WASTE MANAGEMENT

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July 25, 2014

Mr. Brian Davidson
NYSDEC – DER
625 Broadway
Albany, NY 12233-7016

Re: Former Pratt Oil Works – Acid Condition IRM Work Plan

Dear Mr. Davidson:

Enclosed please find the Interim Remedial Measure Work Plan for the Interim Remedial Measure to Address the Acid Condition on Parcel A of the Former Pratt Oil Works Site, Long Island City, Queens, New York (IRM Work Plan). The IRM Work Plan is being submitted by Waste Management of New York, LLC (WMNY) subject to and contingent upon the execution of a mutually agreeable Order on Consent and Administrative Settlement between WMNY and NYSDEC to address the Acid Condition in the Treatment Area as defined in the IRM Work Plan.

Please do not hesitate to contact me with any questions or to discuss further.

Sincerely,

Glen Schultz

Cc w/encl: File
Cc w/ enclosures via email:
Jay Kaplan, WMNY
Steve Joyce, WM
Michelle Gale, Esq., WMNY

Interim Remedial Measure Work Plan

For

The Interim Remedial Measure to Address the Acid Condition on Parcel A of the Former Pratt Oil Works Site, Long Island City, Queens, New York

Case Number D2-1002-12-07 AM

Prepared for Waste Management of New York, LLC

Prepared by

Savin Engineers, P.C.

3 Campus Drive

Pleasantville, NY 10570

and

HydroGeoLogic, Inc.

331 Newman Springs Road, Suite 143

Red Bank, NJ 07701

July 2014

Certification Statement

I, Joseph J. Fiteni, Jr., certify that I am currently a New York State registered Professional Engineer and that this Interim Remedial Measures (IRM) Work Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

STATE OF NEW YORK
JOSEPH J. FITENI JR.
LICENSED PROFESSIONAL ENGINEER

7/25/14

Joseph J. Fiteni, Jr.
License Number 59843

In accordance with New York State Education Law, it is a violation for any person, unless he is acting under the direction of a licensed professional engineer, to alter the IRM Work Plan in any way.

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List of Acronyms

COC	Certificate of Completion
EDD	Electronic Data Deliverable
EPA	Environmental Protection Agency
FPOW	Former Pratt Oil Works
IRM	Interim Remedial Measures
NAPL	Non-aqueous phase liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDEC DER	NYSDEC Division of Environmental Remediation
NYSDOH	New York State Department of Health
NYSPE	New York State Professional Engineer
PDF	Portable Document Format
PE	Professional Engineer
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/Quality control
SOCONY	Standard Oil Company of New York
SSCR	Supplemental Site Characterization Report (Kleinfelder, 2013)
USDOT	United States Department of Transportation
WMNY	Waste Management of New York, LLC

Executive Summary

This Interim Remedial Measure (IRM) Work Plan pertains to neutralization of the Acid Condition in the Treatment Area, located on a portion of what is presently known as Lot 300, Block 312 at the Former Pratt Oil Works Site in Long Island City, Queens, New York (Property). The Acid Condition is the low pH groundwater and co-located acidic material depicted in Figure 2. The Treatment Area, also referred to as the IRM Site, is depicted in Figure 3 and consists of the Acid Condition and footprint of the Building Expansion. The Property is currently owned by Waste Management of New York, LLC (WMNY), which operates a non-hazardous solid waste transfer station (Transfer Station) in accordance with a permit issued by the New York City Department of Sanitation (NYCDOS) and the New York State Department of Environmental Conservation (NYSDEC). In accordance with a 2014 modification to this permit, WMNY is expanding the Transfer Station in the location of the Acid Condition.

Characterization and interim remedial measures have been underway, at the Property and surrounding properties previously occupied by the Former Pratt Oil Works, by ExxonMobil Corporation (ExxonMobil) in accordance with Consent Order Case No. D2-1002-12-07AM (ExxonMobil Consent Order) executed between ExxonMobil and the NYSDEC on July 15, 2008. Environmental characterization, including initial characterization of the Acid Condition, is documented in the 2013 *Supplemental Site Characterization Report* (SSCR)[1] submitted by Kleinfelder on behalf of ExxonMobil. The IRM described in this Work Plan pertains only to the Acid Condition in the Treatment Area, pursuant to an Order on Consent and Administrative Settlement addressing the Acid Area IRM of Parcel A of the Former Pratt Oil Works, Index No. A2-0830-14-03, executed between NYSDEC and WMNY.

The objectives of the IRM are to neutralize the Acid Condition in the Treatment Area. Personnel and community air monitoring associated with the activities will help evaluate the current or future potential exposure to acidic vapors.

This IRM Work Plan evaluates the following four potential alternatives to address the Acid Condition:

- Engineering and institutional controls
- Addition of alkalinity through infiltration
- Addition of alkalinity with *in situ* mixing
- Removal of acidic material and groundwater

In selecting the preferred alternative, WMNY considered the effectiveness of protecting human health and the environment; compliance with standards, criteria and guidance; implementability; and cost. After considering these factors, and given the environmental conditions and site constraints, addition of alkalinity with *in situ* mixing is selected as the preferred IRM.

The IRM activities include the following steps in approximately 21 individual treatment cells that are approximately 20 feet by 24 feet in area:

[1] WMNY's reference to documents submitted by ExxonMobil and/or Kleinfelder should not be considered an admission to or agreement with the information, data, opinions, analysis, or conclusions contained in such documents, nor should such references be considered a representation by WMNY as to the accuracy or completeness of the information, data, opinions or conclusions contained in the documents submitted by ExxonMobil and/or Kleinfelder. WMNY expressly reserves any objections, rights, claims, defenses or challenges it may have with respect to anything contained in the documents submitted by ExxonMobil and/or Kleinfelder.

- removal of overlying non-acidic asphalt and fill;
- *in situ* mixing of hydrated lime (or another alkalinity) and acidic material;
- performance and confirmation sampling of the Acid Condition;
- backfill of treatment cell;
- disposal of remaining fill; and
- surface restoration to the specifications of the Transfer Station solid waste permit.

This IRM Work Plan provides other pertinent information to executing and managing the IRM, including project organization and oversight, security and work hours, quality assurance project plan, health and safety plan, community air monitoring plan, soil/materials management plan, field preparation, and reporting.

1.0 Introduction

Waste Management of New York, LLC (WMNY) retained Savin Engineers and HydroGeoLogic to prepare this Interim Remedial Measure (IRM) Work Plan to neutralize the Acid Condition in the Treatment Area, located on a portion of what is currently known as Lot 300, Block 312 (Property), Long Island City, Queens, New York (see Figure 1). The Acid Condition is defined as the low pH groundwater and co-located acidic material depicted in Figure 2. The Treatment Area, also referred to as the IRM Site, is depicted in Figure 3 and consists of the Acid Condition and footprint of the Building Expansion. The Property is currently owned by WMNY, which operates a non-hazardous solid waste transfer station (Transfer Station) in accordance with a permit issued by the New York City Department of Sanitation and the NYSDEC. In accordance with a 2014 modification to this permit, WMNY is expanding the Transfer Station in the location of the Acid Condition.

Characterization and interim remedial measures have been underway, at the Property and surrounding properties previously occupied by the Former Pratt Oil Works, by ExxonMobil Corporation (ExxonMobil) in accordance with Consent Order Case No. D2-1002-12-07AM (ExxonMobil Consent Order) executed between ExxonMobil and the NYSDEC on July 15, 2008. Environmental characterization, including initial characterization of the Acid Condition, is documented in the 2013 *Supplemental Site Characterization Report* (SSCR)[2] submitted by Kleinfelder on behalf of ExxonMobil. The IRM described in this Work Plan pertains only to the Acid Condition in the Treatment Area, pursuant to an Order on Consent and Administrative Settlement addressing the Acid Area IRM of Parcel A of the Former Pratt Oil Works, Index No. A2-0830-14-03, executed between NYSDEC and WMNY.

This IRM Work Plan has been prepared, on behalf of WMNY, to address the Acid Condition in the Treatment Area in a timely, effective, and cost-efficient manner. This IRM Work Plan:

- summarizes past investigations of the Acid Condition, including supplemental characterization of the Acid Condition by WMNY in February 2014;
- evaluates various potential remedial measures for the Acid Condition;
- selects an appropriate remedial measure for the Acid Condition; and
- presents a plan for implementing the IRM.

Sections relevant to the Acid Condition in the following documents and data were reviewed and used in preparation of this IRM Work Plan:

- *Supplemental Site Characterization Report*, prepared by Kleinfelder, May 7, 2013
- Data from the 2014 February WMNY characterization of the Acid Condition

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[2] WMNY's reference to documents submitted by ExxonMobil and/or Kleinfelder should not be considered an admission to or agreement with the information, data, opinions, analysis, or conclusions contained in such documents, nor should such references be considered a representation by WMNY as to the accuracy or completeness of the information, data, opinions or conclusions contained in the documents submitted by ExxonMobil and/or Kleinfelder. WMNY expressly reserves any objections, rights, claims, defenses or challenges it may have with respect to anything contained in the documents submitted by ExxonMobil and/or Kleinfelder.

- *Tidal Study & Hydraulic Conductivity Evaluation Report*, prepared by Kleinfelder, January 11, 2011
- *Bulkhead Sheen Investigation Report*, prepared by Kleinfelder, February 20, 2012
- *Interim Site Characterization Report: The Waterfront Parcels (Tract 1) Former Pratt Oil Works*, March 11, 2010, prepared by Kleinfelder, March 11, 2010
- *Site Characterization Work Plan: The Waterfront Parcels (Tract II), Former Pratt Oil Works, Long Island, City, New York*, prepared by Kleinfelder, May 2008
- *Interim Remedial Measure Feasibility Study Report*, prepared by Kleinfelder, July 1, 2010
- *Supplemental Site Characterization Work Plan & Quality Assurance Project Plan, The Inland Parcels (Tract I) & The Waterfront Project Area (Tract II)*, Former Pratt Oil Works, prepared by Kleinfelder, July 27, 2010.
- *Interim Remedial Measure Work Plan*, prepared by Kleinfelder, September 21, 2010
- *Barrier Wall Interim Remedial Measure Work Plan*, prepared by Kleinfelder, October 15, 2012

1.1 Location and Description

The location of the Property is depicted on Figure 1. The Property is approximately 1.4 acres. Asphalt paving covers more than 50% of the Property. A 12,000 square foot one-story corrugated metal building occupies the southeastern corner of the Property. Truck scales are present in the northern portion of the Property. The Property is served by public utilities, including subsurface water, gas, electric, and telecommunication lines. The current monitoring network on the Property includes 11 monitoring wells installed by ExxonMobil and its contractors in accordance with the ExxonMobil Consent Order.

1.2 History

The SSCR summarizes the Property history in part, as follows: The North American Kerosene Gas Lamp Company developed the Property in the early 1850s. Around 1876, Charles Pratt & Company acquired the Property (and surrounding properties) under the name Pratt Long Island Refinery. Standard Oil Company of New York (SOCONY) acquired the Former Pratt Oil Works (FPOW) in 1892 and operated the Property until 1949. From 1949 through 1998 the Property was owned by various industrial parties. WMNY purchased the Property in 1998 for use as a permitted solid waste transfer station.

1.3 Description of Surrounding Area

Additional properties owned by WMNY and functioning as part of the Transfer Station are located to the east and west of the Property. Tracks owned by the Long Island Railroad are located to the north of the Property.

1.4 Proposed Facility Expansion

The expansion of the Transfer Station will include re-grading portions of the Property, extending a rail spur onto the Property, and expanding the existing corrugated metal building approximately 75 feet to the west. The planned areas for re-grading and Building Expansion are located in the Treatment Area. The expanded facility will need to be constructed no later than May 2015 to meet contractual obligations with the NYCDOS, commencing in June 2015. In order to meet that schedule, construction of the Building Expansion in the Treatment Area will need to start by October 2014.

2.0 Summary of Relevant Remedial Investigations

Remedial investigation by ExxonMobil at the Property to date is documented in the 2013 SSCR. The reader is referred to the 2013 SSCR for additional information about characterization of the Property.

2.1 Summary of Area of Concern

The Acid Condition in the Treatment Area is depicted in Figure 2. Measurements of pH from groundwater at MW-3, MW-41S, and MW-47 currently define the known extent of the Acid Condition. Monitoring wells MW-45 and MW-46 do not have acidic groundwater. The Acid Condition, as depicted in Figure 2, is adjacent to the existing corrugated metal building, and within the footprint of the planned Building Expansion.

2.2 Summary of Investigation Work Conducted to Date and Findings

The SSCR identified the Acid Condition during the installation of monitoring well MW-3, soil borings SB-16 and LIF-26. Soil samples collected from soil boring MW-3 had a pH less than 1 suggesting the presence of an acidic compound. Low pH has been detected in groundwater samples from MW-3 (1.53 to 2.14), SB-16/MW-47 (-0.07), and SB-18 (1.63). Relatively high adsorbed (360,000J mg/kg) and dissolved phase (874,000 milligrams per liter) sulfate concentrations from soil boring SB-16 indicate sulfuric acid as a potential source of the low pH.

A direct-push characterization event conducted by WMNY in February 2014 included nine borings (AC-1 through AC-9) and identified an acidic coal-like residue (acidic material) as the source of the Acid Condition where it is in contact with groundwater. The acidic material was present in borings AC-1, AC-2, and AC-4 through AC-9 and was found at various thicknesses between 5 feet below ground surface (bgs) and 15 feet bgs. The groundwater pH measurements in MW-3, MW-41S, MW-43, MW-45, MW-46, and MW-47 define the Acid Condition as shown in Figure 2.

Appendix A includes the boring logs, pH, and acidity information for borings AC-1 through AC-9 and also includes the boring logs for MW-3, SB-16, SB-18, MW-41S, MW-43, MW-45, MW-46, and MW-47. The acidity information collected with borings AC-1 through AC-9 indicate that approximately 0.1 grams of sodium hydroxide is required to increase the pH of 1 gram of the acidic material to pH 6. The bulk density of the acidic material is approximately 60 pounds per cubic foot.

Figures 4a through 4c present geologic cross-sections in the vicinity of the Acid Condition based on soil descriptions on boring logs. The water table and the vertical intervals of acidic material and acidic groundwater are shown on these figures.

2.3 Qualitative Human Health Exposure Assessment

This qualitative human health exposure assessment was conducted in accordance with Appendix 3B of DER-10: *NYSDOH Qualitative Human Health Exposure Assessment* to evaluate potential existing and future exposure pathways to the Acid Condition.

Receptor Population

The potential receptors of the Acid Condition include commercial and industrial workers associated with commercial and industrial use within the Acid Condition at the Property. The Property and all surrounding properties are designated for commercial and industrial use. Newtown Creek is located south of the Acid Condition. The Acid Condition is covered with asphalt and concrete. Solid waste transfer activities occur immediately above the Acid Condition 24 hours per day, 6 or more days per week. There is no groundwater use in the immediate vicinity of the Acid Condition.

Sources of Contamination

The source of the Acid Condition is the co-located acidic material that is in contact with groundwater. The acidic material was found to have a pH less than 1.0 and an alkalinity demand of greater than 0.1 grams of sodium hydroxide per gram of acidic material.

Environmental Media, Transport Mechanisms, and Points of Exposure

Groundwater is present at varying depths below ground surface ranging from approximately 4 feet below ground surface to approximately 8 feet below ground surface. The unsaturated zone above the Acid Condition is historic fill, asphalt sub-base, and asphalt or concrete). Clay is present at varying depths beneath the acidic material, limiting the vertical flux of acidity. Groundwater flow is toward Newtown Creek, which is within 25 feet of the known southern extent of the Acid Condition.

Routes of Exposure

Various potential routes of exposure are evaluated in the following table:

Potential Route of Exposure	**Exposure Assessment**
Ingestion of surface water	The surface water of Newtown Creek is not used for human consumption or other uses. This exposure pathway is incomplete.
Inhalation of vapor in indoor ambient air	Acidic vapors have not been assessed in the subsurface or indoor air. This exposure route cannot be assessed at this time.
Inhalation of vapor from outdoor ambient air	Acidic vapors have not been thoroughly assessed in the subsurface or outdoor air. This exposure route cannot be assessed at this time.
Groundwater ingestion	Groundwater is not used in the vicinity of the Property for consumption or other purposes. This pathway is considered incomplete.
Dust inhalation	Inhalation of acidic dust by commercial, industrial, or construction work could occur during intrusive activities. This exposure pathway is considered complete unless controls and planning are put in place to provide for appropriate safety precautions.
Direct contact and incidental ingestion of soil	Direct contact and incidental ingestion of acidic groundwater or co-located acidic material by commercial, industrial, or construction work could occur during intrusive activities. This exposure pathway is considered complete unless controls and planning are put in place to provide for appropriate safety precautions.
Direct contact with groundwater	Direct contact with acidic groundwater or co-located acidic material by commercial, industrial, or construction work could occur during intrusive activities that reach the water table. This exposure pathway is considered complete unless controls and planning are put in place to provide for appropriate safety precautions.

3.0 IRM Objective

The objective of this IRM is to increase the pH of the Acid Condition in the Treatment Area identified in Figure 3 to between 6.0 and 9.0. The Treatment Area consists of the Acid Condition and the footprint of the Building Expansion depicted in Figures 2 and 3.

4.0 Alternatives Analysis and IRM Selection

Remedial technologies capable of treating the Acid Condition include:

- engineering and institutional controls;
- alkalinity infiltration to neutralize the acidic groundwater and co-located acidic material;
- alkalinity addition by soil mixing to neutralize the acidic groundwater and co-located acidic material; and
- removal of the acidic groundwater and acidic material with off-site disposal.

Potential application of these technologies may be influenced by infrastructure on the Property, such that each IRM alternative may consist of more than one of the above technologies. Information gained during the IRM process may also affect how each technology is applied.

4.1 Description of Alternatives

The following alternatives are considered for evaluation.

Alternative 1 – Engineering and Institutional Controls

This alternative contemplates institutional controls to prevent intrusive activities on the Property without prior notification to NYSDEC. This alternative eliminates the only potential route for future human exposure by controlling access to the Acid Condition to prevent direct contact and by establishing institutional controls to provide appropriate planning and implementation for potential future intrusive activities.

Alternative 2 – Alkalinity Addition through Infiltration

This alternative involves addition of anti-scaling agents and alkalinity to the subsurface through a combination of direct-push injections, injection/extraction wells arranged in recirculation cells, and/or surface infiltration. The anti-scaling agents would be used to mitigate the precipitation of metal hydroxides as alkalinity is added and the pH increases. Mitigating metals precipitation would help prevent clogging of the injection points and surrounding pore space during the injections and would help deliver sufficient alkalinity through each injection point. A 20% sodium hydroxide solution would be the preferred alkalinity reagent because the solution contains a larger amount of alkalinity per volume, does not include solids (like a lime slurry), and does not generate gas (like sodium bicarbonate or other carbonates). Solids are a concern because they clog pore space and inhibit alkalinity delivery. Gas generation is a concern because the vapor off-gas could continue for days after treatment and could be difficult to control.

The Treatment Area is approximately 10,000 square feet and has an average thickness of 7 feet. Using the bulk density of 60 pounds per cubic foot, these dimensions translate to approximately 4.2 million pounds of acidic material targeted for treatment. Using the sodium hydroxide demand of 0.1 grams per gram translates to approximately 420,000 pounds of sodium hydroxide required for treatment. The density of a 20% sodium hydroxide solution is approximately 10.2 pounds per gallon. Approximately 206,000 gallons of 20% sodium hydroxide solution would need to be delivered to the subsurface. Actual dosage and total quantity would be confirmed with pilot studies and adjusted in the field during implementation.

Because of the relatively large volume of solution to be delivered, groundwater extraction would be required to minimize the mobilization of impacted groundwater outside of the treatment area. In addition, because acidic material is present above the water table sodium hydroxide would need to be delivered through infiltration rather than injection. Treatment would involve the following:

- install a network of 10 extraction wells through the target treatment area;
- remove the asphalt in individual treatment cells;
- dewater the treatment area with the extraction wells;
- dispose of the extracted water (over 206,000 gallons) at an approved off-site facility;
- evenly distribute the 20% sodium hydroxide solution at the surface at approximately 21 gallons per square foot to allow for infiltration through the full acidic material thickness; and
- surface restoration to the specifications of the Transfer Station solid waste permit.

This alternative also incorporates Alternative 1.

Alternative 3 – Alkalinity Addition through *in situ* Soil Mixing

This alternative involves alkalinity addition through *in situ* soil mixing. Alkalinity addition would be achieved through *in situ* soil mixing above and below the water table within the Treatment Area depicted in Figure 3. This approach would involve excavating and stockpiling overlying non-acidic fill and using soil mixing equipment to mix the acidic groundwater, co-located acidic material, and alkalinity reagent *in situ*. Approximately 5 feet of non-acidic fill is present above the acidic material, and the depth of acidic material extends to 15 feet bgs. Alkalinity could be added using a number of potential reagents, including sodium hydroxide, hydrated lime, limestone or other carbonates, and cement kiln dust or other pozzolanic material. Hydrated lime is selected as the primary alkalinity reagent for the following reasons:

- It is significantly less costly than sodium hydroxide.
- It does not generate gas (like limestone or other carbonates) that would present a vapor control concern.
- It does not generate heat (like cement kiln dust or lime kiln dust) that would present a steam/vapor control concern.

It is recognized that the mixing process will affect the geotechnical properties of the subsurface material. Future construction over the treated area would need to consider the post-treatment geotechnical properties of the subsurface.

Soil mixing is a proven technology for distributing reagents to treat soil and groundwater contamination and does not require pilot testing. Soil mixing overcomes potential concerns associated with distributing the reagents throughout the treatment zone in heterogeneous conditions. To accommodate facility operations, soil mixing would occur in individual treatment cells. Figure 5 depicts the Acid Condition divided into 21 treatment cells that vary in area with an average cell size of 20 feet by 24 feet and a treatment thickness of 7 feet. Using a bulk density of 60 pounds per cubic foot, approximately 202,000 pounds of acidic material would be treated in each cell. Based on the sodium hydroxide demand of 0.1 gram of sodium hydroxide to 1 gram of acidic material and a comparable alkalinity to mass ratio between sodium hydroxide and hydrated lime, approximately 20,000 pounds of lime would be needed per cell.

Treatment would involve the following steps in each treatment cell:

- remove and stockpile the asphalt and non-acidic fill (believed to be approximately 5 feet) in the treatment cell;
- remove fill in the center of the treatment cell to the non-aqueous phase liquid (NAPL) surface, water table, or top of acidic material (whichever is shallowest) and extract recoverable NAPL for off-site disposal;
- add hydrated lime into the treatment cell in batches and mix with a drum mixer attached to an excavator or equivalent until target pH is achieved throughout the treatment cell;
- use excavator bucket to compact treated acidic material;
- backfill remaining cell volume in controlled compacted lifts with stockpiled fill suitable to specifications of the geotechnical engineer for the building expansion;
- recycle removed asphalt and dispose of unused fill; and
- surface restoration to the specifications of the Transfer Station solid waste permit.

