	1-5	$150,000	$30,000	4.33	$129,884	
					$1,982,284	
TOTAL PRESENT VALUE OF ALTERNATIVE					**$1,982,000**	

** Per USEPA 540-R-00-002, "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study". July 2000.*

TABLE 11

Remedial Alternative Cost Summary

OPINION OF PROBABLE COST SUMMARY

Site: Former Paulsen-Holbrook Site
Location: Guilderland, New York
Phase: Feasibility Study (-30% to +50%)
Base Year: 2009
Date: November 2009

Alternative	Description	Capital Costs	Annual O&M Costs	Estimated Remediation Time (years)	Total Present Value
Alternative 2	INSTITUTIONAL CONTROLS + LONG-TERM MONITORING	$70,800	$30,000	30	$532,000
Alternative 3	CAPPING + LONG-TERM MONITORING + INSTITUTIONAL CONTROLS	$1,721,200	$30,000	10	$1,953,000
Alternative 4	EXCAVATION (USCO) + LONG-TERM MONITORING + INSTITUTIONAL CONTROLS	$3,591,300	$30,000	10	$3,823,000
Alternative 5	EXCAVATION (USCO)+ IN-SITU GROUNDWATER SOURCE REMEDIATION + LONG-TERM MONITORING + INSTITUTIONAL CONTROLS	$3,860,500	$30,000	5	$3,990,000
Alternative 6A	IN-SITU SOIL STABILIZATION/SOLIDIFICATION BELOW THE WATER TABLE + LONG-TERM MONITORING + INSTITUTIONAL CONTROLS	$2,340,400	$30,000	5	$2,470,000
Alternative 6B	IN-SITU SOIL STABILIZATION/SOLIDIFICATION TO THE WATER TABLE + IN-SITU GROUNDWATER SOURCE REMEDIATION + LONG-TERM MONITORING + INSTITUTIONAL CONTROLS	$1,852,400	$30,000	5	$1,982,000

Note: Unit prices used herein based on vendor quotes/information and/or prior experience.

New York State Department of Environmental Conservation

Feasibility Study Report

Plates

0266376 / ALB

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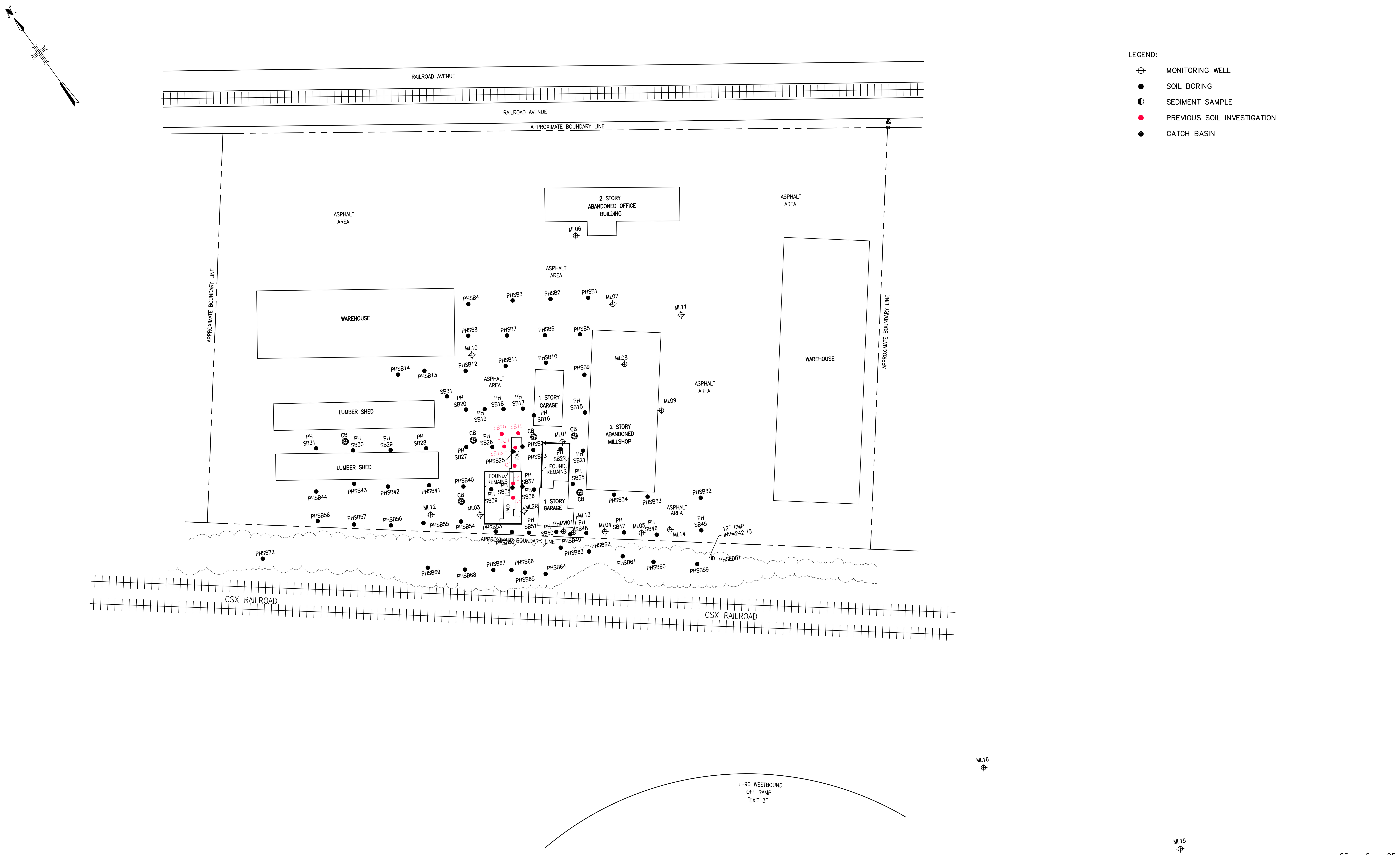

SOURCE: MJ ENGINEERING AND LAND SURVEYING, P.C., SURVEY CONDUCTED ON 11/17/08 AND 12/6/08

MALCOLM PIRNIE

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
GUILDERLAND, NEW YORK

FORMER PAULSEN–HOLBROOK SITE (#401046)

WORK ASSIGNMENT #D–00439–21

SITE PLAN

SCALE: 1"=50'

MALCOLM PIRNIE, INC.

MARCH 2009

PLATE 1