This alternative also incorporates Alternative 1.

Alternative 4 – Acidic Material and Groundwater Removal

This alternative involves removing from the Treatment Area the acidic groundwater and the co-located acidic material above and below the water table. Steel sheet pile would be used to shore the excavations as shown in Figure 6. Corrosion of the steel sheet pile by the acidic soils during excavation would be a concern. Alkalinity injections adjacent to the sheet pile would be needed to mitigate the corrosion. Dewatering would be needed to both remove the acidic groundwater and facilitate excavation. The minimum volume of extracted water is likely 180,000 gallons. Substantially more water could be extracted depending the hydraulic connection to more permeable subsurface material and tidal influences. Given the complexity of treatment required to meet discharge standards, containerization and off-site disposal of extracted water is assumed.

Excavated fill overlying the acidic material would be stockpiled for backfill. Excavated acidic material would be transferred directly to a lined container for off-site disposal or incineration at an approved facility.

The excavation would be backfilled with certified clean, non-reactive (e.g., not concrete or limestone) fill in controlled compacted lifts. Sheet pile would be removed.

This alternative also incorporates Alternative 1.

4.2 IRM Selection

Alternative 1 does not neutralize the Acid Condition in the Treatment Area and therefore does not achieve the IRM objective. This alternative will not be selected.

Alternatives 2, 3 and 4 protect human health and the environment by achieving the IRM objective to neutralize or remove the Acid Condition in the Treatment Area. There is no established standard, criteria, or guidance for pH in groundwater or soil, but Alternatives 2, 3, and 4 all meet IRM remedial action objective of restoring the pH of the Treatment Area to a value between 6 and 9. These three alternatives are therefore further evaluated for effectiveness, implementability, and cost.

Effectiveness at Protecting Human Health and the Environment

Alternative 1 does not neutralize the Acid Condition in the Treatment Area. This alternative will not be selected.

Alternatives 2, 3 and 4 all directly neutralize or remove the Acid Condition in the Treatment Area in an immediate manner.

Alternative 2 has the lowest likelihood of uniformly addressing the Acid Condition in the Treatment Area in a timely manner because alkalinity distribution is highly dependent on material heterogeneity. Preferential flow of the alkalinity can leave some areas untreated until natural dispersion and diffusion bring the alkalinity into contact with the acidity. Due to the potential for preferential flow, Alternative 2 also has the highest likelihood of mobilizing impacted groundwater or sodium hydroxide outside of the treatment zone.

By contrast, Alternative 3 uses mixing to provide uniform distribution and Alternative 4 removes acidic groundwater and material.

Alternatives 2 and 4 involve transporting large volumes of contaminated groundwater and/or large volumes of acidic material off site for disposal. Transportation of this waste increases the likelihood of exposure to the public.

Alternatives 4 is sufficiently intrusive that facility operations would be discontinued during excavation to minimize the potential unintentional exposures to facility workers.

Implementability

Alternative 2 involves infiltration. Reagent delivery and dispersal through the subsurface can be a challenge due to subsurface heterogeneity, limited infiltration rates due to gravity flow, and alternations in geochemistry caused by increasing alkalinity. Limited infiltration rates could be overcome by pressure injections, but pressure injections would have a limited radius of influence in unsaturated material. Additional testing would be needed to determine implementability. Although Alternative 2 includes groundwater extraction, there is potential for impacted groundwater or sodium hydroxide to migrate outside of the treatment zone. Removal of asphalt will affect facility operations, but treatment in individual treatment cells will allow for treatment in off hours and use of the facility the following day.

Alternative 3 involves *in situ* soil mixing, which is problematic immediately near the building. Limited injections of alkalinity could be used for portions of the treatment area that are within 5 feet of the building. No pilot studies are required to evaluate effectiveness or implementability. Removal of NAPL that has a thickness greater than 6-inches will reduce the potential adverse effects of NAPL on the neutralization process. Removal of the non-acidic fill will reduce the potential for subsurface debris, including structural iron and concrete, to complicate the mixing process. The open pit nature of *in situ* soil mixing could present odor and health and safety issues that could be addressed by targeted engineering controls, administrative controls, and personal protective equipment. Mixing of the soil will change the geotechnical properties of the soil, requiring assessment of the geotechnical properties prior to construction in the area. Removal of asphalt will affect facility operations, but treatment in individual treatment cells will allow for treatment in off hours and use of the facility the following day.

Alternative 4 involves installation of steel sheeting, dewatering, and excavation. Steel sheeting would be required to shore the walls of the excavation to prevent structural damage to the building, the Newtown Creek bulkhead, and the active driveway at the facility. Installation of sheet pile into acidic conditions would pose a safety concern if the steel sheeting were to corrode. Alkalinity could be added to the soil in locations of the steel sheeting but would be an added complexity to the project. Dewatering would be needed to allow excavation to occur to the appropriate depth. Treatment of the water would be complex, and upsets in the treatment system would slow excavation work. Transport of the large volumes of water off-site would address this potential problem but presents potential exposure scenarios and other logistical challenges. The open pit nature of the excavation could present odor and health and safety issues that may be challenging to control, especially given the size of the planned excavations. Given the size of the excavation activities, the Transfer Station would need to be shut down for several weeks and would not accommodate daily operation like Alternatives 2 and 3.

Cost

Costs are compared qualitatively. The primary cost drivers for Alternative 2 is the sodium hydroxide and the transportation and disposal of extracted water. The primary cost drivers for Alternative 3 are the soil mixing equipment, the lime, and the disposal of unused excavated fill. The primary cost drivers for Alternative 4 are the sheet pile installation, excavation/backfill, acidic material disposal, and extracted groundwater disposal.

Alternative 3 has the lowest cost because the hydrated lime is significantly less expensive than sodium hydroxide and Alternative 3 does not involve disposal of extracted groundwater or acidic material. Alternative 4 has the highest costs because of the disposal of significant quantities of extracted groundwater and hazardous waste requiring disposal.

Selection

Based on the above analysis Alternative 3 has been selected as the IRM. Alternative 3 meets the IRM objective and therefore protects human health and the environment for exposure to the Acid Condition in the Treatment Area. Although no soil or groundwater standard, criteria, or guidance exists, Alternative 3 meets the meets the IRM objective of neutralizing the Acid Condition in the Treatment Area.

With respect to short-term effectiveness, long-term effectiveness, and reducing acidity, Alternative 3 is preferred over Alternative 2 because Alternative 3 uses a proven technology to mix the reagents and the material. The effectiveness of Alternative 2 would be adversely affected by subsurface heterogeneity.

With respect to meeting the IRM objective and directly neutralizing the acidity, Alternative 3 is equally effective as Alternative 4. However, Alternative 3 is preferred over Alternative 4 with respect to short-term effectiveness and implementability because Alternative 3 does not require the sheeting, dewatering, and transport of hazardous waste across public roads associated with Alternative 4. Alternative 3 also provides more operational flexibility than Alternative 4.

5.0 IRM

5.1 Implementation

Implementation will be conducted as described in Section 4.1 – Alternative 3.

5.2 Performance Objectives

There is no established soil cleanup objective for pH that can be applied to the acidic material. Solid waste regulations define corrosive waste as having a pH value less than or equal to 2.0 or a pH value greater than or equal to 10.5. The impact of solids pH on groundwater is a function of several factors, including the solids pH and buffering capacity, groundwater pH and buffering capacity, groundwater flow, and transfer rate of acidity between solids and groundwater. The pH of solids like the acidic material is measured by blending the material and water and measuring the pH of the material/water mixture (e.g., EPA Method 9045C). Consistent with the groundwater IRM objectives below, the proposed IRM performance objective for the acidic material within the Acid Condition is to achieve a pH above 6.0 and below 9.0 in one confirmation sample collected from each of the approximate 21 treatment cells. Confirmation samples will be collected and analyzed as described in Section 5.4 and the QAPP. An exception to this performance objective will be granted if obstructions within the overlying fill or within the acidic material make it impractical to access or mix the acidic material. This judgment of access will be based on assessment by the engineer.

Groundwater pH depends on the acidic material pH, and groundwater and acidic material will be evenly mixed throughout the treatment volume. Therefore, soil pH measurements will adequately demonstrate remedy performance. However, if groundwater can be collected from the treated material, a sample will be collected and analyzed for pH. Groundwater samples will be collected and analyzed as described in Section 5.4 and the QAPP.

5.3 Soils/Materials Management Plan

This plan has been created to describe the procedures that will be employed during the handling of acidic material, fill, and other materials during the IRM.

Non-acidic fill will be removed through shallow excavation and stockpiled on site for potential reuse or disposal. The removed fill will be visually evaluated for the presence of NAPL. Fill visually impacted with NAPL will be containerized for characterization and off-site disposal. Fill not impacted with NAPL will be used for backfilling the treatment cells. Excess fill and fill impacted with NAPL will be disposed of off-site at an approved facility.

Off-site fill/material transport will be conducted in USDOT approved containers using licensed haulers, following all Federal, State, and local laws and regulations. All transport of material will be performed by licensed haulers in accordance with local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Loose material from the IRM transported by trucks (if any) exiting the Property will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used. Should a transport vehicle appear to have excavated material on its exterior, it will be washed prior to leaving the Property. Truck/vehicle wash waters will be collected and disposed of off-site in an appropriate manner.

Prior to the removal of material from the Property, trucking routes from the Property to the selected soil disposal facility will be selected, and all haulers will be required to follow these predetermined routes. An insignificant number of truck trips are anticipated relative to normal traffic for the area.

All soil/fill/solid waste excavated and removed from the Property as part of this IRM will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6 NYCRR Part 360) and Federal regulations.

Appropriate disposal facilities will be chosen depending on the outcome of the soil characterization results. Soil will be transported to the designated disposal facilities while adhering to all Federal, State, and local rules and regulations. All required facility information will be reported to the NYSDEC Project Manager before commencing disposal activities. This will include estimated quantities and a breakdown by class of disposal facility if appropriate (i.e., hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, construction/demolition recycling facility). Actual disposal quantities and associated documentation will be reported to the NYSDEC in the IRM Report. This documentation will include waste profiles, test results, facility acceptance letters, manifests, bills of lading and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6 NYCRR Part 360-1.2. Material that does not meet Track 1 Unrestricted Use Soil Cleanup Objectives (SCOs) is prohibited from being taken to a New York State recycling facility (6 NYCRR Part 360-16 Registration Facility).

Characteristic hazardous waste fill will be disposed of in a facility licensed to accept/dispose of that type of hazardous waste. Excavated impacted fill that is not a characteristic hazardous waste but constitutes a non-hazardous regulated waste (industrial or special) and cannot be used as backfill in the excavation from which it originated or relocated elsewhere will also be disposed of at an off-site facility that is in compliance with current regulations for disposal of that material. Disposal of any materials that do not meet SCOs are prohibited from being admitted to a New York State recycling facility (6 NYCRR Part 360-16 registration Facility).

5.4 IRM Performance Evaluation

The IRM performance/confirmation monitoring program will involve measuring and recording lime addition to each treatment cell compared to the alkalinity demand based on the February 2014 characterization and pH measurements documented in the SSCR. In addition, alkalinity amended acidic material will be collected from four locations per treatment cell (approximately 21 treatment cells), composited into a single sample, and analyzed for pH on site in accordance with the QAPP. The alkalinity amended acidic material will be collected from two locations within the upper half of the treated acidic material and from two locations in the lower half of the treated acidic material. The pH result for the composited sample will be compared to the IRM performance objective (pH between 6 and 9). If the IRM performance objective is met, then mixing and alkalinity addition will be discontinued and the treatment cell will be backfilled and compacted. If the IRM performance objective is not met, then mixing and alkalinity addition will continue until a new composite sample demonstrates attainment of the IRM performance objective.

Field pH and/or alkalinity demand tests may also be conducted at one or more intervals during mixing to determine progress toward reaching the performance objective of a pH between 6 and 9. These samples collected during mixing will be used to inform field staff about the status of mixing and will not be considered in the above-mentioned composited performance/confirmation sample. If groundwater can be collected from the treated material brought to the surface for sampling in sufficient quantity to be analyzed, a groundwater sample will then be collected for analysis of pH and compared to the IRM objective of a pH between 6 and 9. The groundwater pH measurement will be used for information purposes only because over the intermediate and long term, the pH of the solids will control the pH of groundwater.

5.5 Engineering Controls

Engineering controls will be used during remedy implementation to control vapors and odors as needed. Odors and vapors will be abated with the application of foam to the exposed acidic condition soils while the alkalinity addition is being performed depending on the odor and vapor concentrations encountered. Mechanical ventilation may also be used to direct vapors and odors from the alkalinity mixing area to a filter/treatment system. Dust suppression with water or foam will also be implemented as needed to prevent migration of particles from leaving the site.

Upon completion of the remedy, the surface will be restored to the specifications of the Transfer Station solid waste permit. Engineering controls will be further developed in the Site Management Plan (SMP).

5.6 Institutional Controls

The IRM Report will propose institutional controls to be placed on the Property. Upon NYSDEC approval of the IRM Report and completion of the Transfer Station expansion, the institutional controls will be incorporated into the As-Built Engineering Report and made part of the Transfer Station solid waste permit. Institutional controls will also be recorded in the Queens County land records.

5.7 Site Management Plan

Site Management is the last phase of remediation and begins with the approval of the IRM Report and issuance of the Certificate of Completion (COC) for the IRM. The SMP is submitted as part of the IRM but will be written in a manner that allows its future incorporation into the Transfer Station's solid waste permit. The property owner is responsible to ensure that all Site Management responsibilities defined in the SMP are performed.

The SMP is intended to provide a detailed description of the procedures required to manage residual contamination left in place at the Site following completion of the IRM. For this Site, these procedures include 1) development, implementation, and management of all ECs and ICs and 2) submittal of Site Management Reports, performance of inspections and certification of results, and demonstration of proper communication of Site information to NYSDEC.

To address these needs, this SMP will include the following two plans:

- Engineering and Institutional Control Plan for implementation and management of EC/ICs
- Site Management Reporting Plan for submittal of data, information, recommendations, and certifications to NYSDEC

The SMP will be prepared in accordance with the requirements in NYSDEC Draft DER-10 Technical Guidance for Site Investigation and Remediation, dated 2010. Site management activities, reporting, and EC/IC certification will be scheduled on an annual basis with reporting due by March 1 of the year following the reporting period. All handling of residual contaminated material will be subject to provisions contained in the SMP.

6.0 IRM Program

6.1 Project Organization and Oversight

The WMNY Project Manager will be Glen Schultz. The Remedial Engineer (RE) for this project is Joseph Fiteni (NYSPE) of Savin Engineers, P.C. The Quality Assurance Manager (QAM) will be a representative of the construction contractor. The Quality Control Manager (QCM) will be Douglas Sutton (Ph.D., NJ PE) of HydroGeoLogic, Inc. The field oversight scientist/engineer will report to the QCM and will provide daily summary reports to document that the IRM is implemented in accordance with this IRM Work Plan, QAPP, and supporting documents. The field oversight scientist/engineer will promptly report any deviations from these documents to the RE, the QAM, and QCM so that the issue can be rectified in a timely manner. The Project-Specific Safety Coordinator will be a qualified representative from the construction contractor. He will document that the IRM is implemented in accordance with the HASP and will report to Glen Schultz. An organization chart is included in Figure 7. Resumes of key personnel involved in the IRM are included in Appendix B.

6.2 Security and Work Hours

The facility is currently operated Monday through Saturday 24-hours per day as a permitted solid waste facility. IRM work is anticipated to occur when waste transfer activities can be temporarily discontinued for eight hours or more, including evening/overnight hours. Security is maintained during operations. Security on Sundays involves a fence and locked gate.

6.3 Quality Assurance Project Plan

The QAPP describes the quality control components used to guide sampling and analytical procedures used to collect data to guide and evaluate the IRM. The QAPP is attached in Appendix C.

6.4 Health and Safety Plan

The HASP is included in Appendix D. The Project-Specific Safety Coordinator will be a qualified representative of the construction contractor. Work performed under this IRM will be in compliance with the HASP and applicable health and safety laws and regulations, including OSHA worker safety requirements and HAZWOPER requirements. Project-specific training will be provided to field personnel. Emergency telephone numbers will be posted at the site location before any IRM work begins. A safety meeting will be conducted before each shift begins. Topics to be discussed include task hazards and protective measures, emergency procedures, PPE levels, and other relevant safety topics. Meetings will be documented in a log book or specific form. An emergency contact sheet with names and phone numbers is included in the HASP.

6.5 Community Air Monitoring Plan

Air monitoring for VOCs, sulfuric acid mist, organic acid mist, sulfur dioxide, hydrogen sulfide, and particulate levels at the perimeter of the exclusion zone or work area will be performed. Continuous VOC and particulate monitoring will be performed for all ground intrusive activities (including excavations and soil mixing) and during the handling of contaminated or potentially contaminated media. Periodic monitoring for VOCs, sulfuric acid mist, organic acid mist, sulfur dioxide, and hydrogen sulfide will be performed during non-intrusive activities. Periodic monitoring during sample collection, for instance, will consist of taking a reading upon arrival at a sample location, monitoring while overturning soil, and taking a reading prior to leaving a sample location. Exceedances of action levels observed during performance of the Community Air Monitoring Plan (CAMP) will be reported to the NYSDEC Project Manager and included in the Daily Report.

VOC and Hydrogen Sulfide Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) will be monitored using a photoionization detector and hydrogen sulfide will be monitored with a hydrogen sulfide meter at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis during invasive work. Upwind concentrations will be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work will be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment will be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment will be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

- If the ambient air concentration of total organic vapors or hydrogen sulfide at the downwind perimeter of the work area or exclusion zone exceeds 2.5 parts per million (ppm) above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the levels readily decrease (per instantaneous readings) below 2.5 ppm over background, work activities will resume with continued monitoring.
- If total organic vapor or hydrogen sulfide levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 2.5 ppm over background but less than 5 ppm, work activities will be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities will resume provided that levels 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less, but in no case less than 20 feet, is below 2.5 ppm over background for the 15-minute average.
- If the organic vapor level is above 5 ppm at the perimeter of the work area, activities will be shutdown.

All 15-minute readings must be recorded and be available for NYSDEC Division of Environmental Remediation (NYSDEC DER) personnel to review. Instantaneous readings, if any, used for decision purposes will also be recorded.

Sulfuric Acid, Organic Acid Mist, and Sulfur Dioxide Monitoring, Response Levels, and Actions

Sulfuric acid, organic acid mist, and hydrogen sulfide concentrations will be monitored at the upwind and downwind perimeters of the exclusion zone and at monitoring stations. The monitoring will be performed using gas detector tubes with a measurement range of 0.5 mg/m^3 to 5 mg/m^3 for sulfuric acid, 1 to 100 ppm for acetic acid (and other organic acids), and 0.5 to 60 ppm for sulfur dioxide Monitoring will be conducted once every two hours hour during intrusive activities.

If the downwind levels exceed the following concentrations, then the source of the vapors will be identified, corrective actions will be taken, and monitoring continued

- sulfuric acid – 0.5 mg/m^3
- acetic acid or other measured organic acid – 2.5 ppm
- sulfur dioxide – 1 ppm

Work will resume after the next downwind measurements are below the stated criteria.

All readings will be recorded and be available for NYSDEC DER personnel to review.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations will be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring will be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter ($\mu g/m^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques will be employed. Work will continue with dust suppression techniques provided that downwind PM-10particulate levels do not exceed 150 $\mu g/m^3$
- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 $\mu g/m^3$ above the upwind level work will be stopped and a re-evaluation of activities initiated. Work will resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 $\mu g/m^3$.

All readings will be recorded and be available for NYSDEC DER personnel to review.

6.6 Permits and Approvals

All permits or government approvals required for IRM implementation have been or will be obtained prior to the start of implementation. Approval of this IRM by NYSDEC does not constitute satisfaction of these requirements and will not be a substitute for any required permit.

6.7 Field Operations and Preparation

Field Operations Plan

A field operations plan prepared by the construction contractor reviewed by WMNY, the RE, and the QCM will document specific field procedures and decision logic for addressing upset or unexpected conditions. This field operations plans will be provided to NYSDEC for informational purposes.

Pre-construction Notification and Meeting

A pre-construction notification will be given to NYSDEC seven days prior to the start of soil mixing. NYSDEC will also be invited to the pre-construction meeting to take place on or before the first day of the pilot-scale or full-scale injections.

Mobilization

All remedial equipment will be delivered to the property via normal trucking routes, and will be stored on-site.

Stabilized Construction Entrances

The IRM does not necessitate construction entrances.

Utility Marker Layouts, Easement Layouts

The property owner and its contractors are solely responsible for the identification of utilities that might be affected by work conducted under this IRM Work Plan. The property owner and its contractors are solely responsible for safe execution of all invasive and other work performed under this IRM Work Plan.

Soil and Erosion Control Measures

An Erosion and Sediment Control Plan (ESCP) will be developed in conformance with requirements presented in the New York State Guidelines for Urban Erosion and Sediment Control. Best Management Practices (BMPs) for soil erosion will be selected to minimize erosion and sedimentation off-site from the start of the IRM to completion. The ESCP will include the following information:

- Descriptions of the selected BMPs that will be used to control erosion and sedimentation.
- Map showing the location of the proposed BMPs.
- Implementation schedule and maintenance requirements for the proposed BMPs.
- For active work zones, a perimeter BMP system will be installed and maintained to contain soil and sediment.

Accumulated sediment in the BMPs that is removed will be screened for the presence of petroleum and disposed of properly if found.

Equipment and Reagent Staging

Equipment and reagent staging areas will be designated during the IRM to facilitate work and prevent in advertent releases of reagents.

Decontamination Area

A temporary decontamination area lined with polyethylene sheeting will be constructed for steam-cleaning or washing of equipment before equipment is taken off site. The location of the decontamination area will be coordinated with the facilities manager. At a minimum, the decontamination pad will have a 30 mil low-permeability liner, be bermed and sloped to a collection sump to contain and collect fluids, and have side walls to mitigate, to the extent practicable, errant overspray, especially when decontaminating large equipment. Wash waters will be collected and properly disposed of in accordance with regulations.

Demobilization

After IRM work is complete, all areas disturbed to accommodate support areas (e.g., staging areas, decontamination areas, storage areas), will be restored to conditions acceptable to the facilities manager. Temporary access areas (on-site and off-site) will be removed and disturbed access areas will be conditions acceptable to the facilities manager. All sediment and erosion control measures will be removed and materials will be disposed in accordance with applicable rules and regulations. All excavation and mixing equipment will be decontaminated, and general refuse will be disposed in accordance with applicable rules and regulations.

6.8 Reporting and Recordkeeping

Daily logs will be maintained, and monthly reports will be submitted throughout the IRM. The Remedial Engineer will be responsible for certifying all reports and will be an individual licensed to practice engineering in the State of New York. All daily logs will be included in the monthly reports, and the monthly reports will be included in the IRM Report.

Daily logs will include a brief description of activities conducted during the day, samples collected, injections completed, quantities of reagents used, waste generated, CAMP monitoring results, and any corrective actions taken.

Monthly reports will be submitted no later than one week following the end of the month in electronic format (PDF) only. All monthly reports will be submitted to the NYSDEC Project Manager and NYSDOH. These reports will include a description of the work done during the reporting period, including information such as injection points conducted and reagent quantities delivered. Any deviations from this IRM Work Plan will also be provided, including an explanation for the change. Monthly reports will include all sampling results and analytical testing performed during the month. The planned activities for the next month, an updated schedule, and any anticipated problems will also be stated.

All IRM activities will be photographed and submitted to the NYSDEC. Photographs will document ongoing IRM activities and will provide before and after representations of the contamination. They will clearly illustrate the identified locations of contamination and structures involved in the cleanup. A photo log will be created to include the photograph, date, and brief description of the photograph. The photo log will be submitted to the NYSDEC in their approved format, compact disc, or other acceptable media at an agreed upon frequency. All relevant photographs and other reports will be kept at the job location at all times for reference and inspection by NYSDEC staff. Information will be submitted in Electronic Data Deliverable (EDD) format pursuant to NYSDEC Division of Environmental Remediation requirements. Data will be formatted to meet the guidelines specified by NYSDEC.

6.9 Complaint Management

All complaints filed by the public regarding any problems with the IRM will be kept on file and reviewed by the RE, the QAM, and the QCM. During IRM activities a sign will be prominently displayed indicating a cleanup is in progress. Also on this sign will be a complaint hotline phone number to be used if odors or any other hazards are detected by the public during the IRM.

6.10 Deviation from the IRM Work Plan

Any changes to the scope of work as stated in this plan will be noted in Monthly Progress Reports and the IRM Report. Any change will be accompanied by the reasons for the change, approval process for the change, and the effects that the change will have on the overall IRM.

6.11 Data Usability Summary Report

Dr. Sutton will prepare a Data Usability Summary Report. A copy of this report will be included in the IRM Report.

7.0 IRM Report

An IRM Report will be submitted to NYSDEC following implementation of the IRM defined in this IRM Work Plan. The IRM Report provides the documentation that the work required under this IRM Work Plan has been completed and has been performed in compliance with this plan. The IRM Report will provide a comprehensive account of all samples and injection points. The IRM Report will provide a description of the changes in the IRM from the elements provided in the IRM Work Plan. The IRM Report will provide a tabular summary of all performance evaluation sampling results and all material characterization results and other sampling and chemical analysis performed as part of the IRM. The IRM Report will be prepared in conformance with DER-10.

The IRM Report will include written and photographic documentation of the IRM.

The IRM Report will include an itemized tabular description of actual costs incurred during all aspects of the IRM.

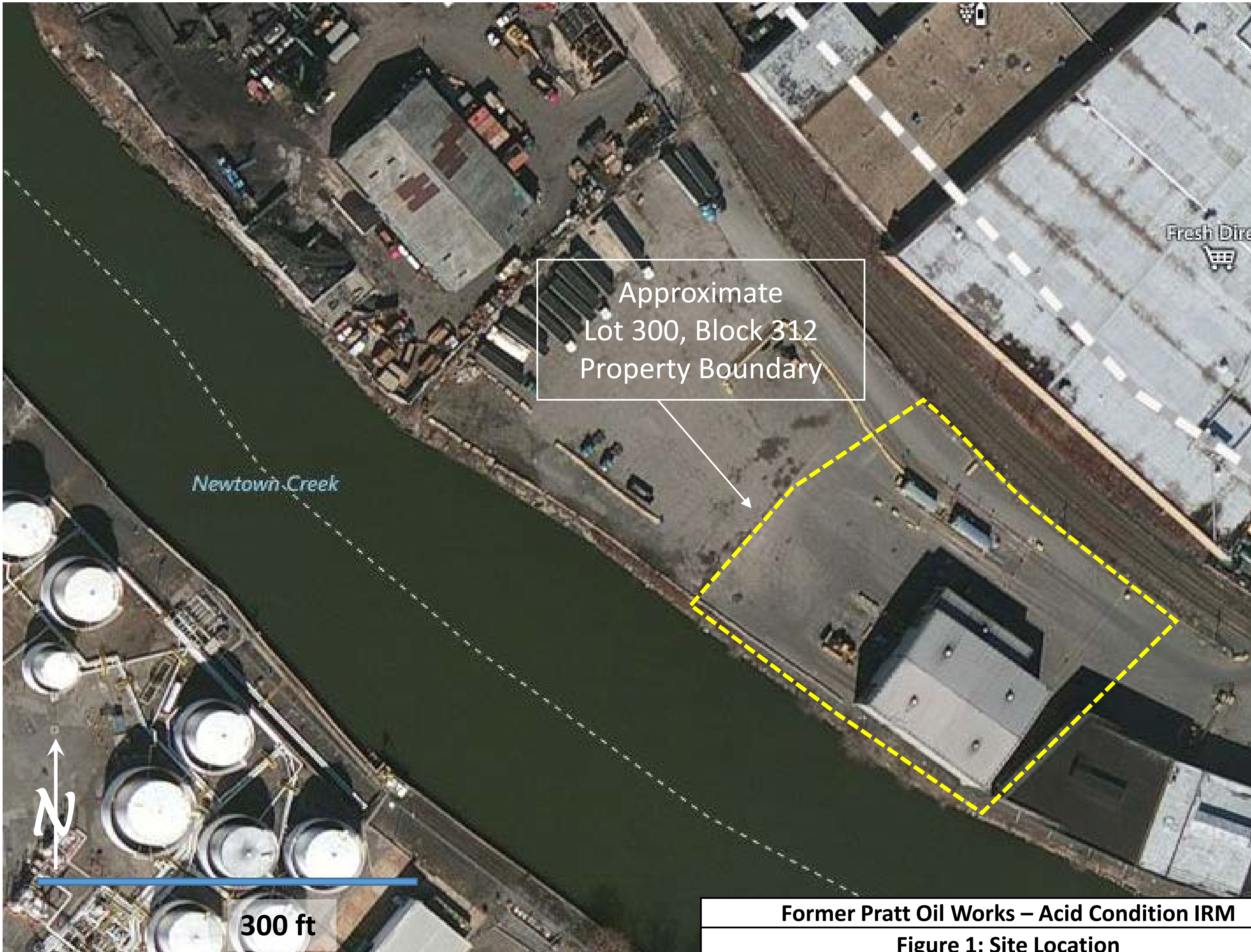
The IRM will include an accounting of the destination of all IRM material removed from the Property, including investigation derived waste and fluids. Documentation associated with disposal of all material will also include records and approvals for receipt of the material. It will provide an accounting of the origin and chemical quality of all IRM-related material for backfill imported onto the Property, if any.

All project reports must be submitted in digital form on electronic media (PDF).

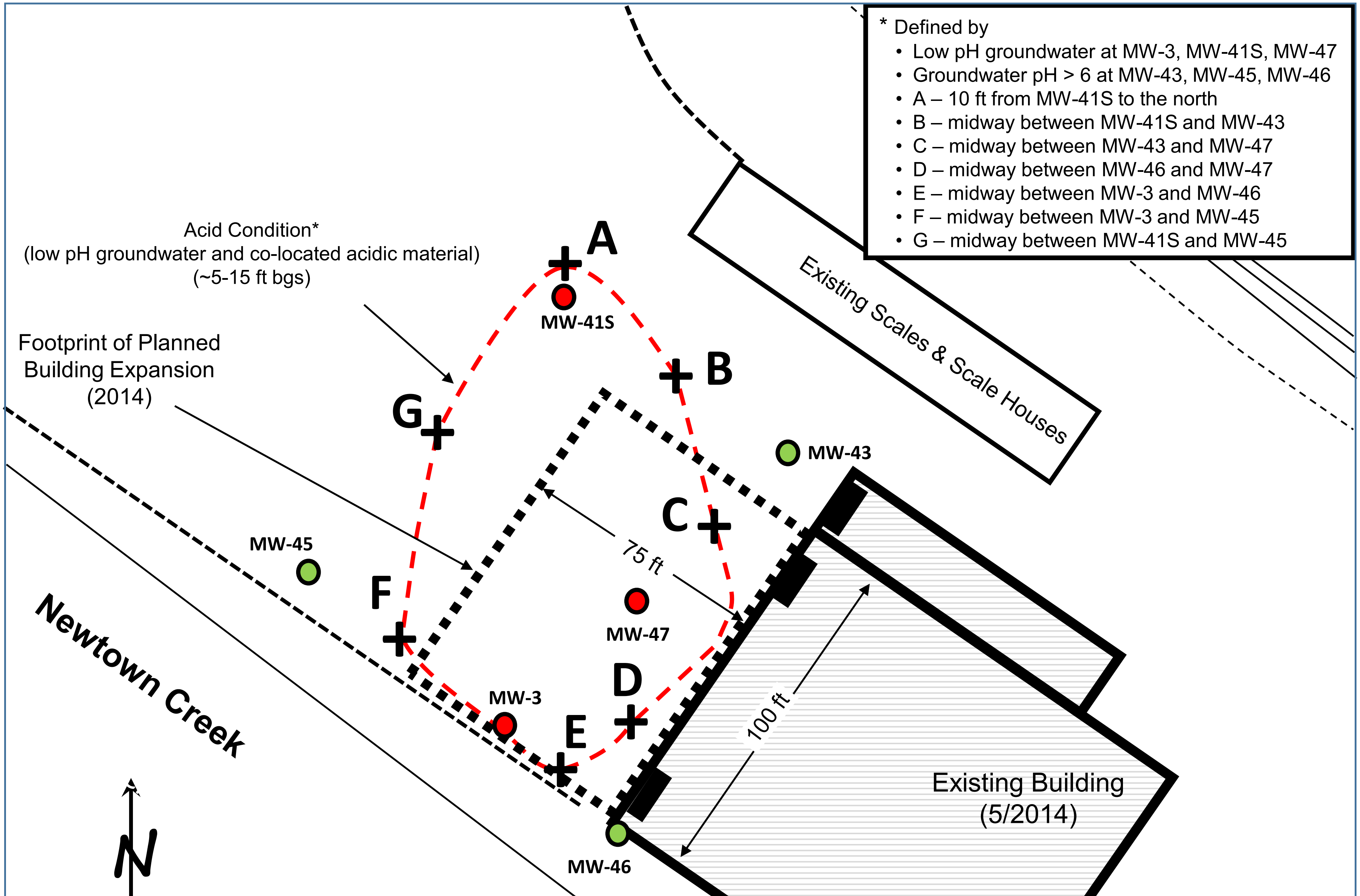
8.0 Schedule

The expansion of the Transfer Station will include re-grading portions of the Property, installing new truck scales and scale house, extending a rail spur onto the Property, and expanding the existing corrugated metal building approximately 75 feet to the west. The planned areas for re-grading and building expansion are located in the Treatment Area. The expanded facility will need to be constructed no later than May 2015 to meet contractual obligations with the NYCDOS, commencing in June 2015. In order to meet that schedule, construction in the Treatment Area will need to start in early November 2014. Assuming IRM Work Plan approval by August 1, 2014, construction will be completed and the IRM Report submitted within 90 days by October 31, 2014. A more detailed schedule will be provided in the Field Operations Plan that will be made available to NYSDEC.

FIGURES

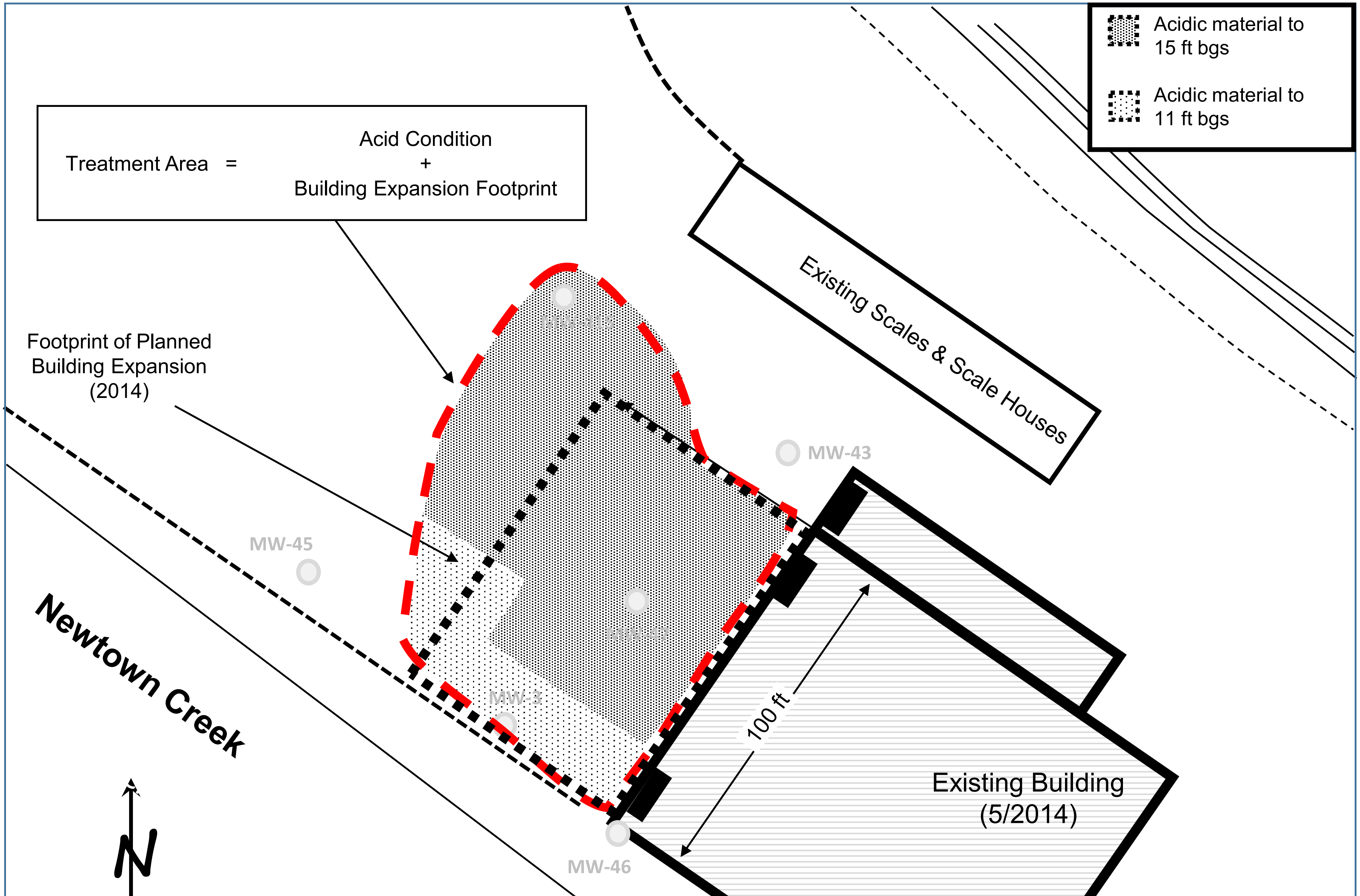


Former Pratt Oil Works – Acid Condition IRM
Figure 1: Site Location



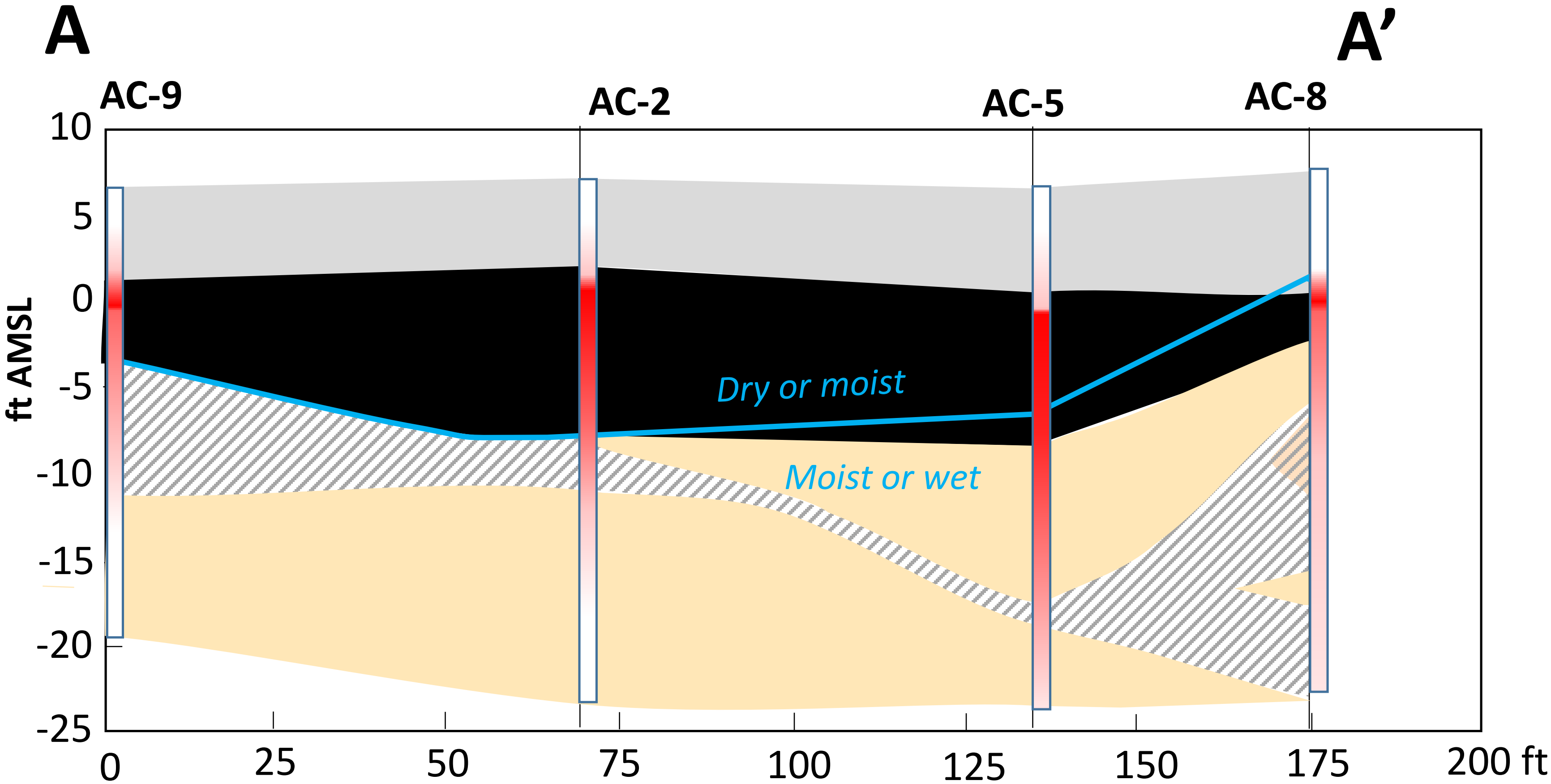
Former Pratt Oil Works – Acid Condition IRM

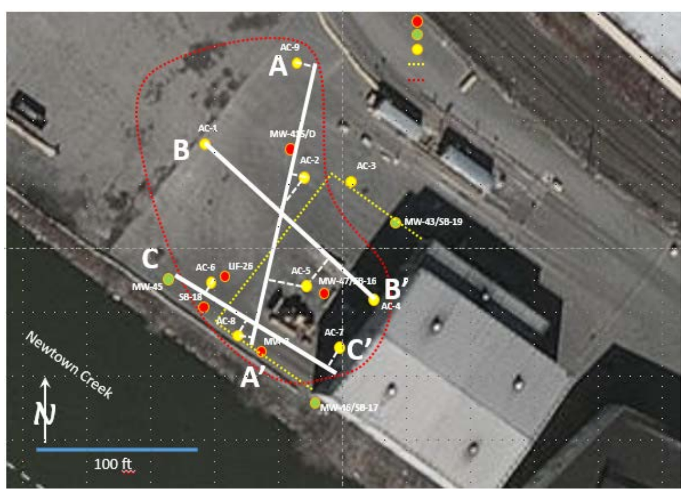
Figure 2: Existing Building, Planned Expansion, and Extent of Acid Condition



Former Pratt Oil Works – Acid Condition IRM

Figure 3: Treatment Area

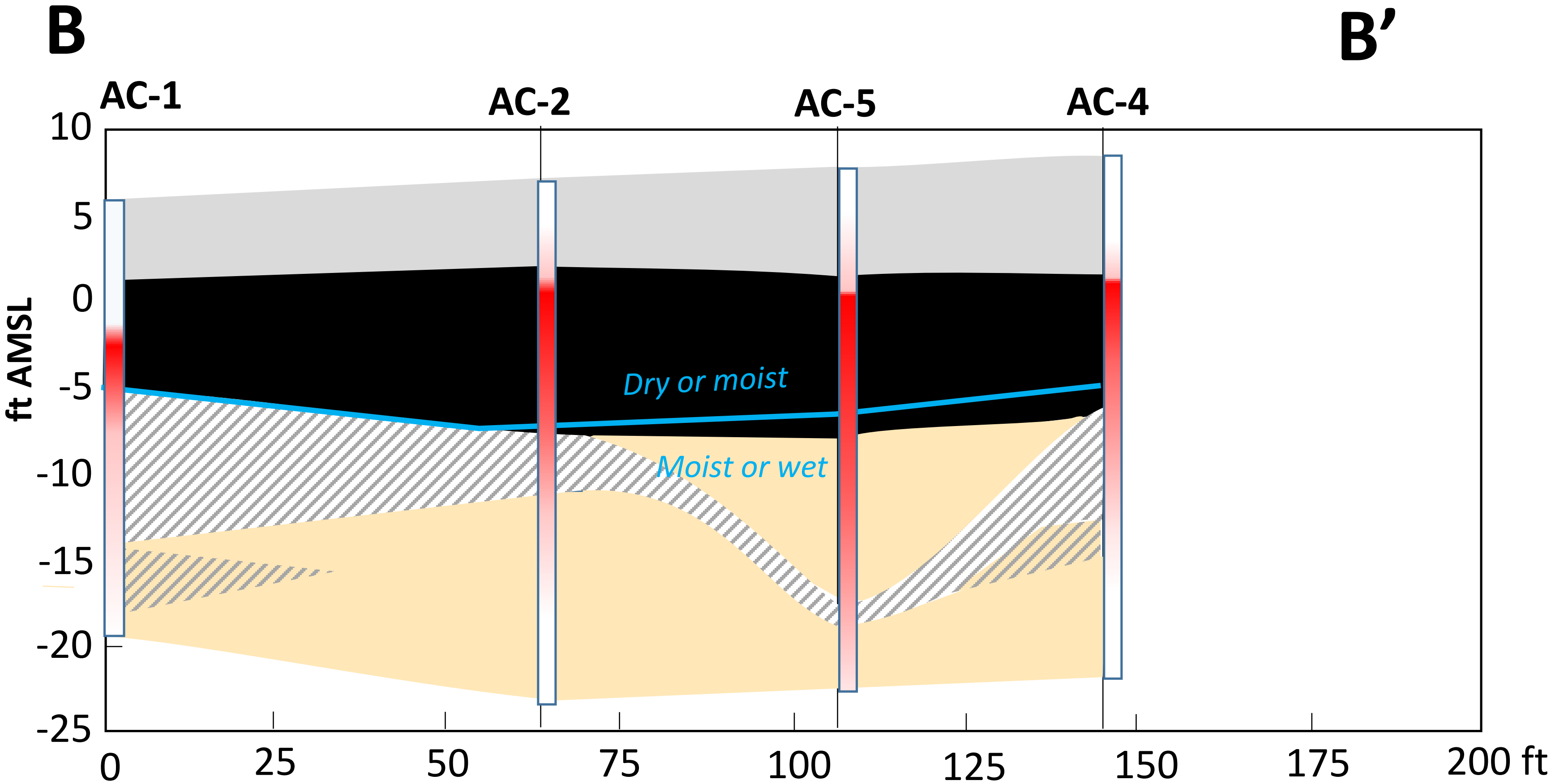


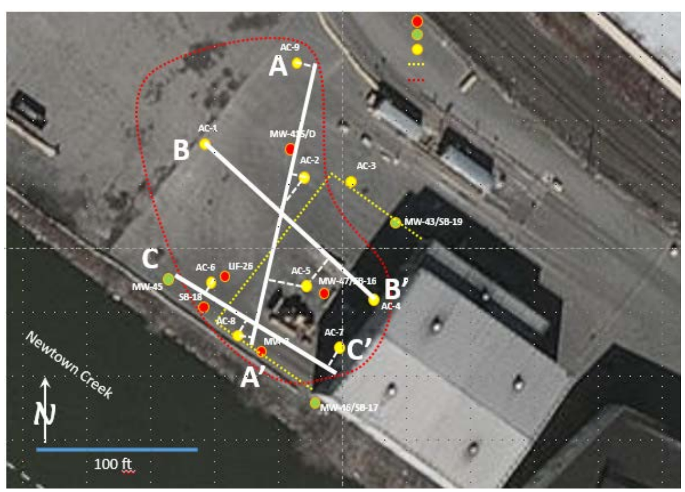


	Fill
	Acidic material (coal-like material)
	Silty sand, sand, or gravel
	Clay
	Semi-quantitative indicator of soil pH

Soil type and soil pH interpreted from AC borings conducted between 2/6/14 and 2/9/14

Former Pratt Oil Works – Acid Condition IRM
Figure 4a: Cross-Section A-A’



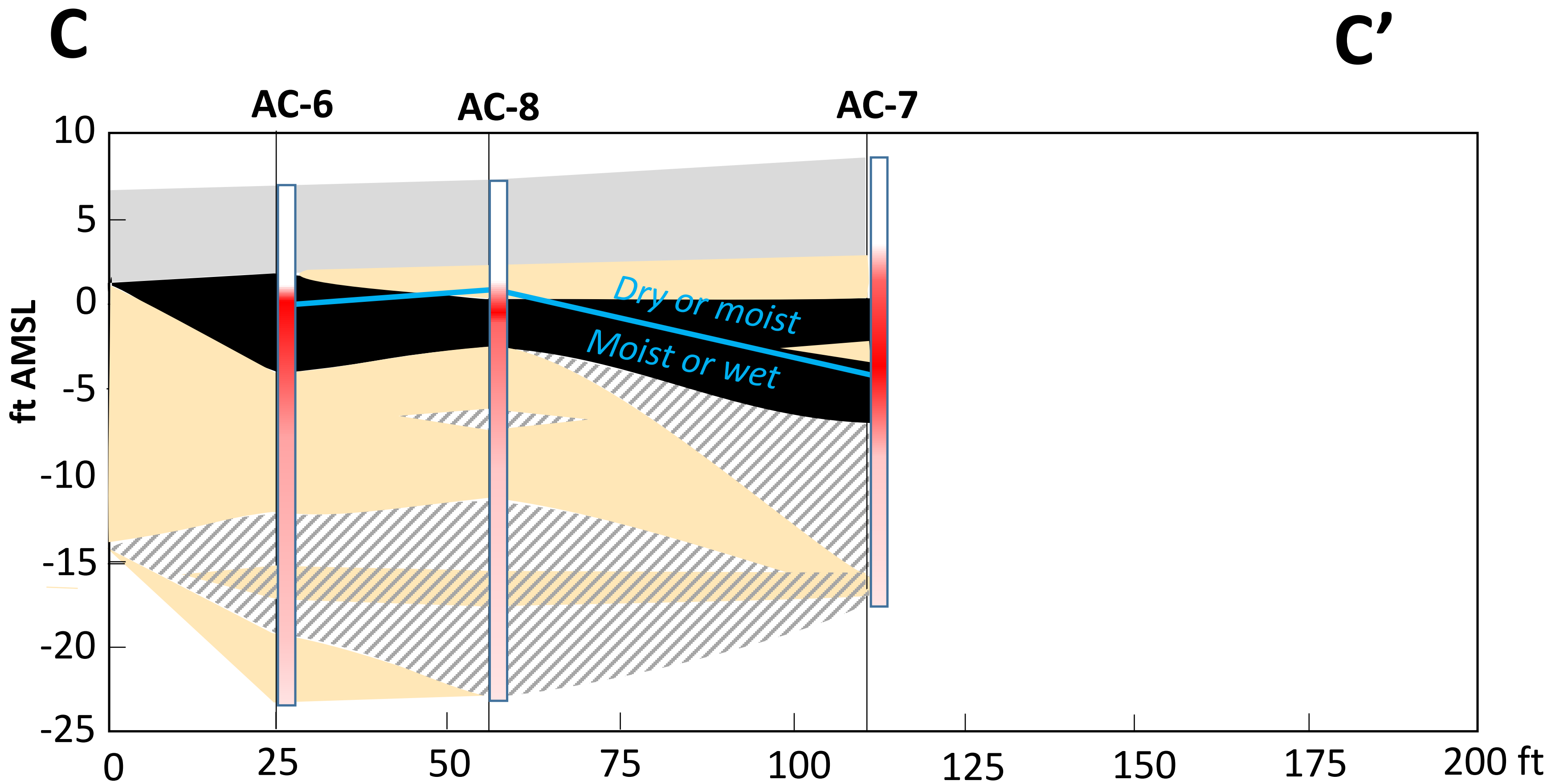


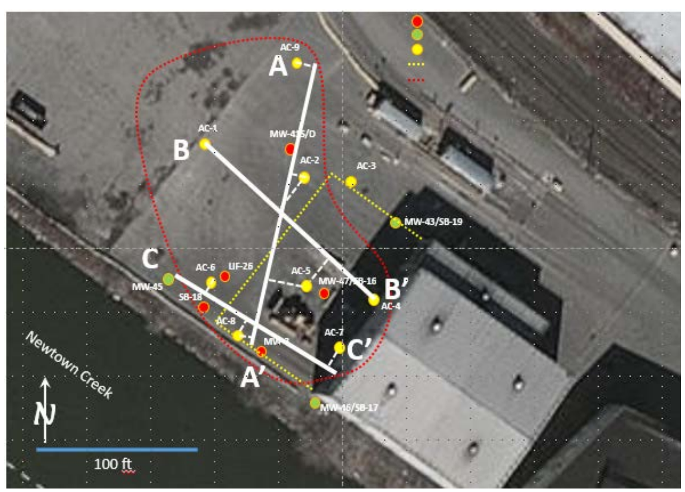
Fill	
Acidic material (coal-like material)	
Silty sand, sand, or gravel	
Clay	
Semi-quantitative indicator of soil pH	

Soil type and soil pH interpreted from AC borings conducted between 2/6/14 and 2/9/14

Former Pratt Oil Works – Acid Condition IRM

Figure 4b: Cross-Sections B-B'





Fill

Acidic material (coal-like material)

Silty sand, sand, or gravel

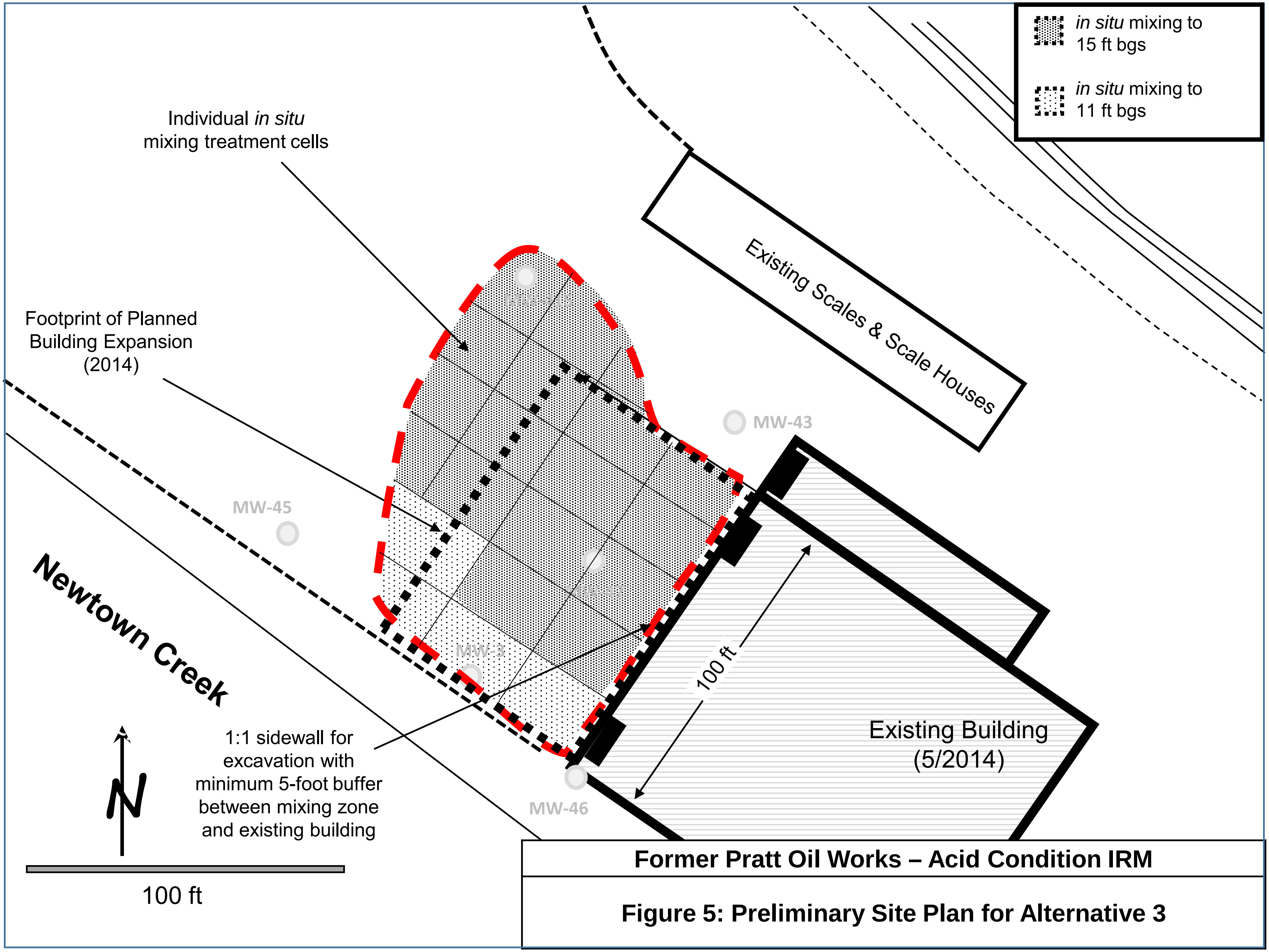
Clay

Semi-quantitative indicator of soil pH

Soil type and soil pH interpreted from AC borings conducted between 2/6/14 and 2/9/14

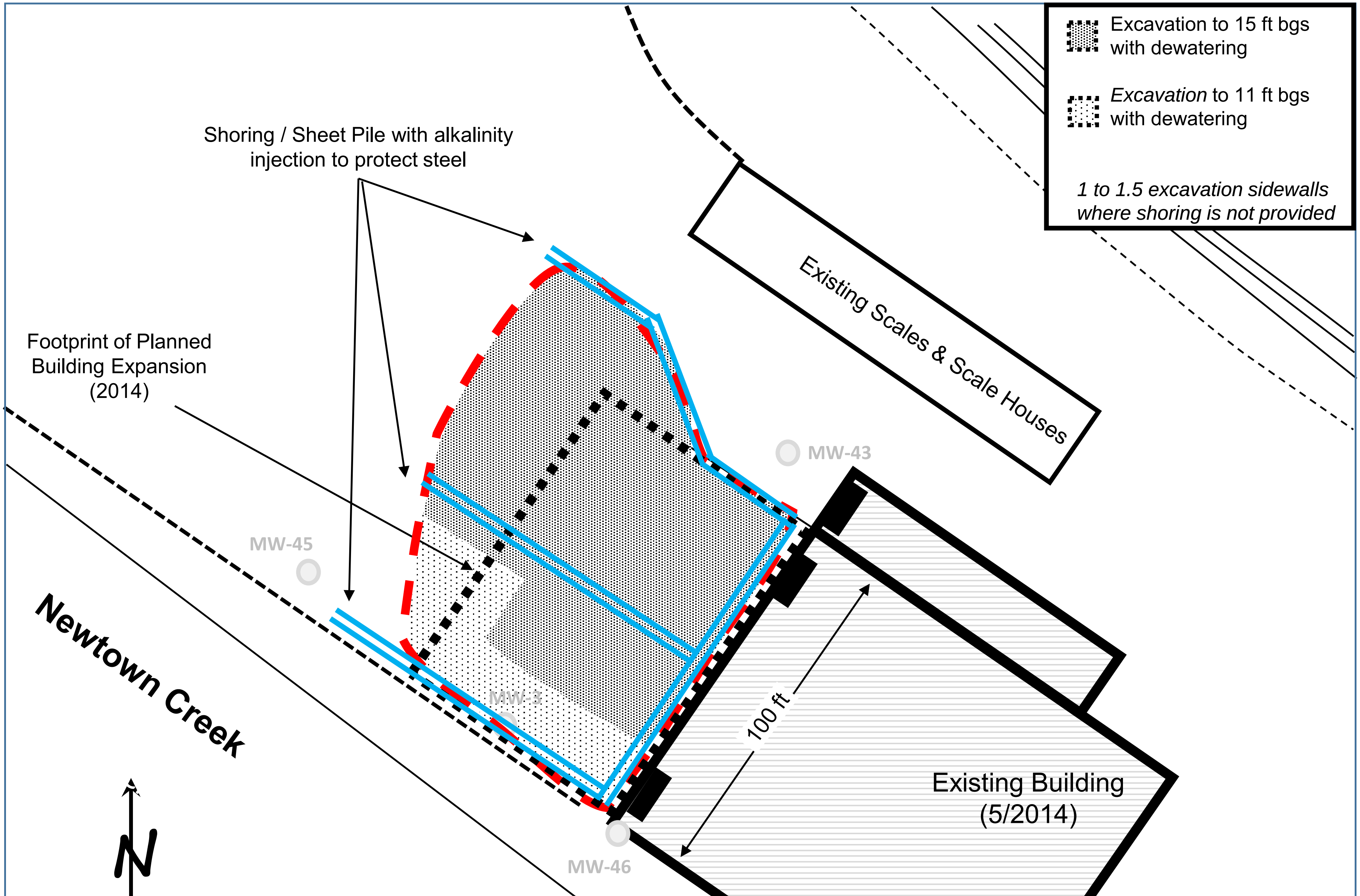
Former Pratt Oil Works – Acid Condition IRM

Figure 4c: Cross-Sections C-C’



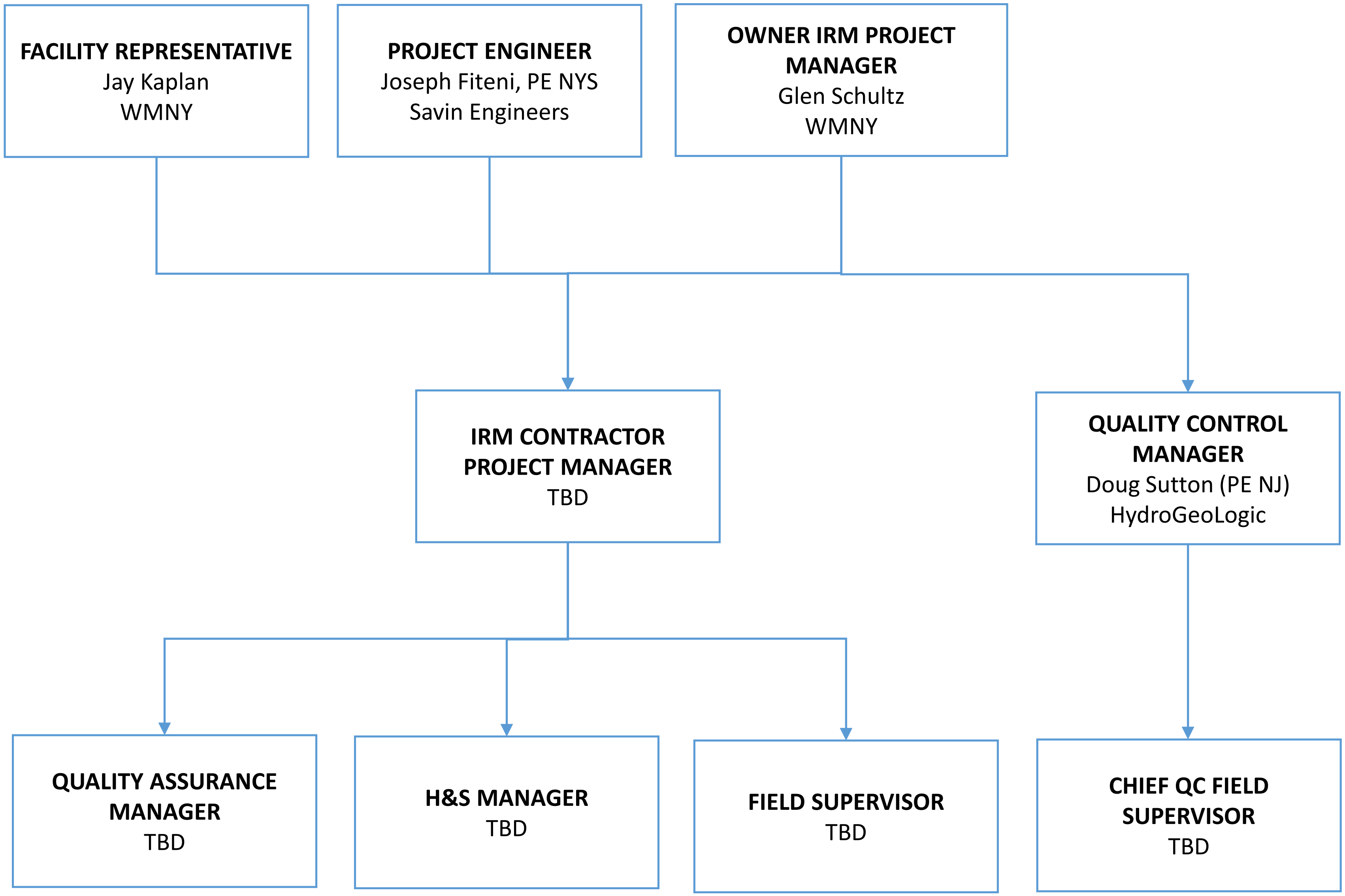
Former Pratt Oil Works – Acid Condition IRM

Figure 5: Preliminary Site Plan for Alternative 3



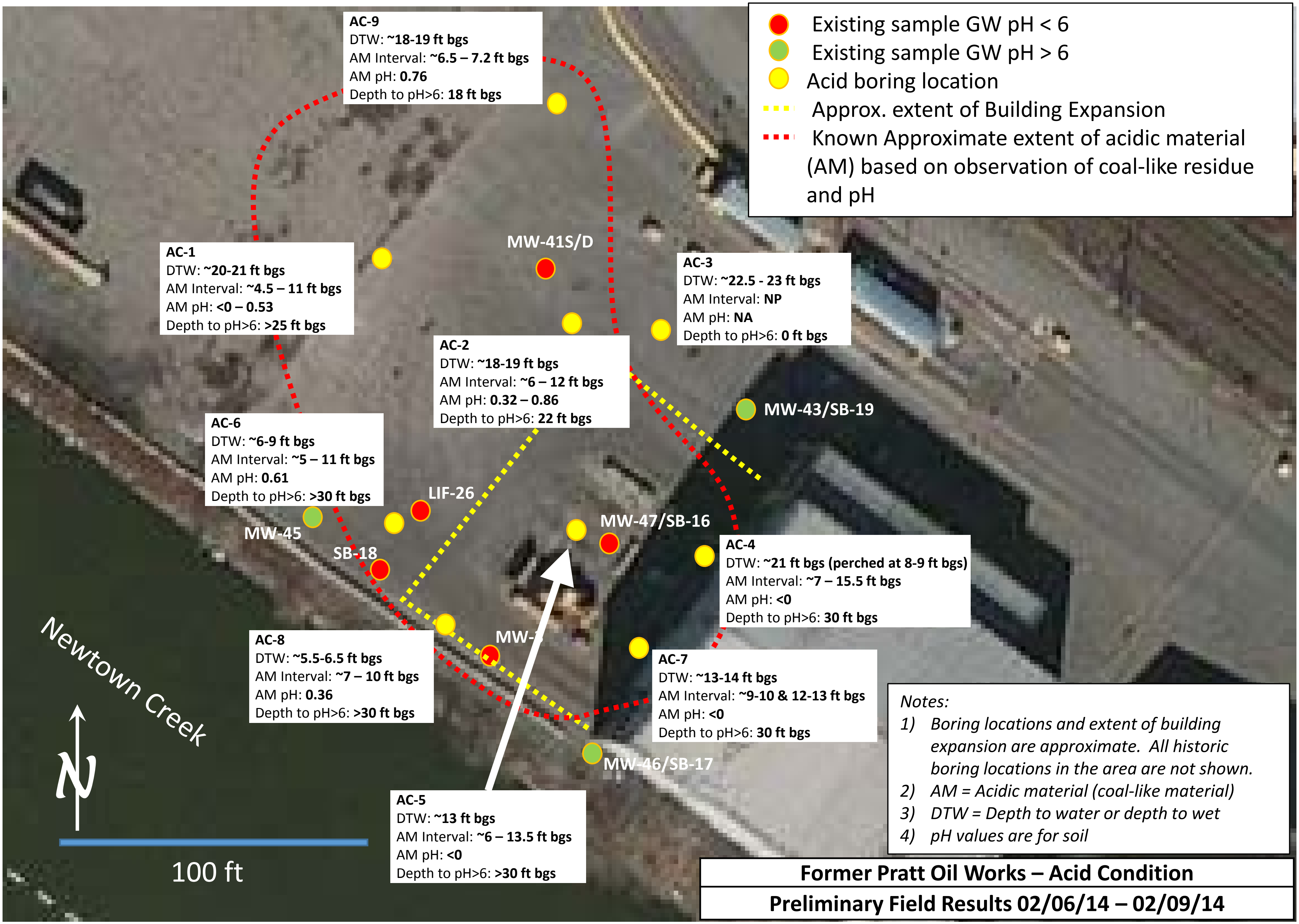
Former Pratt Oil Works – Acid Condition IRM

Figure 6: Preliminary Site Plan for Alternative 4



Former Pratt Oil Works – Acid Condition IRM
Figure 7: Organization Chart

APPENDIX A



Former Pratt Oil Works – Acid Condition

Preliminary Field Results 02/06/14 – 02/09/14

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-1**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Andrew Solomon - HydroGeoLogic	
Sample Date	2/8/2014	

Depth (ft BGS)	**Water Table**	**Material**	**PID (ppm)**	**Sample Mass (g)**	**pH**	**Alkalinity Demand**
1		Asphalt and subbase	NA	NA	NA	NA
2						
3		dry, silty sand FILL with fine gravel	NM	NM	NA	NA
4						
5		4.5-11.0 ft: Pulverized carbon/coal, black, dry, very fine, silt and clay-like texture, less dense than soil	35.7	10.0	8.70	NA
6						
7			0.6	10.1	0.24	0.03960
8						
9			1.8	10.1	<0	0.10693
10						
11			4.1	10.0	0.53	0.03600
12		CL: moist, brown, plastic to semi-plastic at 13.5 ft, CLAY				
13			2.9	9.9	1.29	0.01212
14						
15			0.0	10.1	2.50	0.01188
16						
17			0.0	9.9	3.68	0.00788
18						
19		moist, fine, sandy CLAY	0.0	9.9	3.70	0.00364
20						
21		SW-SC: moist to wet, gray to brown, very fine, poorly graded, clayey SAND	0.0	10.2	3.70	0.00086
22						
23			0.0	10.2	3.58	0.00078
24						
25		SP-SC: wet, fine, gravelly SAND	0.0	9.9	4.00	0.00101
26		Refusal at 25 ft - no recovery	NA	NA	NA	NA
27						
28						
29						
30						

Borings were logged in accordance with the USCS
BGS = "below ground surface"
Water Table = based on observation of dry, moist, or wet soil
pH = field determined pH
Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6
NM = not measured, NA = not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-2**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Doug Sutton - HydroGeoLogic	
Sample Date	2/6/2014	

Depth (ft BGS)	Water Table	Material	PID (ppm)	Sample Mass (g)	pH	Alkalinity Demand
1		asphalt and subbase with some bricks	NA	NA	NA	NA
2						
3		SP-SM: dry, fine, poorly graded, silty sand **FILL** with some silt and fine, subangular gravel	57	10.0	9.71	NA
4						
5				10.0	4.64	0.00400
6		6.4 - 15 ft: Pulverized carbon/coal, black, dry very fine silt and clay-like texture. Less dense than soil.	92.3			
7				9.8	0.86	0.05306
8			1.6			
9				10.5	0.32	0.08762
10						
11			0.8	10.1	0.72	0.03168
12						
13			0.7	10.4	1.20	0.02308
14						
15				10.3	1.76	0.02718
16		CL: moist, gray plastic CLAY	0			
17				9.6	2.90	0.03000
18			0			
19		SP: wet, dark gray to gray, poorly graded SAND with some silt to very wet, pink, poorly graded SAND with some silt		10.2	4.29	0.00067
20						
21			0	10.3	5.84	0.00388
22		SP: very wet, gray, fine to medium, poorly graded SAND with some fine and medium rounded gravel				
23			0	10.1	6.75	NA
24						
25				10.0	6.80	NA
26			0			
27				9.8	6.50	NA
28			0			
29				10.0	6.60	NA
30						

Borings were logged in accordance with the USCS

BGS = "below ground surface"

Water Table = based on observation of dry, moist, or wet soil

pH = field determined pH

Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6

NM = not measured, NA = Not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-3**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Doug Sutton - HydroGeoLogic	
Sample Date	2/6/2014	

Depth (ft BGS)	Water Table	Material	PID (ppm)	Sample Mass (g)	pH	Alkalinity Demand
1		asphalt and subbase	NA	NA	NA	NA
2						
3		Concrete				
4		SP-SM: dry, fine, poorly graded, silty sand FILL with some fine sub-angular gravel	806	10.4	NA	NA
5				10.0	NM	NA
6		SP: dry, fine, poorly graded SAND/FILL, fuel stained				
7			345	10.2	NM	NA
8						
9				10.2	7.03	NA
10		CL: moist, plastic CLAY with some organics	247			
11				10.3	NA	NA
12						
13			198	10.4	7.10	NA
14						
15				NA	7.34	NA
16			296			
17				9.9	7.21	NA
18						
19		SP-SM: fine, wet, silty SAND, fuel stained	13.5	12.1	7.35	NA
20		CL: moist, firm, semi-plastic CLAY				
21				10.8	7.84	NA
22			2.7			
23				10.6	8.00	NA
24		SP-SM: very wet, reddish-brown, fine, poorly graded, silty SAND				
25			0	10.6	7.07	NA
26		SP: very wet, fine, poorly graded SAND				
27				10.2	7.30	NA
28			3.3			
29				10.2	NM	NA
30						

Borings were logged in accordance with the USCS
BGS = "below ground surface"
Water Table = based on observation of dry, moist, or wet soil
pH = field determined pH
Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6
NM = not measured, NA = not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-4**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Andrew Solomon - HydroGeoLogic	
Sample Date	2/9/2014	

Depth (ft BGS)	**Water Table**	**Material**	**PID (ppm)**	**Sample Mass (g)**	**pH**	**Alkalinity Demand**
1		Asphalt and subbase	NA	NA	NA	NA
2						
3		dry, fine, silty, sand FILL with fine and medium sub-angular gravel, fuel stained	NM	NM	NA	NA
4						
5				10.0	7.19	NA
6		SP-GW: dry, light gray, fine SAND and medium angular GRAVEL	1.2			
7				10.1	3.18	0.00396
8		7.0 - 15.5 ft: Pulverized carbon/coal, black, moist to wet, very fine, silt and clay-like texture, less dense than soil	1.1			
9				10.2	<0	0.14314
10						
11			0.2	10.0	<0	0.19600
12						
13			0	10.0	0.58	0.02840
14						
15				10.1	1.49	0.01267
16		CL: moist, gray, plastic, CLAY	12.8			
17				10.0	3.63	0.00408
18			3.1			
19				10.0	4.27	0.00100
20						
21		CL: moist, fine sandy plastic CLAY	0	9.9	5.28	0.00028
22		SC: wet, gray, fine, poorly graded, clayey SAND				
23			0.0	10.1	4.89	0.00079
24		SP: very wet, brown, very fine, poorly graded SAND with some silt				
25				10.0	5.40	0.00052
26		SP: wet, medium, poorly graded SAND	0.0			
27				9.9	5.74	0.00012
28			0.0			
29				10	6.11	NA
30						

Borings were logged in accordance with the USCS
BGS = "below ground surface"
Water Table = based on observation of dry, moist, or wet soil
pH = field determined pH
Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6
NM = not measured, NA = not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-5**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Andrew Solomon - HydroGeoLogic	
Sample Date	2/7/2014	

Depth (ft BGS)	Water Table	Material	PID (ppm)	Sample Mass (g)	pH	Alkalinity Demand
1		Asphalt and subbase	NA	NA	NA	NA
2						
3		SP-SM: dry, brown, fine, poorly graded silty sand FILL with some fine sub-angular gravel	NM	NM	NA	NA
4						
5			48.3	10.2	8.75	NA
6						
7		6-15.5 ft: Pulverized carbon/coal, dry to wet, very fine silt and clay-like, less dense than soil	3.4	10.1	0.08	0.04752
8						
9			1.2	10.2	0.12	0.11373
10						
11			0.6	10.0	<0	0.24800
12						
13			9.0	10.2	0.05	0.13725
14						
15			86.6	10.1	1.40	0.00792
16		SP-SM: very wet, gray, fine silty SAND and fine angular GRAVEL				
17			0.0	9.9	1.03	0.01010
18						
19			3.5	10.2	1.22	0.00980
20						
21			2.0	10.0	1.25	0.00400
22						
23		SP: very wet, very fine, poorly graded SAND	0.0	10.1	1.31	0.00792
24						
25		CL: moist, pinkish brown, firm, semi-plastic CLAY with some medium, sub-angular gravel	2.8	10.2	2.40	0.00196
26		SP: very wet, fine, poorly graded SAND				
27		GP: very wet, medium, sub-angular, gravel with some sand	0.0	10.0	2.28	0.00200
28		SP: very wet, brown, fine, poorly graded SAND				
29			0.0	9.9	2.27	0.00202
30						

Borings were logged in accordance with the USCS
BGS = "below ground surface"
Water Table = based on observation of dry, moist, or wet soil
pH = field determined pH
Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6
NM = not measured, NA = not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-6**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Doug Sutton - HydroGeoLogic	
Sample Date	2/7/2014	

Depth (ft BGS)	Water Table	Material	PID (ppm)	Sample Mass (g)	pH	Alkalinity Demand
1–2		Asphalt and subbase	NA	NA	NA	NA
3–4		SP-SM: dry, gray, fine, poorly graded silty sand FILL with fine, sub-angular gravel	NM	9.9	10.58	NA
5–6			NM	10.2	6.14	NA
7–8		5.0-11.0 ft: Pulverized carbon/coal moist to wet, black, very fine, silty clay-like texture, less dense than soil	0.5	10.1	0.61	0.04356
9–10			1.2	10.1	0.65	0.14257
11–12			2.8	9.8	1.08	0.01633
13–14		SP-SM: very wet, gray, fine, poorly sorted, silty SAND with some clay	0.6	10.2	1.67	0.00392
15–16			1.6	10.6	1.80	0.00566
17–18			1.1	10.4	1.81	0.00769
19–20			0.2	10.4	1.91	0.01538
21–22		CL: wet, gray, soft, plastic, CLAY with some fine sand	0.3	10.7	1.80	0.01121
23–24		SW-SC: very wet, gray, fine, poorly graded, clayey SAND, sheen	0.8	10.8	2.03	0.00741
25–26		CL: moist, gray, soft, plastic CLAY with some fine sand	23.4	9.9	3.87	0.00202
27–28		SP: very wet, gray, fine, poorly graded SAND	0.0	10.2	4.52	0.00098
29–30			0.9	10.1	4.55	0.00198

Borings were logged in accordance with the USCS

BGS = "below ground surface"

Water Table = based on observation of dry, moist, or wet soil

pH = field determined pH

Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6

NM = not measured, NA = not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-7**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Andrew Solomon - HydroGeoLogic	
Sample Date	2/7/2014	

Depth (ft BGS)	Water Table	Material	PID (ppm)	Sample Mass (g)	pH	Alkalinity Demand
1		Asphalt and subbase	NA	NA	NA	NA
2						
3		SP-SM: dry, fine, silty FILL with fine gravel	NM	10.1	8.54	NA
4						
5			NM	10.3	6.99	NA
6						
7		SP: dry, light brown to gray, fine, poorly graded SAND	NM	9.8	2.41	0.00204
8		ML: dry, gray, fine, sandy SILT				
9		8.5-10 ft: Pulverized carbon/coal, black, dry, very fine, silt and clay-like texture, less dense than soil	NM	9.9	0.47	0.02424
10						
11		SP-SM: moist, fine, poorly graded, silty SAND	NM	9.9	2.30	0.00202
12						
13		12-15 ft: Pulverized carbon/coal, black, moist to wet, very fine silt and clay-like texture, less dense than soil	NM	10.6	<0	0.18113
14						
15			NM	10	<0	0.28000
16		CL: moist to wet, gray, plastic to semi-plastic from 18.5 to 20.5 ft, fine, sandy CL				
17			NM	10.5	3.20	0.00857
18						
19			NM	10.2	3.47	0.00588
20						
21			NM	10.2	4.07	0.00392
22						
23			NM	10.5	5.17	0.00190
24						
25		SP-SM: moist, very fine, poorly graded, silty SAND with some clay	NM	10.3	3.82	0.00388
26		Refusal at 25 ft - no recovery	NA	NA	NA	NA
27						
28						
29						
30						

Borings were logged in accordance with the USCS

BGS = "below ground surface"

Water Table = based on observation of dry, moist, or wet soil

pH = field determined pH

Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6

NM = not measured, NA = not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue						**AC-8**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft						
Driller	Land, Air, and Water Environmental Services, Inc.						
Soil Logging by	Andrew Solomon - HydroGeoLogic						
Analysis by	Andrew Solomon - HydroGeoLogic						
Sample Date	2/7/2014						

Depth (ft BGS)	Water Table	Material	PID (ppm)	Sample Mass (g)	pH	Alkalinity Demand
1–2		Asphalt and subbase	NM	NA	NA	NA
3–4		SP-SM: dry, dark brown, fine, poorly graded, silty sand FILL	NM	9.9	9.85	NA
5–6		SP: dry, brown, fine, poorly graded SAND; SP-SM: wet, gray, fine and medium, silty SAND w/ some medium rounded gravel, fuel stained	0.0	10.0	7.7	NA
7–8		7.0-10 ft. Pulverized carbon/coal, moist, black, very fine silt and clay-like texture, less dense than soil	0.0	10.1	0.36	0.07921
9–10			0.0	10.2	0.38	0.11373
11–12		SP-SM: wet, medium, poorly graded silty SAND with some clay, fuel stained	0.0	10.5	3.71	0.00190
13–14		CL: gray, soft, plastic, CLAY, fuel stained	0.0	9.9	3.85	0.00404
15–16		SP-SM: wet to very wet, medium, poorly graded, silty SAND with some CLAY, sheen	0.1	9.9	2.41	0.00404
17–18			NM	9.9	2.34	0.00808
19–20			NM	10.1	2.84	0.00792
21–22		CL: moist, soft, plastic, fine, sandy CLAY, becoming firm with less plasticity	0.0	10.0	4.12	0.00800
23–24		SP-SM: wet, fine, poorly graded, silty SAND with some clay, sheen	0.6	10.2	3.59	0.00784
25–26			0.0	10.0	3.92	0.00800
27–28		CL: semi-plastic, firm CLAY with some fine sand	0.0	9.9	3.93	0.00808
29–30			0.0	10.0	3.96	0.00800

Borings were logged in accordance with the USCS

BGS = "below ground surface"

Water Table = based on observation of dry, moist, or wet soil

pH = field determined pH

Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6

NM = not measured, NA = not applicable

Site	Former Pratt Oil Works - 38-50 Review Avenue	**AC-9**
Sampling Method	Air knife/hand auger to 5 ft, GeoProbe macrocore from 5-30 ft	
Driller	Land, Air, and Water Environmental Services, Inc.	
Soil Logging by	Andrew Solomon - HydroGeoLogic	
Analysis by	Andrew Solomon - HydroGeoLogic	
Sample Date	2/8/2014	

Depth (ft BGS)	Water Table	Material	PID (ppm)	Sample Mass (g)	pH	Alkalinity Demand
1		Asphalt and subbase	NA	NA	NA	NA
2						
3		dry, fine, silty, sand, FILL with sub-angular gravel	NM	NM	NA	NA
4						
5			498.0	10.0	3.92	0.00100
6		SP-SM: dry, brown, fine, poorly graded, silty SAND with sub-angular gravel, fuel stained				
7		6.5-10 ft: Pulverized carbon/coal, black, dry to moist, very fine, silt and clay-like texture, less dense than soil, some plastic clay and silt 7.2-10 ft	1.4	9.9	0.76	0.03838
8						
9			10.7	10.0	1.62	0.00700
10						
11		CL: moist, firm, semi-plastic CLAY	70.7	10.2	3.66	0.00196
12						
13			3.3	10.0	3.88	0.00200
14						
15			70.6	10.1	3.25	0.00198
16						
17			4.7	10.0	7.54	NA
18		CL: wet, gray, fine, poorly graded, sandy CLAY				
19		SP: very wet, gray to brown, fine to very fine, poorly graded SAND with some clay 24-25 ft	6.1	10.0	7.88	NA
20						
21			1.4	10.2	6.64	NA
22						
23			0.2	10.0	6.76	NA
24						
25			1.9	10.1	6.31	NA
26		GW: very wet, well graded, sandy, rounded and sub-angular GRAVEL				
27		Refusal at 26 ft	NA	NA	NA	NA
28						
29						
30						

Borings were logged in accordance with the USCS

BGS = "below ground surface"

Water Table = based on observation of dry, moist, or wet soil

pH = field determined pH

Alkalinity demand = grams of NaOH required per gram of sample to attain pH > 6

NM = not measured, NA = not applicable

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Soil Boring Log/Monitoring Well Construction Diagram
Well No. MW-3

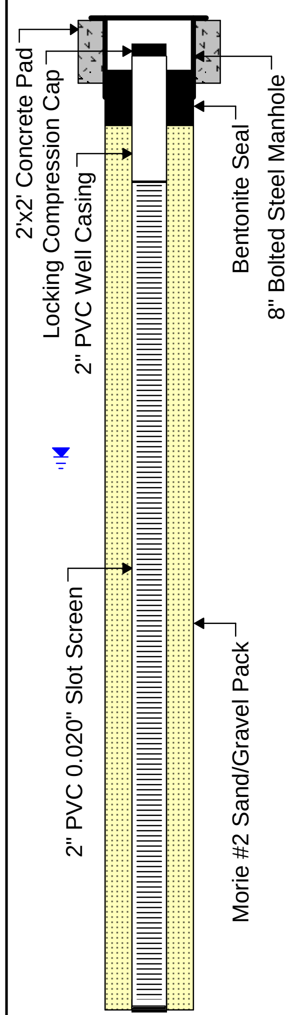
Project Name: Former Pratt Oil Works, Parcel A
Site Location: 38-50 Newtown Creek, Long Island City, New York
Kleinfelder Project No: 102021
Client: ExxonMobil Environmental Services
Start Date: December 29, 2008
End Date: March 12, 2009
Logged By (Geol.): Scott Strom
Checked By: John E. Wolf

Drilling Company: LAWES
Driller: Scott Pederson
Drill Rig Type: Geoprobe 77
Drilling Method: Direct Push
Total Hole Depth: 18 fbg
Depth to Bedrock: Not encountered
Borehole Diameter: 12 inches
Sampling Method: Split-spoon

Surface Elevation: 8.25 feet
Initial Water Level: 8 fbg
Notes: Boring precleared approximately 3.5 feet using vactron unit. Geology collected from preclearing activities on December 29, 2008 and drilling on January 8, 2009 via split-spoon. Drilling ceased due to strong vinegar-like odor. Well installed on March 12, 2009 via Geoprobe using 3-inch driver casings.

SUBSURFACE PROFILE		SAMPLE			
Depth (feet)	Soil/Geologic Description	Sample ID (fbg)	Blow Counts (6-inch interval)	Sample Recovery (inches)	PID Headspace (ppmv) 0 250 500
0	Ground Surface				
0–1	***CONCRETE*** CONCRETE/ASPHALT	0-3.5	NM	NA	NM
1–2	***Fine to coarse SAND*** Black fine to coarse SAND, some fine to coarse gravel, concrete, no odor, dry				8.8 (1); 20.1 (2)
2–3.5	***FILL*** FILL, (brick, concrete, some fine to coarse sand and gravel), dry				9.1
3.5–5.5	***FILL*** FILL, (brick, concrete, some fine to coarse sand and gravel), dry, Refusal met at 3.5 fbg (solid concrete)	3.5-5.5	NM	NA	NM
5.5–6	***CONCRETE*** CONCRETE				
6–8	***SILT and Sand*** Black SILT and fine Sand, unknown vinegar-like odor, moist	6-8*	18-29-30-39	24	2.8
18	End of Borehole				

Well Completion Details



BDL - below instrument detection limit
fbg - feet below grade
msl - mean sea level
NA - not applicable
NAPL - non-aqueous phase liquid
NR - no soil recovered
NS - not sampled
PID - photoionization detector
ppmv - parts per million by volume
PVC - polyvinyl chloride
Colors approximated using Munsell Color Chart, 2000.
Geologic descriptions based on ASTM D 2488.
* - sample collected for laboratory analysis

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Soil Boring Log

Boring No. SB-16

Project Name: Former Pratt Oil Works, Parcel A
Site Location: 38-50 Newtown Creek, Long Island City, New York
Kleinfelder Project No: 116669
Client: ExxonMobil Environmental Services
Start Date: October 11, 2010
End Date: October 12, 2010
Logged By (Geol.): Scott Strom
Checked By: John Wolf

Drilling Company: LAWES
Driller: Kevin McGourty
Drill Rig Type: Geoprobe 66
Drilling Method: Direct Push
Total Hole Depth: 25 fbg
Depth to Bedrock: Not encountered
Borehole Diameter: 2 inches
Sampling Method: 5-foot Macro-core

Surface Elevation: 8.62
Initial Water Level: 5 fbg
Notes: Pre-cleared 0-5 fbg 10/11/10
Drilled 5-25 fbg 10/12/10

SUBSURFACE PROFILE			SAMPLE				
Depth (feet)	Graphic Log	Soil/Geologic Description	Sample ID (fbg)	PID Headspace (ppmv) 0 250 500	Blow Counts (6-inch interval)	Sample Recovery (inches)	Depth (feet)
		Ground Surface					
0–1		***ASPHALT*** **FILL** - ASPHALT/RCA.	0-1		NA	NA	0–1
1–2		***FILL*** **FILL** - ASPHALT layer, dry.	1-2		NA	NA	1–2
2–3		***FILL*** **FILL** - CONCRETE, FILL material, dry.	2-3		NA	NA	2–3
3–5		***FILL*** **FILL -** Mostly fine to coarse grained SAND, some fine and coarse Gravel, dry.	3-5	44.0; 65.7	NA	NA	3–5
5–7		***FILL*** **FILL** - FILL material, trace NAPL (coal ash), fine to coarse gravel sized coal ash, wet.	5-10	23.5	NA	50	5–7
7–15		***ML*** **Dark brown SILT** - Mostly SILT, some Clay, few fine grained sand, dry.	5-10	7.0	NA	50	7–10
			10-15	5.2; 2.3	NA	48	10–15

BDL - below instrument detection limit
fbg - feet below grade
msl - mean sea level
NA - not applicable
NAPL - non-aqueous phase liquid
NM - not measured

NR - no soil recovered
NS - not sampled
PID - photoionization detector
ppmv - parts per million by volume
PVC - polyvinyl chloride

Colors approximated using Munsell Color Chart, 2000.
Geologic descriptions based on ASTM D 2488.
* - sample collected for laboratory analysis

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Soil Boring Log

Boring No. SB-16

Project Name: Former Pratt Oil Works, Parcel A
Site Location: 38-50 Newtown Creek, Long Island City, New York
Kleinfelder Project No: 116669
Client: ExxonMobil Environmental Services
Start Date: October 11, 2010
End Date: October 12, 2010
Logged By (Geol.): Scott Strom
Checked By: John Wolf

Drilling Company: LAWES
Driller: Kevin McGourty
Drill Rig Type: Geoprobe 66
Drilling Method: Direct Push
Total Hole Depth: 25 fbg
Depth to Bedrock: Not encountered
Borehole Diameter: 2 inches
Sampling Method: 5-foot Macro-core

Surface Elevation: 8.62
Initial Water Level: 5 fbg
Notes: Pre-cleared 0-5 fbg 10/11/10
Drilled 5-25 fbg 10/12/10

SUBSURFACE PROFILE			SAMPLE				
Depth (feet)	Graphic Log	Soil/Geologic Description	Sample ID (fbg)	PID Headspace (ppmv) 0 250 500	Blow Counts (6-inch interval)	Sample Recovery (inches)	Depth (feet)
15–20		***CH*** **Black, fat CLAY -** Mostly CLAY, some Silt, dry.	15-20	1.1 (~16.2); 0.0 (~19)	NA	45	15–20
20–20.5		***OL*** **Brown, ORGANIC SOIL** - Peat, dry.	20-25		NA	55	20
20.5–24		***SM*** **Light Brownish Gray, Silty SAND** - Mostly fine grained SAND, little silt, wet.		1.1 (~21.2); 10.0 (~24)			21–24
24–25		***CH*** **Light brownish-gray, fat CLAY** - Mostly CLAY, some Silt, moist.					24–25
25		End of Borehole					25
26–30							26–30

BDL - below instrument detection limit
fbg - feet below grade
msl - mean sea level
NA - not applicable
NAPL - non-aqueous phase liquid
NM - not measured
NR - no soil recovered
NS - not sampled
PID - photoionization detector
ppmv - parts per million by volume
PVC - polyvinyl chloride
Colors approximated using Munsell Color Chart, 2000.
Geologic descriptions based on ASTM D 2488.
* - sample collected for laboratory analysis

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Soil Boring Log

Boring No. SB-18

Project Name: Former Pratt Oil Works Parcel A
Site Location: 38-50 Newtown Creek, Long Island City, New York
Kleinfelder Project No: 116669
Client: ExxonMobil Environmental Services
Start Date: October 11, 2010
End Date: October 13, 2010
Logged By (Geol.): Scott Strom
Checked By: John Wolf

Drilling Company: LAWES
Driller: Kevin McGourty
Drill Rig Type: Geoprobe 66
Drilling Method: Direct Push
Total Hole Depth: 25 fbg
Depth to Bedrock: Not encountered
Borehole Diameter: 2 inches
Sampling Method: 5-foot Macro-core

Surface Elevation: 6.93
Initial Water Level: 7 fbg
Notes: Precleared to 5 fbg

SUBSURFACE PROFILE			SAMPLE				
Depth (feet)	Graphic Log	Soil/Geologic Description	Sample ID (fbg)	PID Headspace (ppmv) 0 250 500	Blow Counts (6-inch interval)	Sample Recovery (inches)	Depth (feet)
		Ground Surface					
0–1.5		***ASPHALT*** **FILL** - ASPHALT, RCA FILL.	0-1.5	NA; 1.2	NA	NA	0–1.5
1.5–2		***FILL*** **FILL** - Black FILL material, red brick, some pieces of concrete, dry.	1.5-2	85.2	NA	NA	1.5–2
2–3.5		***FILL*** **FILL** - Mostly black fine to coarse grained Sand and gravel, odor.	2-3.5	20.3	NA	NA	2–3.5
3.5–5		***FILL*** **FILL** -Mostly black fine to coarse grained Sand and gravel, moist, odor.	3.5-5	10.7; 8.9	NA	NA	3.5–5
5–7		***FILL*** **FILL** - Mostly reddish-brown fine to medium grained angular SAND, some Coal ash, little brick.	5-7	0.5	NA	32	5–7
7–10		***FILL*** **FILL** - Mostly black,fine to medium grained angular SAND, some Coal ash, little brick, wet.	7-10	164.0	NA	32	7–10
10–12.5		***SP*** **Light brownish-gray, poorly graded SAND** - Mostly fine to medium grained SAND, NAPL, wet.	10-12.5	245	NA	60	10–12.5
12.5–15		***SP*** **Light brownish-gray, poorly graded SAND** - Mostly fine to medium grained SAND, wet.	12.5-15	21.0	NA	60	12.5–15

BDL - below instrument detection limit
fbg - feet below grade
msl - mean sea level
NA - not applicable
NAPL - non-aqueous phase liquid
NM - not measured

NR - no soil recovered
NS - not sampled
PID - photoionization detector
ppmv - parts per million by volume
PVC - polyvinyl chloride

Colors approximated using Munsell Color Chart, 2000.
Geologic descriptions based on ASTM D 2488.
* - sample collected for laboratory analysis

KLEINFELDER
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One Corporate Drive, Suite 201
Bohemia, NY 11716
(631) 218-0612

Soil Boring Log

Boring No. SB-18

Project Name: Former Pratt Oil Works Parcel A
Site Location: 38-50 Newtown Creek, Long Island City, New York
Kleinfelder Project No: 116669
Client: ExxonMobil Environmental Services
Start Date: October 11, 2010
End Date: October 13, 2010
Logged By (Geol.): Scott Strom
Checked By: John Wolf

Drilling Company: LAWES
Driller: Kevin McGourty
Drill Rig Type: Geoprobe 66
Drilling Method: Direct Push
Total Hole Depth: 25 fbg
Depth to Bedrock: Not encountered
Borehole Diameter: 2 inches
Sampling Method: 5-foot Macro-core

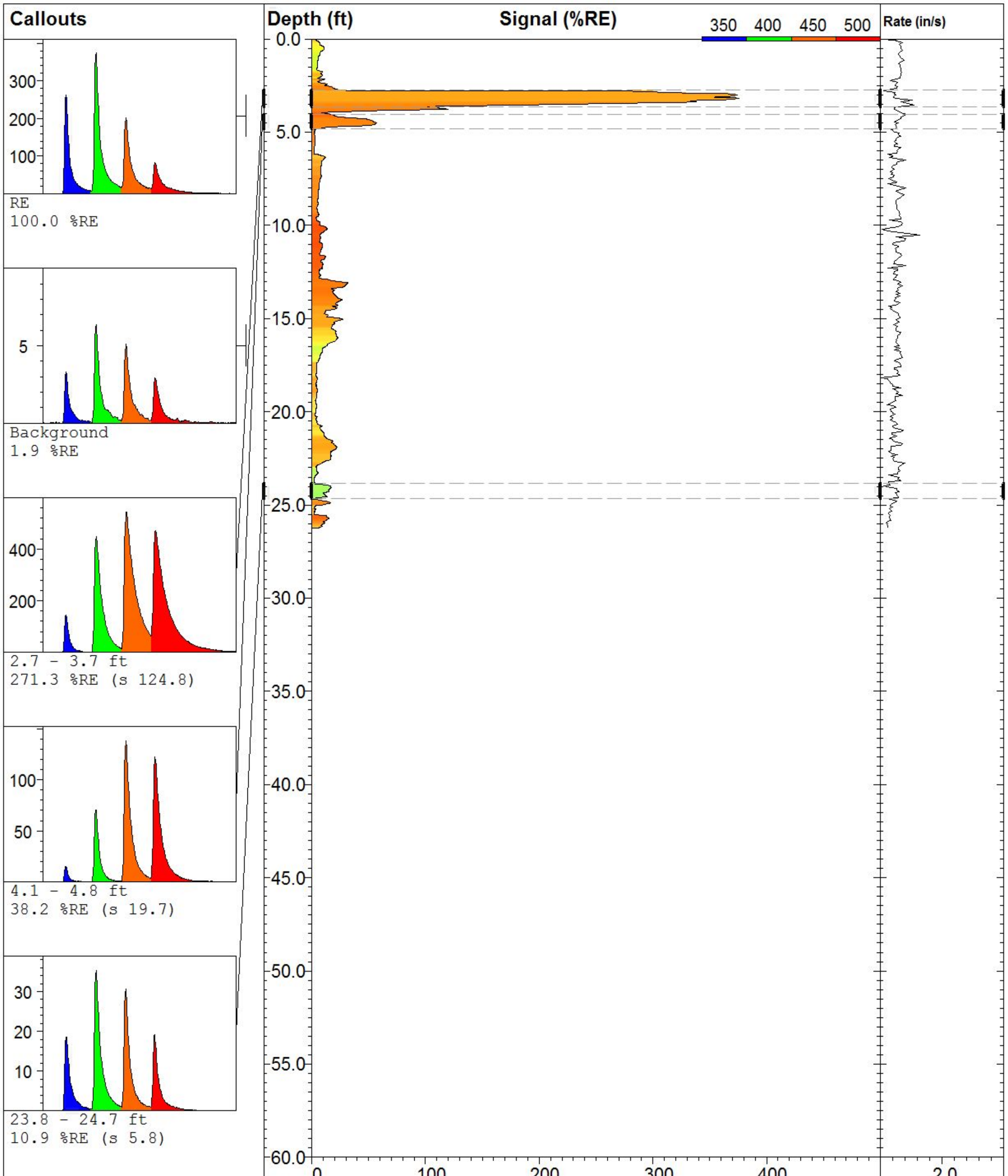
Surface Elevation: 6.93
Initial Water Level: 7 fbg
Notes: Precleared to 5 fbg

SUBSURFACE PROFILE			SAMPLE				
Depth (feet)	Graphic Log	Soil/Geologic Description	Sample ID (fbg)	PID Headspace (ppmv) 0 250 500	Blow Counts (6-inch interval)	Sample Recovery (inches)	Depth (feet)
15–20		***SM*** **Gray, Silty SAND** - Mostly fine grained SAND, little silt, trace clay, wet.	15-20	3.4; 3.0	NA	36	15–20
20–22		***SM*** **Gray, Silty SAND** - Mostly fine grained SAND, little silt, wet.	20-22	2.0	NA	40	20–22
22–23		***CH*** **Gray, fat CLAY** - Mostly CLAY, some Silt.	22-23				22–23
23–25		***SM*** **Gray, Silty SAND** - Mostly fine to coarse grained SAND, some Silt, trace clay.	23-25	1.8			23–25
25–30		End of Borehole					25–30

BDL - below instrument detection limit
fbg - feet below grade
msl - mean sea level
NA - not applicable
NAPL - non-aqueous phase liquid
NM - not measured

NR - no soil recovered
NS - not sampled
PID - photoionization detector
ppmv - parts per million by volume
PVC - polyvinyl chloride

Colors approximated using Munsell Color Chart, 2000.
Geologic descriptions based on ASTM D 2488.
* - sample collected for laboratory analysis



COLUMBIA TECHNOLOGIES

COLUMBIA Technologies
Baltimore, MD 888-344-2704
www.columbiatechnologies.com

LIF-26

UVOST By Dakota
www.DakotaTechnologies.com

Site: **Pratt Oil - Queens, NY**	*Latitude / Datum:* **Unavailable / NA**	*Final depth:* **26.22 ft**
Client: **Kleinfelder**	*Longitude / Fix:* **Unavailable / NA**	*Max signal:* **376.2 % @ 3.19 ft**
Job:	*Operator/Unit:* **DMB/UVOST1005**	*Date & Time:* **2010-10-28 08:36 EDT**

Date Begin - End:	4/17/12 - 5/1/12	**Drill Company:**	Aquifer Drilling & Testing
Logged By:	S. Strom	**Drill Crew:**	
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous
Weather:		**Auger Diameter:**	6 inches

BORING LOG MW-41S

FIELD EXPLORATION

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

MONITORING WELL

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
							Air knife - Utility clearance from 0 to 5 feet on 4/17/12	4" dia. Sch 40 PVC casing in concrete
					457		**Artificial Fill** **BRICK AND CONCRETE some sand (GW-GM)**: fine to coarse grained, black	4" dia. Sch 40 PVC casing packed in bentonite
					567		Fine to medium grained, odor, trace coal ash	4" dia. Sch 40 PVC casing packed in #1 sand
					550		Fine to coarse grained, wet, angular coal ash	
5		MW-41-5-7			115		**Artificial Fill** **Well-Graded SAND some gravel (SW)**: fine to coarse grained, gray/brown, odor, dry	
		MW-41-7-8			140.2		Olive brown, odor, wet, with peat and coal ash	
					21.5		**Artificial Fill** **Poorly Graded SAND with silt (SP)**: fine grained, black, odor, dry	
10					11.0		**Well-Graded SAND with gravel (SW)**: fine to coarse grained, gray, odor, wet, trace peat	
					10.4			
15					14.7		**Poorly Graded SAND some clay (SP)**: grayish black, odor, wet	4" dia. 0.03 slotted Sch 40 PVC well screen from 3 to 16 feet packed in #1 sand
					0.8		**Well-Graded SAND some gravel (SW)**: fine to coarse grained, moist	
20							The boring was terminated at approximately 20 feet below ground surface.	
25								
30								

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 11 ft. below ground surface during drilling.

GENERAL NOTES:
A 4-inch diameter well was installed to a depth of 16 ft.
The exploration was backfilled with sand and pipe on May 01, 2012.

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KLEINFELDER
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PROJECT NO. 124102	BORING LOG MW-41S		PLATE 13
DRAWN BY: MEH			
CHECKED BY: SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York		
DATE:			
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/17/12 - 6/5/12	**Drill Company:**	Aquifer Drilling & Testing
Logged By:	S. Strom	**Drill Crew:**	
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous
Weather:		**Auger Diameter:**	4 inches

BORING LOG MW-41D

FIELD EXPLORATION — MONITORING WELL

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Number	PID / FID (ppm)	Description	Monitoring Well
0			Air knife - Utility clearance from 0 to 5 feet on 4/17/12	4" dia. Sch 40 PVC casing in concrete
1		457	**Artificial Fill** **BRICK AND CONCRETE some sand (GW-GM)**: fine to coarse grained, black	
3		567	Fine to medium grained, odor, trace coal ash	
4		550	Fine to coarse grained, wet, angular coal ash	
5	MW-41-5-7	115	**Artificial Fill** **Well-Graded SAND some gravel (SW)**: fine to coarse grained, gray/brown, odor, dry	
7	MW-41-7-8	140.2	Olive brown, odor, wet, with peat and coal ash	
8		21.5	**Artificial Fill** **Poorly Graded SAND with silt (SP)**: fine grained, black, odor, dry	
10		11.0	**Well-Graded SAND with gravel (SW)**: fine to coarse grained, gray, odor, wet, trace peat	4" dia. Sch 40 PVC casing in grout
12.5		10.4		
15		14.7	**Poorly Graded SAND some clay (SP)**: grayish black, odor, wet	
17.5		0.8		
20		1.1	**CLAY little silt (CH)**: gray, moist	4" dia. Sch 40 PVC casing packed in bentonite 4" dia. Sch 40 PVC casing packed in sand
23		2.0	**Poorly Graded SAND with silt (SP-SM)**: fine grained, dark brown, moist, little clay	
24			**Poorly Graded SAND with gravel (SP)**: fine to medium grained, dark brown, wet, rounded gravel	
25		3.5		4" dia. 0.01 slotted Sch 40 PVC well screen from 23 to 28 feet packed in #00 sand
27		1.1	**SILT little clay (ML)**: light brown, moist	
28			**Poorly Graded SAND little gravel (SP)**: light brown, moist The boring was terminated at approximately 28 feet below ground surface.	
30		2.2		

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 11 ft. below ground surface during drilling.

GENERAL NOTES:
A 4-inch diameter well was installed to a depth of 25 ft.
The exploration was backfilled with sand and pipe on June 05, 2012.

Date Begin - End:	4/26/12 - 5/3/12	**Drill Company:**	Aquifer Drilling & Testing
Logged By:	S. Strom	**Drill Crew:**	
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous
Weather:		**Auger Diameter:**	4 inches

BORING LOG MW-43

FIELD EXPLORATION / MONITORING WELL

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
0							Air knife - Utility clearance from 0 to 5 feet on 4/26/12	2" dia. Sch 40 PVC casing in concrete
1							**Artificial Fill** **SAND some gravel (SP-SC)**: fine to medium grained, brown, odor, dry	2" dia. Sch 40 PVC casing packed in bentonite
2					930			2" dia. Sch 40 PVC casing packed in #00 sand
4					>15K		**Artificial Fill** **Poorly Graded SAND little gravel (SP)**: brown, odor, dry, grout from previous soil boring	
6					>15K			2" dia. 0.01 slotted Sch 40 PVC well screen from 3 to 13 feet packed in #00 sand
8					12,560		**Some sand**: fine grained, black, wood pieces, some coal ash	
9							Wet	
10					2,350		Fine to medium grained, black	
13					252		**Clayey SILT and peat (CL-ML)**: black, wet	
15							The boring was terminated at approximately 15 feet below ground surface.	

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 9 ft. below ground surface during drilling.
GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 13 ft.
The exploration was backfilled with sand and pipe on May 03, 2012.

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PROJECT NO. 124102	BORING LOG MW-43		PLATE
DRAWN BY: MEH			16
CHECKED BY: SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York		
DATE:			
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/18/12 - 5/4/12	**Drill Company:**	Aquifer Drilling & Testing	**BORING LOG MW-45**
Logged By:	S. Strom	**Drill Crew:**		
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig	
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous	
Weather:		**Auger Diameter:**	4 inches	

FIELD EXPLORATION

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

MONITORING WELL

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
0							Air knife - Utility clearance from 0 to 5 feet on 4/18/12	
1							**Artificial Fill** **SAND (SP)**: fine to medium grained, dark brown, dry, some brick and concrete pieces, coal ash	2" dia. Sch 40 PVC casing packed in bentonite 2" dia. Sch 40 PVC casing packed in #00 sand
2					40.0			
3					5.2			
4					7.2			
5 ∇		MW-45-5-7			0.3		**Artificial Fill** **Well-Graded SAND trace gravel (SW)**: fine to coarse grained, dark brown, wet, trace NAPL	
6					5.2			
8					7.5			
10					4.8			2" dia. 0.01 slotted Sch 40 PVC well screen from 2 to 17 feet packed in #00 sand
11							**Artificial Fill** **SAND (SP)**: fine to medium grained, brown, wet	
15					1.0			
18					0.2			Bentonite fill from 17 to 20 feet
20							The boring was terminated at approximately 20 feet below ground surface.	

GROUNDWATER LEVEL INFORMATION:
∇ Groundwater was observed at approximately 5 ft. below ground surface during drilling.

GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 17 ft.
The exploration was backfilled with sand and pipe on May 04, 2012.

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PROJECT NO. 124102	BORING LOG MW-45		PLATE
DRAWN BY: MEH			18
CHECKED BY: SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York		
DATE:			
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/18/12 - 5/7/12	**Drill Company:**	Aquifer Drilling & Testing
Logged By:	M. Hearne	**Drill Crew:**	
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous
Weather:		**Auger Diameter:**	4 inches

BORING LOG MW-46

FIELD EXPLORATION

MONITORING WELL

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
0–5							Air knife - Utility clearance from 0 to 5 feet on 4/18/12	2" dia. Sch 40 PVC casing in concrete
					10.2 8.1 5.6		**Artificial Fill** **SAND (SP)**: fine to medium grained, brown, dry, with concrete and brick fragments	2" dia. Sch 40 PVC casing packed in bentonite 2" dia. Sch 40 PVC casing packed in #00 sand
5					8.7 2.0		**Artificial Fill** **Clayey GRAVEL (GW-GC)**: reddish brown, wet, concrete and wood	2" dia. 0.01 slotted Sch 40 PVC well screen from 2 to 17 feet packed in #00 sand
10		MW-46-11-12			4.9		**Artificial Fill** **Silty SAND trace clay (SM)**: black, odor, wet, micaceous, trace NAPL Wood chunks from 15 to 17 feet bgs	
15							**Artificial Fill** **Silty GRAVEL with sand (GM)**: fine to medium grained, black, wet, many brick pieces and construction debris	
17							The boring was terminated at approximately 17 feet below ground surface.	

Depth scale: 5, 10, 15, 20, 25, 30

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 6 ft. below ground surface during drilling.

GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 17 ft.
The exploration was backfilled with sand and pipe on May 07, 2012.

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PROJECT NO. 124102	BORING LOG MW-46		PLATE
DRAWN BY: MEH			
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DATE:			
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/26/12 - 5/7/12	**Drill Company:**	Aquifer Drilling & Testing
Logged By:	S. Strom	**Drill Crew:**	
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous
Weather:		**Auger Diameter:**	4 inches

BORING LOG MW-47

FIELD EXPLORATION

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

MONITORING WELL

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description
0							Air knife - Utility clearance from 0 to 5 feet on 4/26/12
1					3.5		**Artificial Fill** **SAND some gravel (SP)**: fine to medium grained, brown, dry
3					21.7		
4					57.9		**Trace gravel**: odor
5					61.3		Odor, moist
6					22.7		**Artificial Fill** **GRAVEL and sand (GW-GM)**: fine to coarse grained, black, moist, little coal ash
7					8.8		
8							**Artificial Fill** **COAL ASH (GP-GM)**: fine grained, black, odor, moist, trace NAPL
10					5.7		
14					4.3		
15							**CLAY (CL)**: gray
19					0.8		
20							The boring was terminated at approximately 20 feet below ground surface.

Depth scale: 5, 10, 15, 20, 25, 30

Monitoring well:
- 2" dia. Sch 40 PVC casing in concrete
- 2" dia. Sch 40 PVC casing packed in bentonite
- 2" dia. Sch 40 PVC casing packed in #00 sand
- 2" dia. 0.01 slotted Sch 40 PVC well screen from 3 to 13 feet packed in #00 sand

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.
GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 13 ft.
The exploration was backfilled with sand and pipe on May 07, 2012.

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PROJECT NO. 124102	BORING LOG MW-47		PLATE
DRAWN BY: MEH			20
CHECKED BY: SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York		
DATE:			
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/17/12 - 5/1/12	**Drill Company:**	Aquifer Drilling & Testing
Logged By:	S. Strom	**Drill Crew:**	
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous
Weather:		**Auger Diameter:**	6 inches

BORING LOG MW-41S

FIELD EXPLORATION / MONITORING WELL

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
							Air knife - Utility clearance from 0 to 5 feet on 4/17/12	4" dia. Sch 40 PVC casing in concrete
					457		**Artificial Fill** **BRICK AND CONCRETE some sand (GW-GM)**: fine to coarse grained, black	4" dia. Sch 40 PVC casing packed in bentonite; 4" dia. Sch 40 PVC casing packed in #1 sand
					567		Fine to medium grained, odor, trace coal ash	
					550		Fine to coarse grained, wet, angular coal ash	
5		MW-41-5-7			115		**Artificial Fill** **Well-Graded SAND some gravel (SW)**: fine to coarse grained, gray/brown, odor, dry	
		MW-41-7-8			140.2		Olive brown, odor, wet, with peat and coal ash	
					21.5		**Artificial Fill** **Poorly Graded SAND with silt (SP)**: fine grained, black, odor, dry	
10					11.0		**Well-Graded SAND with gravel (SW)**: fine to coarse grained, gray, odor, wet, trace peat	
					10.4			
15					14.7		**Poorly Graded SAND some clay (SP)**: grayish black, odor, wet	4" dia. 0.03 slotted Sch 40 PVC well screen from 3 to 16 feet packed in #1 sand
					0.8		**Well-Graded SAND some gravel (SW)**: fine to coarse grained, moist	
20							The boring was terminated at approximately 20 feet below ground surface.	
25								
30								

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 11 ft. below ground surface during drilling.
GENERAL NOTES:
A 4-inch diameter well was installed to a depth of 16 ft.
The exploration was backfilled with sand and pipe on May 01, 2012.

KLEINFELDER
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PROJECT NO.	124102
DRAWN BY:	MEH
CHECKED BY:	SES
DATE:	
REVISED:	

BORING LOG MW-41S

Former Pratt Oil Works
39-14 Review Avenue
Long Island City, New York

PLATE
13

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Date Begin - End:	4/26/12 - 5/3/12	**Drill Company:**	Aquifer Drilling & Testing	**BORING LOG MW-43**
Logged By:	S. Strom	**Drill Crew:**		
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig	
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous	
Weather:		**Auger Diameter:**	4 inches	

FIELD EXPLORATION

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

MONITORING WELL

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
0–1							Air knife - Utility clearance from 0 to 5 feet on 4/26/12	2" dia. Sch 40 PVC casing in concrete
1–2					930		**Artificial Fill** **SAND some gravel (SP-SC)**: fine to medium grained, brown, odor, dry	2" dia. Sch 40 PVC casing packed in bentonite
2–3								2" dia. Sch 40 PVC casing packed in #00 sand
4					>15K		**Artificial Fill** **Poorly Graded SAND little gravel (SP)**: brown, odor, dry, grout from previous soil boring	
6					>15K			
7								2" dia. 0.01 slotted Sch 40 PVC well screen from 3 to 13 feet packed in #00 sand
8					12,560		**Some sand**: fine grained, black, wood pieces, some coal ash	
9							Wet	
10					2,350		Fine to medium grained, black	
13					252		**Clayey SILT and peat (CL-ML)**: black, wet	
15							The boring was terminated at approximately 15 feet below ground surface.	

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 9 ft. below ground surface during drilling.
GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 13 ft.
The exploration was backfilled with sand and pipe on May 03, 2012.

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KLEINFELDER Bright People. Right Solutions.	PROJECT NO. 124102	BORING LOG MW-43	PLATE
	DRAWN BY: MEH		16
	CHECKED BY: SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York	
	DATE:		
	REVISED:		PAGE: 1 of 1

Date Begin - End:	4/18/12 - 5/4/12	**Drill Company:**	Aquifer Drilling & Testing	**BORING LOG MW-45**
Logged By:	S. Strom	**Drill Crew:**		
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig	
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous	
Weather:		**Auger Diameter:**	4 inches	

FIELD EXPLORATION | MONITORING WELL

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
0							Air knife - Utility clearance from 0 to 5 feet on 4/18/12	
1							**Artificial Fill** **SAND (SP)**: fine to medium grained, dark brown, dry, some brick and concrete pieces, coal ash	2" dia. Sch 40 PVC casing packed in bentonite 2" dia. Sch 40 PVC casing packed in #00 sand
2					40.0			
3					5.2			
4					7.2			
5		MW-45-5-7			0.3		**Artificial Fill** **Well-Graded SAND trace gravel (SW)**: fine to coarse grained, dark brown, wet, trace NAPL	
6					5.2			
8					7.5			
10					4.8			2" dia. 0.01 slotted Sch 40 PVC well screen from 2 to 17 feet packed in #00 sand
11							**Artificial Fill** **SAND (SP)**: fine to medium grained, brown, wet	
15					1.0			
18					0.2			Bentonite fill from 17 to 20 feet
20							The boring was terminated at approximately 20 feet below ground surface.	

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 5 ft. below ground surface during drilling.
GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 17 ft.
The exploration was backfilled with sand and pipe on May 04, 2012.

25

30

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KLEINFELDER
Bright People. Right Solutions.

PROJECT NO. 124102	BORING LOG MW-45	PLATE
DRAWN BY: MEH		
CHECKED BY: SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York	18
DATE:		
REVISED:		PAGE: 1 of 1

Date Begin - End:	4/18/12 - 5/7/12	**Drill Company:**	Aquifer Drilling & Testing
Logged By:	M. Hearne	**Drill Crew:**	
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous
Weather:		**Auger Diameter:**	4 inches

BORING LOG MW-46

FIELD EXPLORATION

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

MONITORING WELL

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description	Monitoring Well
0–5							Air knife - Utility clearance from 0 to 5 feet on 4/18/12	
					10.2 8.1 5.6		**Artificial Fill** **SAND (SP)**: fine to medium grained, brown, dry, with concrete and brick fragments	2" dia. Sch 40 PVC casing in concrete 2" dia. Sch 40 PVC casing packed in bentonite 2" dia. Sch 40 PVC casing packed in #00 sand
5					8.7 2.0		**Artificial Fill** **Clayey GRAVEL (GW-GC)**: reddish brown, wet, concrete and wood	2" dia. 0.01 slotted Sch 40 PVC well screen from 2 to 17 feet packed in #00 sand
10		MW-46-11-12			4.9		**Artificial Fill** **Silty SAND trace clay (SM)**: black, odor, wet, micaceous, trace NAPL Wood chunks from 15 to 17 feet bgs	
15							**Artificial Fill** **Silty GRAVEL with sand (GM)**: fine to medium grained, black, wet, many brick pieces and construction debris	
17							The boring was terminated at approximately 17 feet below ground surface.	

Depth scale: 5, 10, 15, 20, 25, 30

GROUNDWATER LEVEL INFORMATION:
Groundwater was observed at approximately 6 ft. below ground surface during drilling.

GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 17 ft.
The exploration was backfilled with sand and pipe on May 07, 2012.

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KLEINFELDER
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PROJECT NO.	124102	BORING LOG MW-46	PLATE
DRAWN BY:	MEH		19
CHECKED BY:	SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York	
DATE:			
REVISED:			PAGE: 1 of 1

Date Begin - End:	4/26/12 - 5/7/12	**Drill Company:**	Aquifer Drilling & Testing	**BORING LOG MW-47**
Logged By:	S. Strom	**Drill Crew:**		
Hor.-Vert. Datum:	Not Available	**Drill Equipment:**	Limited Access Sonic Rig	
Angle from Vert.:	0 degrees	**Exploration Method:**	Sonic Continuous	
Weather:		**Auger Diameter:**	4 inches	

FIELD EXPLORATION

No Coordinates Available
No Elevation Available
Surface Condition: Asphalt

MONITORING WELL

Completion Method: Well completed to grade with 2' x 2' concrete well pad and 8" diameter traffic-rated, steel road box

Depth (feet)	Sample Interval / Type	Sample Number	Recovery (in)	Uncorr. blows/6"	PID / FID (ppm)	Graphical Log	Description
0							Air knife - Utility clearance from 0 to 5 feet on 4/26/12
					3.5		**Artificial Fill** **SAND some gravel (SP)**: fine to medium grained, brown, dry
					21.7		
					57.9		**Trace gravel**: odor
5					61.3		Odor, moist
					22.7		**Artificial Fill** **GRAVEL and sand (GW-GM)**: fine to coarse grained, black, moist, little coal ash
					8.8		
							Artificial Fill **COAL ASH (GP-GM)**: fine grained, black, odor, moist, trace NAPL
10					5.7		
					4.3		
15							**CLAY (CL)**: gray
					0.8		
20							The boring was terminated at approximately 20 feet below ground surface.
25							
30							

Monitoring well:

2" dia. Sch 40 PVC casing in concrete

2" dia. Sch 40 PVC casing packed in bentonite

2" dia. Sch 40 PVC casing packed in #00 sand

2" dia. 0.01 slotted Sch 40 PVC well screen from 3 to 13 feet packed in #00 sand

GROUNDWATER LEVEL INFORMATION:
Groundwater was not encountered during drilling or after completion.

GENERAL NOTES:
A 2-inch diameter well was installed to a depth of 13 ft.
The exploration was backfilled with sand and pipe on May 07, 2012.

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KLEINFELDER Bright People. Right Solutions.	PROJECT NO. 124102	BORING LOG MW-47	PLATE
	DRAWN BY: MEH		20
	CHECKED BY: SES	Former Pratt Oil Works 39-14 Review Avenue Long Island City, New York	
	DATE:		
	REVISED:		PAGE: 1 of 1

APPENDIX B

Joseph J. Fiteni, Jr., P.E.

Vice President, Water/Wastewater Facilities Group Manager

EDUCATION

MCE, Civil Engineering, Geology Minor, Cornell University, 1977
BS, Civil Engineering, Cornell University, 1976

PROFESSIONAL LICENSES

Professional Engineer, New York, #059843, 1983

PROFESSIONAL MEMBERSHIPS

American Society of Civil Engineers
Water Environment Association

RELEVANT EXPERIENCE

Mr. Fiteni has more than 30 years of experience in management, planning, environmental studies, design, permitting, and construction inspections for major projects related to waste management, water, wastewater, geotechnical engineering, waterfront facilities, and institutional buildings and facilities.

Site Assessment and Remediation

Waste Management, Inc., Phase I and II Environmental Assessments Program, New York and New Jersey. Principal-in-charge of environmental site assessments, including Phase I and II, at properties being considered for purchase by Waste Management, Inc. Sites are located throughout the New York/New Jersey metro area and includes transfer stations and trucking facilities with maintenance garages, many of which had leaky underground storage tanks and inadequate stormwater drainage. Facilities that were investigated were subjected to corrective action and permitting.

City of Stamford, Washington Boulevard Environmental Site Assessment, Stamford, Connecticut. Principal-in-charge of a Phase I environmental assessment for an urban manufacturing facility being purchased for use as a firehouse.

New Jersey School Construction Corporation, PS 3/MS 4 Staff Parking Feasibility Study, Jersey City, New Jersey. Project manager for a feasibility study for constructing a parking facility for approximately 100 faculty on a site totaling 20,000 square feet. Managing hazardous waste screening, environmental and land use issues, geotechnical utilities, traffic, architectural programming, and site design.

New Jersey School Construction Corporation, Cognis Corporation Site, Hoboken, New Jersey. Project manager for a site feasibility study in connection with the planned acquisition of a former polymer, paint and personal care product manufacturing facility subject to NJDEP Industrial Site Recovery Act (ISRA).

New Jersey School Construction Corporation, Early Childhood Center No. 14, Early Childhood Center No. 1, and Public School No. 2, Hudson County, New Jersey. Project manager for site feasibility studies in connection with the planned acquisition of commercial and industrial sites in Hudson County for future development as schools.

Solid Waste Management

Waste Management of New York – Review Avenue Transfer Station, Queens, New York. Project Manager for environmental and solid waste permitting, design, plans and specifications and construction inspection services for a new 2200TPD truck to rail putrescible solid waste transfer station. The transfer station will be 31,000 square foot state of the art fully enclosed odor controlled building designed to meet LEED certification requirements. Site work includes the reconstruction of an existing bulkhead, construction of on site intermodal rail loading are and use of best available control technology to manage potentially contaminated storm water.

Waste Management of New York – Varick 1. Transfer Station, Brooklyn, New York – Project Manager for permitting and design to convert a 4,400 TPD putrescible solid waste transfer station from a truck to truck to truck to rail transfer operation. Reconfigured existing tipping/ loading floor to allow waste to be containerized and designed intermodal rail yard on adjacent site for loading and unloading of rail containers to train.

Rhode Island Resource Recovery Corp., Central Landfill Solid Waste Tipping Facility, Johnston, Rhode Island. Principal-in-charge of the engineering design and final contract document preparation for a 4,000-ton per day, truck-to-truck solid waste transfer station. The multidisciplinary project includes project management, civil-site plan design, and architectural, electrical, mechanical, structural, and geotechnical services. The civil-site plan design work for the nine - acre site includes grading and drainage, roadways, and utilities.

Waste Management, Inc., Harlem River Yard Solid Waste Transfer Station, Bronx, New York. Program manager for the conceptual layout through the final design (including solid waste permitting) for a 5,000-tpd, truck-to-rail putrescible solid waste transfer station. The final design included all aspects of the facility including site, utility, railroad, architectural, foundation, structural, HVAC, Plumbing, electrical, odor control and fire protection. Building department permits and DEP permits were applied for and obtained CM services including coordination with general contractors were carried out. The project was recognized by the New York Association of Consulting Engineers with the 2000 Gold Award for Excellence in Environmental Engineering.

Hazardous Waste Remediation

US Army Corps of Engineers, Douglassville Disposal Superfund Site, Thermal Treatment Remedial Design, Berks County, Pennsylvania. Project manager for a 50-acre former waste oil recycling facility located on the flood plain of the Schuylkill River, provided field investigations, physical and chemical testing, regulatory and permitting reviews, a remedial design for incineration and chemical fixation, bench scale testing, a design for the landfilling of treated waste material, final capping and closure designs, and stormwater management and drainage designs for the site. Complete bidding and contract documents included plans, specifications, and cost estimates.

New York State Department of Environmental Conservation, Love Canal, Black and Bergholtz Creeks Remediation, Niagara Falls, New York. Project manager for design and construction services for the removal and secure land storage of dioxin-contaminated creek sediments in compliance with the RCRA. Subsequent phases included the design and formulation of contract documents for the on-site thermal destruction of 30,000 cubic yards of sediments.

New Jersey Department of Environmental Protection, Gloucester Environmental Management Services Landfill Site (NPL No. 12) Remediation, New Jersey. Team leader for Construction Contract 2, which included landfill capping and gas collection treatment systems development.

Wastewater

Westchester County DPW – New Rochelle WWTP Composite Performance Implementation and Plant Expansion – New Rochelle, NY. Project Manager for design and construction management of the expansion and system upgrades to the New Rochelle Wastewater Treatment Plant. The NRWWTP is being expanded from a 13.9 mgd average daily flow and all plant systems are being upgraded and processes added to handle the new flow and to meet new permit discharge limits.

Plant upgrades and expansion include: influent screening, main influent pumps, aerated grit separation facilities, primary tank mechanisms and covers, pure oxygen secondary treatment, liquid oxygen supply, final clarifiers, sludge pumping New Sludge Processing Building which includes sludge thickening with gravity belts, sludge drying with belt filter presses, additional dry sludge storage and loadout capacity, plant wide electrical system upgrade, new odor control systems, new ID card SCADA systems and upgrades to support systems and utilities.

Westchester County DPW – New Rochelle Wastewater Treatment Plant – BNR Upgrades. Project Manager for design and construction management of Biological Aerated Filter (BAF). BNR upgrades at the New Rochelle Wastewater Treatment Plant BAF. BNR is being added to the New Rochelle WWTP to meet new total nitrogen permit discharge limits. The addition of the BNR requires the construction of a 60 mgd pumping station, fine screens, nitrification and denitrification BAF's and a UV treatment system together with associated I&C and yard piping including large force and gravity mains.

New York City Department of Environmental Protection, Construction Safety and Health Management, Project Director for project to monitor environmental, safety, and health compliance on all NYCDEP capital project construction sites and improve EH&S policies, procedures and standards for BEDC.

DOUGLAS J. SUTTON, PH.D., PE
Principal Engineer

EDUCATION & TRAINING:

Ph.D., Civil and Environmental Engineering/Water Resources Engineering, Duke University, 2000.
M.S., Civil and Environmental Engineering/Water Resources Engineering, Duke University, 1999.
B.A., Earth and Planetary Sciences (Magna Cum Laude), Harvard University, 1994.

CERTIFICATIONS:

Licensed Professional Engineer: NJ
Leadership in Energy and Environmental Design (LEED®) Accredited Professional, Spring 2006
Associate Value Specialist, Society of American Value Engineers (SAVE International), 2007

PROFESSIONAL EXPERTISE:

Dr. Sutton has 18 years of experience in environmental science and engineering with expertise in the following areas:

- Designing, evaluating, and/or operating pump and treat, air sparging/soil vapor extraction, bioremediation, in-situ chemical oxidation, in-situ thermal remediation and other groundwater remedies with particular emphasis on the following site types:
    - Wood treating (PAHs, pentachlorophenol, etc.)
    - Chlorinated solvents (TCE, PCE, etc.)
    - Heavy metals (arsenic, chromium, etc.)
    - DNAPL and LNAPL
    - 1,4-Dioxane
    - PCBs
- Conducting groundwater investigations including pump tests, tracer tests, and ground water monitoring.
- Developing, evaluating, and improving conceptual site models, including sources of contamination; interactions between soil, groundwater, and vapor contamination; and contaminant transport.
- Evaluating potential for vapor intrusion.
- Analytical and numerical modeling of environmental phenomena including groundwater flow and contaminant transport.
- Representing clients in cost allocation arbitration hearings.
- Operating and maintaining environmental field stations.
- Sustainability engineering:
    - Design and installation of photovoltaic systems
    - Design and feasibility analysis of geothermal heat pump systems
    - Sustainability evaluations for environmental remedies

RELEVANT EXPERIENCE:

Environmental Engineering Project Experience

- ***U.S. Environmental Protection Agency (USEPA) Office of Superfund Remediation and Technology Innovation (OSRTI), Optimization Technical Support, (2000-2013).*** Managed and served as technical lead for evaluating and improving EPA-financed groundwater remedies.
  - Conducted Remediation System Evaluations (RSEs), Independent Design Reviews (IDRs), and Optimization Reviews at approximately 70 Superfund sites on behalf of EPA (the majority were financed by USEPA).
  - For each site, reviewed documents, visited site (or conducted conference call), analyzed data, and prepared report highlighting recommendations to improve effectiveness, reduced operating costs, provided technical improvements, and speed site closeout. Topics include:
    - Improving the site conceptual model
    - Evaluating potential impact to nearby receptors (including potential for vapor intrusion)
    - Improving sampling programs
    - Improving extraction and treatment systems
    - Identifying viable alternative remedial strategies
  - Assisted USEPA with tracking progress toward implementation of recommendations
  - Provided technical assistance on an ongoing basis to assist with implementing recommendations.
  - Evaluations also conducted at 9 RCRA facilities and 3 UST sites.
  - RSEs/IDRs for 2009 and later have included sustainability or green remediation in the evaluation.

- ***Confidential Client, Legal Matter Technical Support, (2007-2013).*** Provided hydrogeologic and remedial engineering analysis regarding a litigation matter for a site in northern New Jersey. Issues involved likely sources, adequacy of previous investigations, likely fate and transport of contaminants, remedy performance, remedial strategy, and reasonableness of past costs. Case settled after mediation.

- ***Confidential Client, Gasoline Service Station Cost Allocation Hearing, (2003-2004).*** Managed and co-executed technical work for a project representing client in cost allocation hearings at over 40 sites. For each site, reviewed site documents, assisted client with developing its position on cost allocation, authored and submitted report to an arbiter, and presented position to arbiter in a cost allocation hearing.

- ***Confidential Client, Progress to Site Closure, (2011-2013).*** Assisted large, North American beverage manufacturer and counsel with closing a site in Pennsylvania with persistent groundwater contamination. Developed site conceptual model, remedial strategy, and manage field efforts.

- ***Confidential Client, In-Situ Chemical Oxidation Conceptual Design, (2005).*** Developed chemical oxidation remedial options with costs for hydrocarbon contamination under a commercial building. Options included modified Fenton's reagent injected with direct push technology, activated persulfate injected with direct push technology, and upgradient injection/flushing with persulfate catalyzed with high pH.

- ***Confidential Client, Source Area In-Situ Bioremediation Conceptual Design, (2010).*** Provide technical assistance for feasibility analysis and conceptual design of an in-situ bioremediation remedy for TCE groundwater contamination of a 5-acre area located under a manufacturing facility. Considerations included spot injections of donor, the use of horizontal wells, and the creation of recirculation cells.

- ***Confidential Client, Modeling of Biobarrier Performance, (2007-2013).*** Conducted modeling to evaluate the performance of a 1,000-foot long biobarrier that as designed to treat TCE concentration as high as 7,000 μg/L in a highly transmissive aquifer. Subsequently modeled future expected performance of that biobarrier and two other biobarriers to restore an aquifer to cleanup standards.

- ***Confidential Client, Natural Attenuation Decision Support, (2005).*** Applied USEPA BIOSCREEN Natural Attenuation Decision Support System with conservative parameters to demonstrate BTEX concentrations would be below Ohio EPA standards at the compliance point, avoiding the need for further groundwater remediation.

- ***Confidential Client, Vapor Intrusion Screening Evaluation, (2004).*** Evaluated potential for vapor intrusion for a site in central New Jersey using a tiered approach that is consistent with USEPA vapor intrusion guidance. Evaluation included comparison of volatile organic compound concentrations from existing data to screening levels, application of the Johnson-Ettinger model using site-specific information, and coordination of a limited field effort to confirm concentrations in shallow groundwater result in an acceptable risk to receptors.

- ***Confidential Client, Vapor Intrusion Evaluation with Sampling, (2005).*** Evaluated potential for vapor intrusion for a site in upstate New York following New York State Department Environmental Conservation (NYSDEC) and New York State Department of Health (NYSDOH) guidance. Project included sampling for volatile organic compounds (VOCs) in indoor air, sub-slab soil, groundwater, and ambient air for volatile organic compounds. Project also included data evaluation, report preparation, and briefing of the client.

- ***Confidential Client, Vapor Intrusion Evaluation of Industrial Facility, (2006).*** Provided expert review of a vapor intrusion assessment of an operating facility 500,000 square-foot facility in Ohio. The assessment included consideration of groundwater quality data, soil characteristics, building parameters, contaminant properties, and other parameters in accordance with USEPA and Ohio EPA guidance.

- ***Confidential Client, Oversight and Technical Support of Environmental Consultant for Multinational Conglomerate,*** (***2003-2004).*** Co-managed efforts of prime environmental contractors and provided technical oversight at seven impacted sites in North America and Europe. Was responsible for seeing that regulatory and financial obligations were met, provided technical reviews of documents prior to submission to the regulator, and tracked expenditures relative to financial reserve allocated for each site. Managed activities included in-situ bioremediation of a pentachlorophenol (PCP) and hexavalent chromium plume at a site in the south central United States, LNAPL delineation and recovery at a site in Canada, and delineation and remedial planning for a multi-constituent plume at a site in Belgium.

- ***Confidential Client, Acid Mine Drainage System Design, Construction, and O&M, (2007-2013).*** Evaluated, designed, and installed improvements to a remote acid mine drainage site in Central Pennsylvania. Responsible for regulatory discussions with environmental and natural resources agencies, permitting, system design, system construction, and system start-up. Improvements include underground piping and valve pits, steel building for equipment, redundant diesel-powered generators for power (no line power available), auto-start diesel air compressors and sludge pumps for solids handling, new system controls and motor control center, and telemetry system with digital cellular technology. Provided O&M and remedial strategy for the site following upgrades.

- ***Confidential Client, Remedial Investigation and Remedy Selection of Former TSD Facility in New Jersey, (2005-2013).*** Managed all aspects of site investigation, regulatory negotiation, and remedial action selection for a former transport, storage, and disposal facility in New Jersey. Work includes coordinating responses with the regulator, preparing budgets for site work, coordinating field staff, analyzing data, work plan preparation, and remedial strategy. Remedies considered have included P&T, in-situ chemical oxidation, and in-situ thermal remediation.

- ***Confidential Client, Groundwater Remedy Project Management and P&T System Shutdown, (2006-2013).*** Managed all activities related to remedial strategy, reporting, and on-going ground water monitoring at a Superfund Site in Central New Jersey. Work included technical assistance to treatment plant operators, meetings with regulators, numerical modeling, analyzing data, preparing of O&M reports for pump and treat system, conducting quarterly ground water sampling events, validating data, managing the site database, and preparing quarterly ground water monitoring reports. The extraction system consists of five extraction wells. Treatment processes include metals removal and air stripping. Treated water is reinjected. Obtained approval for extraction system and treatment plant shut down in 2013.

- ***Confidential Client, Groundwater Remedy Project Management and Optimization, (2008-2013).*** Managed all activities related to remedial strategy, reporting, and on-going ground water monitoring at a Superfund Site in Central New Jersey. Work included technical assistance to treatment plant operators, optimization of treatment processes, meetings with regulators, analyzing data, and preparing reports, conducting annual groundwater sampling event. The extraction system consists of five wells (only three currently need to operate). Treatment processes include metals removal and treatment of organics with a biological powder activated carbon system. Treated water is discharged to surface water. Prepared initial design documents to streamline treatment plant to pre-treat for 1,4-dioxane, tetrahydrofuran, and other VOCs prior to discharge to the POTW. Scoped permit needs, worked with stakeholders, and prepared preliminary design for discharge line to convey fluids to the POTW.

- ***USEPA Office of Superfund Remediation and Technology Innovation (OSRTI), Preparation of EPA Groundwater Remediation Guidance Documents, (2004-2005).*** Co-authored USEPA guidance documents regarding design, operation, contracting, and reporting for ground water remedies (with emphasis on pump and treat systems) as well as evaluating plume capture with pump and treat systems.

- ***USEPA Office of Research and Development, Preparation of EPA Synthesis Report on DNAPL Remediation, (2007).*** Co-authored USEPA summary report on effectiveness of five DNAPL remediation pilot tests including resistive heating, steam injection, surfactant flushing, and air sparging/soil vapor extraction.

- ***Confidential Client. Expert Review of 1,4-Dioxane Treatment Options, (2013)***. Provided expert review of treatment options for 1,4-dioxane in water from a public water supply well field.

- ***Confidential Client, Private Sector Third-Party Remedy Reviews, (2005-2006).*** Provide "cold-eyes" reviews of multiple sites to provide input on effectiveness of the remedy to protect human health and the environment, to cost-effectively meet its remedial objectives, and to gain site closure. Reviews include evaluation of potential effects on local receptors from impacted groundwater and vapor intrusion. Reviews also include evaluation of completeness of site characterization, developing an appropriate remedial strategy, and assisting in overseeing implementation of that strategy.

- ***Confidential Client, Private Sector Third-Party Remedy Reviews, (2005).*** Perform third-party evaluation to help improve two operating remedies and help fulfill client's corporate requirements for quality control.

- ***Confidential Client, Private Sector Third-Party Remedy Review, (2004).*** Lead team on third-party evaluation of an operating remedy to identify a more appropriate remedy for reaching site closure in an appropriate time frame given the client's interest in divesting the site.

- ***USEPA Office of Superfund Remediation and Technology Innovation (OSRTI), Research for EPA on Technologies to Facilitate Groundwater Monitoring, (2003).*** Research the status of emerging technologies for facilitating monitoring of groundwater contaminants. Identify these emerging technologies and the research groups working on them, evaluate the progress of research and development, and estimate the impact technologies will have on groundwater monitoring. Review technologies such as surface acoustic wave, fiber optic, membrane coated electrochemical, and stripping analysis sensors.

- ***City of Ann Arbor, Evaluation of Capture of 1,4-Dioxane Plume with Numerical Groundwater Model, (2010).*** Developed a groundwater model for the Ann Arbor Landfill site to evaluate the capture of a 1,4-dioxane plume by an existing pump and discharge system. Conducted simulations with the calibrated model to evaluate a pumping strategy that would provide adequate capture while minimizing the extraction rate. Modeling results suggested that discontinuing operation of one extraction well would provide adequate capture while reducing the flow rate by 40%.

- ***City of Ann Arbor, Review of Hydraulic Analysis Report for 1,4-Dioxane Plume, (2009).*** On behalf of the city, evaluated a hydraulic analysis report on 1,4-dioxane plume submitted by a responsible party to the Michigan Department of Environmental Quality. Reported findings and expert opinion to the city regarding the work conducted by the responsible party's consultant. Participated in technical meetings with the City of Ann Arbor and the responsible party.

- ***Park Euclid WQARF Site, Tucson, Arizona, Contaminant Transport Modeling, (2008).*** Performed contaminant transport model calibration related to design of a groundwater extraction system.

- ***Duke University, Department of Civil and Environmental Engineering, Doctoral Research on Tracers for Aquifer Characterization, (1996-2000).*** Co-developed a single-borehole pumping and tracer test for aquifer characterization.
  - Programmed in FORTRAN semi-analytical and numerical models for groundwater flow and tracer transport in the subsurface.
  - Simulated groundwater flow and tracer transport in heterogeneous formations and developed relationships between results of a tracer test and aquifer properties.
  - Developed, conducted, and interpreted the results of tracer tests in a controlled laboratory environment.
  - Conducted and interpreted the results of pumping and tracer tests conducted in the field.

Sustainability Work Experience

- ***USEPA, Development of EPA Methodology for Environmental Footprint Analysis, (2010-2012).*** Developed USEPA document describing a methodology for environmental footprint analysis titled *Methodology for Understanding and Reducing a Project's Environmental Footprint* (EPA 542-R-12-002, February 2012). Also developed the USEPA Spreadsheets for Environmental Footprint Analysis (SEFA), which can be used to implement the methodology. Presented the contents of the document in a half-day training course at the National Association of Remedial Project Managers Conference in Kansas City, MO on May 18, 2010 and other training seminars.

- ***USEPA and U.S. Army Corps of Engineers, Green Remediation and Green and Sustainable Remediation Technical Support, (2010-2013).*** Provided green remediation evaluations and technical assistance to Superfund sites on behalf of USEPA. Review site documents, visit the site, and evaluate effective and efficient use of existing remedial technologies, evaluate the potential use of energy efficient technologies commonly used in other fields (e.g., combined heat and power and water source heat pumps), and consider potential opportunities to develop renewable energy to power the remedy. The evaluations focus on reducing the energy use, air emissions, water use, materials use, waste generation, and land disturbance associated with the remedy. Remedies evaluated include pump and treat, in-situ bioremediation, thermal remediation, in-situ chemical oxidation, soil excavation and disposal, monitored natural attenuation, landfill cover regarding, and phytoremediation.

- ***U.S. Department of the Navy – NAVFAC ESC, Environmental Footprint Analysis and Life-Cycle Assessment, (2011-2013).*** Served as a technical lead for the benchmark team in a project titled *Quantifying Life-Cycle Environmental Footprints of Soil and Groundwater Remedies* and funded by the U.S. Department of Defense Environmental Security Technology Certification Program (ESTCP). Ran Life-Cycle Assessment (LCA) software SimaPro™ on 20 different complex environmental remediation projects and used results to benchmark footprint analysis tools that have been developed by the Department of Defense.

- ***USEPA, Evaluation of Ecosystem Services Software, (2010).*** Served as senior technical reviewer on a project to evaluate ecosystem services software at an USEPA-funded mine reclamation project.

- ***U.S. Department of the Navy – NAVFAC ESC, Green and Sustainable Remediation Training, (2010).*** Prepared and co-presented training seminar on Green and Sustainable Remediation as part of the Navy Remediation Innovative Technology Seminar series in Spring 2010. Course was provided at six locations nationwide.

- ***USEPA, EPA Best Management Practices for Improving Sustainability of Pump and Treat Systems, (2009).*** Prepared an USEPA document on best management practices for improving sustainability of pump and treat remedies (EPA 542-F-09-005, December 2009).

- ***U.S. Army Corps of Engineers, Development and Demonstration of Green and Sustainable Remediation Procedures, (2010-2012).*** Executed project to pilot a green and sustainable remediation approach for the U.S. Army and provided recommendations for implementing the approach full-scale. The final report serves as the centerpiece for forthcoming U.S. Army guidance on conducting green and sustainable remediation at U.S. Army installations.

- ***USEPA, International Presentations on Behalf of EPA, (2010).*** Prepared and co-presented two courses on remedy optimization and prepared one course on green remediation on behalf of USEPA at the 2010 CONSOIL conference in Salzburg, Austria.

- ***Buckley Air Force Base, Renewable Energy Feasibility Assessment, (2009).*** Conducted a renewable energy feasibility assessment for the majority of the installation. Considered technologies including solar (PV), solar thermal, geothermal direct use, geothermal heat pumps, combined heat and power, anaerobic digestion, wind, and other technologies. Develop conceptual designs for implementing combined heat and power and geothermal applications.

- ***Residential Client, Photovoltaic Design and Installation, (2005).*** Designed and oversaw installation of a 4.42 kW roof-mounted photovoltaic system. Responsibilities included evaluating solar output and financial return of project, permitting, system design, equipment procurement, and oversight of construction contractor. System includes 52 85 W solar modules, grounding system, and two 2 kW inverters.

- ***Private Developer in New England, Renewable Energy and Energy Efficiency Feasibility Study, (2003).*** Prepared comprehensive feasibility study for renewable energy and energy efficiency technologies for a 200-acre mixed-use development that is currently in the planning stage. The study included technical and financial evaluations of PV systems, geothermal heat pumps, cogeneration, and various "green building" design technologies. The study also included a review of the LEED® certification process, the applicability to the project, and a preliminary strategy for obtaining LEED® certification for individual buildings that are part of the project. Also contributed energy-efficiency and water conservation language for the Expanded Environmental Notification Form that was submitted for the project.

- ***PEPCO Energy Services, Inc., Photovoltaic and Solar Thermal Feasibility Study, (2004).*** Prepared comprehensive feasibility study for solar electric (PV) and solar thermal technologies for a leachate treatment building at a landfill in central Pennsylvania. The study included technical and financial evaluations for both technologies, including financial incentives related to the Pennsylvania Energy Harvest Grant. The cost-effectiveness of the two technologies was compared. PV would help offset electricity used to power pumps and other aspects of the treatment plant. Solar thermal would help offset propane used to pre-heat the leachate prior to treatment.

- ***Confidential Private Client in New Jersey, Negotiation of Solar Renewable Energy Certificate Purchasing Contract, (2005).*** Negotiated a project contingent purchasing contract for Solar Renewable Energy Credits (SRECs) between a load serving entity (e.g., power company) and a solar project customer. The purchasing contract would help the load serving entity meet its targets for solar energy and help the solar project client finance a >500 kW solar project.

- ***Confidential Private Client in New Jersey. Photovoltaic Design and Analysis (2005).*** Designed 200 kW PV system, including system orientation/layout, specification of materials, diagrams, and costing. The design included the following:
    - Financial analysis for system that incorporates various New Jersey and Federal incentives plus sale of Solar Renewable Energy Certificates

- Ballasted mounting system that eliminates the need for penetrating the roof and minimizes the need for pre-installation roofing upgrades
- Photovoltaic system monitoring with secure internet access to view electricity production data
- Detailed analysis of panel tilt vs. energy production

- ***ARUP Global Consulting and Design, Geothermal Heat Pump Feasibility Analysis, (2008).*** Evaluated feasibility of ground source heat pump for 600 tons of heating and cooling capacity for a proposed development in Rockville, Maryland. Evaluated size and cost of closed-loop, open-loop, and standing column ground heat exchangers.

- ***National Rural Utilities Cooperative Finance Corporation (NRUCFC), Geothermal Ground-Loop Design and Installation, (2008-2009).*** Evaluated feasibility of ground source heat pump for facility headquarters in Northern Virginia. Confirmed parameter for feasibility study through field thermal conductivity test and designed ground-loop for ground source heat pumps capable of providing 50 tons of cooling and 300,000 btuh of heating. Designed ground-loop for the system, and contributed to oversight efforts during construction.

- ***Harvard University, Division of Engineering and Applied Sciences, Management of Greenhouse Gas Measurement Field Station, (1994-1996).*** Managed atmospheric chemistry field station in Thompson, Manitoba, Canada that measured flux of greenhouse gases.
  - Maintained and serviced field station equipment (sonic anemometer, cup anemometer, temperature probes, carbon dioxide and water vapor monitors, solar radiation sensors)
  - Processed and analyzed data
  - Developed and edited data reduction software in FORTRAN

PUBLICATIONS:

Final Report: Quantifying Life-Cycle Environmental Footprints of Soil and Groundwater Remedies, ESTCP Project # ER-201127, July 2013

Final Study Report: Evaluation of Consideration and Incorporation of Green and Sustainable Remediation (GSR) Practices in Army Environmental Remediation, Office of the Assistant Chief of Staff for Installation Management (OACSIM), Installation Services Directorate – Environmental Division, ACSIM Study #5, August 27, 2012.

Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), February 2012.

EPA Spreadsheets for Environmental Footprint Analysis (April 2012), www.cluin.org/greenremediation/methodology.

Green Remediation Best Management Practices: Pump and Treat Technologies (EPA 542-F-09-005), December 2009.

A Cost Comparison Framework for Use in Optimizing Ground Water Pump and Treat Systems (EPA 542-R-07-005), May 2007.

Options for Discharging Treated Water from Pump and Treat Systems (EPA 542-R-07-006), May 2007.

Optimization Strategies for Long-Term Ground Water Remedies (with Particular Emphasis on Pump and Treat Systems), (EPA 542-R-07-007), May 2007.

Synthesis Report on Five Dense, Nonaqueous Phase Liquid (DNAPL) Remediation Technologies (EPA 600-R-07-066), May 2007.

Effective Contracting Approaches for Operating Pump and Treat Systems (EPA 542-R-05-009), April 2005.

O&M Report Template for Ground Water Remedies (With Emphasis on Pump-and-Treat Systems) (EPA 542-R-05-010), April 2005.

Cost-Effective Design of Pump and Treat Systems (EPA 542-R-05-09), April 2005.

A Review of Emerging Sensor Technologies for Facilitating Long-Term Ground Water Monitoring of Volatile Organic Compounds (EPA 542-R-03-007), August 2003.

Elements for Effective Management of Operating Pump and Treat Systems (EPA 542-R-02-009), October 2002.

Pilot Project to Optimize Superfund-financed Pump and Treat Systems: Summary Report and Lessons Learned (EPA 542-R-02-008a), October 2002.

Groundwater Pump and Treat Systems: Summary of Selected Cost and Performance Information at Superfund-financed Sites (EPA 542-R-01-021a), December 2001.

Refereed Journal Articles

Sutton, D.J., Z.J. Kabala, D.E. Schaad, and N.C. Ruud, 2000. The dipole-flow test with a tracer: A new single-borehole tracer test for aquifer characterization. *Journal of Contaminant Hydrology*, 44(2000), 71-101.

Sutton, D.J., Z.J. Kabala, D. Vasudevan, and A. Francisco, 2000. Limitations and potential of Rhodamine WT as a groundwater tracer. *Water Resources Research*, 37(6), 1641-1656.

Goulden, M.L., S. C. Wofsy, J.W. Harden, S.E. Trumbore, P.M. Crill, S.T. Gower, T. Fries, B.C. Daube, S.M. Fan, D.J. Sutton, A. Bazzaz, and J.W. Munger, 1998. Sensitivity of boreal forest carbon balance to soil thaw. *Science* 279(5348), 214-217.

Goulden, M.L., B.C. Daube, S.M. Fan, D.J. Sutton, A. Bazzaz, J.W. Munger, and S.C. Wofsy, 1997. Physiological responses of a black spruce forest to weather. *Journal of Geophysical Research-Atmospheres*, 102(D24), 28987-28996.

Frolking, S., M.L. Goulden, S.C. Wofsy, S.M. Fan, D.J. Sutton, J.W. Munger, A.M. Bazzaz, B.C. Daube, P.M. Crill, J.D.Aber, L.E. Band, X. Wang, K. Savage, T. Moore, and R.C. Harris, 1996. Modeling temporal variability in the carbon balance of a spruce/moss boreal forest, *Global Change Biology*, 2(4) 343-366.

Refereed Symposium Proceedings

Sutton, D.J., R. Greenwald, D.J. Becker, K. Yager, 2002. Lessons learned from optimization of pump and treat systems nationwide. Remediaton of Chlorinated and Recalcitrant Compounds: Proceedings of the 3rd International Conference May 20-23, 2002.

Sutton, D.J., Z.J. Kabala, and D. Vasudevan, 2000c. Rhodamine WT as a reactive tracer: Laboratory studies and field consequences. Proceedings of the International Conference on Tracers and Modelling in Hydrogeology, Tra’M 2000, Liège, Belgium, May 23-26, 2000.

Kabala, Z.J., D.J. Sutton, and D.E. Schaad, 2000. Mode deconvolution for the dipole-flow test with a tracer. Proceedings of the International Conference on Tracers and Modelling in Hydrogeology, Tra’M 2000, Liège, Belgium, May 23-26, 2000.

Dissertation and Thesis

Sutton, D.J., 2000. Development of the Dipole-flow Test with a Tracer. Dissertation, Department of Civil and Environmental Engineering, Duke University. Advisor: Zbigniew J. Kabala.

Sutton, D.J., 1994. *Modeling the Dispersion of Material in Massachusetts and Cape Cod Bays.* Senior thesis, Department of Earth and Planetary Sciences, Harvard University. Advisor: Allan R. Robinson.

Oral Presentations and Internet Seminars

Carol Dona, Mike Bailey, Dave Becker, Nick Stolte (USACE Environmental and Munitions CX), Kevin Roughgarden (Department of the Army), Robert Greenwald, Doug Sutton, Sarah Farron and Michelle Caruso, (Tetra Tech, Inc.).Lessons Learned from Incorporation of GSR Into Army Environmental Remediation: Pilot Project Results. Battelle Conference, Monterey, CA, May 2012.

D. Powell and D. Sutton, Remedy Optimization through Independent Design Reviews (IDRs), CONSOIL 2010, Salzburg, Austria, September 24, 2010.

C. Pachon and D. Sutton, Remedy Optimization through Remediation System Evaluations (RSEs), CONSOIL 2010, Salzburg, Austria, September 24, 2010.

D. Sutton and J. Borgersen, Considerations for Applying Renewable Energy to Environmental Remedies, Battelle Conference, Monterey, CA, May 2010.

D. Sutton, Green Remediation Lessons Learned from Optimization of Operating Pump and Treat Systems, Battelle Conference, Monterey, CA, May 2011.

Pachon, C., D. Allen, D. Sutton, March 10, 2009. Tackling the Carbon Footprint at Pump and Treat Projects: A Case Study in Energy Efficiency. EPA Internet Seminar Sponsored by the U.S. EPA Office of Superfund Remediation and Technology Innovation.

Yager, K., D. Sutton, R. Greenwald, December 5, 2005. Improving Contracting, Design, and Evaluation of Groundwater Pump and Treat Systems. EPA Internet Seminar Sponsored by the U.S. EPA Office of Superfund Remediation and Technology Innovation.

Sutton, D.J., J. Griesert, P. Rich, R. Greenwald, and K. Yager, June 16, 2004. EPA Guidance on Effective Management and Reporting for Operating Pump and Treat Systems. Conference on Accelerating Site Closeout, Improving Performance, and Reducing Costs through Optimization, Dallas, TX.

Sutton, D.J. and K. Yager, June 16, 2004. A Review of Emerging Sensor Technologies for Facilitating Long-Term Ground Water Monitoring of Volatile Organic Compounds. Conference on Accelerating Site Closeout, Improving Performance, and Reducing Costs through Optimization, Dallas, TX.

Rich, P., K. Yager, D. Sutton, and R. Greenwald, June 16, 2004. New EPA Guidance on Cost-Effective Design of Pump and Treat Systems. Conference on Accelerating Site Closeout, Improving Performance, and Reducing Costs through Optimization, Dallas, TX.

Rich, P., K. Yager, R. Greenwald, and D. SUTTON, June 16, 2004. New EPA Guidance – Effective Contracting Approaches for Operating Pump and Treat Systems. Conference on Accelerating Site Closeout, Improving Performance, and Reducing Costs through Optimization, Dallas, TX.

Sutton, D.J and P. Rich, May 26, 2004. O&M 2004 and Beyond: New EPA Fact Sheets. Environmental Protection Agency National Association of Remedial Project Managers Annual Conference, Miami Beach, FL.

Sutton, D.J., October 13, 1999. Dipole-flow tests with tracers. Invited presentation delivered at the Center for Multi-Scale Modeling and Distributed Computing, Duke University.

Sutton, D.J., December 16, 1999. Interpretation of the dipole-flow test with a tracer using a streamtube model. Given at the American Geophysical Union Fall Meeting, San Francisco.

Poster Presentations

Sutton, D.J., June 2, 2000. Rhodamine WT as a Reactive Groundwater Tracer. Presented at the American Geophysical Union Spring Meeting, Washington, D.C.

Sutton, D.J., June 3, 1999. The affect of Rhodamine WT adsorption on the dipole-flow test with a tracer. Presented at the American Geophysical Union Spring Meeting, Boston.

Sutton, D.J., May 29, 1998. Interpretation of dipole-flow tests with a tracer conducted at the Lizzie Field Site. Presented at the American Geophysical Union Spring Meeting, Boston.

Sutton, D.J., April 1, 1998. Dipole-flow tests with a tracer for aquifer characterization, Presented at the Annual North Carolina Water Resources Research Conference, North Carolina State University, Raleigh.

Sutton, D.J., December 12, 1997. Simulated dipole-flow tests with a tracer in heterogeneous formations. Presented at the American Geophysical Union Fall Meeting, San Francisco.

APPENDIX C

Quality Assurance Project Plan

For

Acid Condition IRM on Parcel A of the
Former Pratt Oil Works Site, Long Island City, Queens, New York

Prepared for NYSDEC Division of Environmental Remediation

Prepared by

Savin Engineers, P.C.

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July 2014

List of Acronyms

IRM	Interim Remedial Measures
mL	Milliliter
NAPL	Non-aqueous phase liquid
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSPE	New York State Professional Engineer
PE	Professional Engineer
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/Quality control
SERAS	Scientific Engineering Response and Analytical Services
SSCR	Supplemental Site Characterization Report (Kleinfelder, 2013)

This Quality Assurance Project Plan (QAPP) has been prepared to guide sampling and sample preservation activities associated with the Interim Remedial Measure (IRM) to neutralize the Acid Condition in the Treatment Area, located on a portion of what is presently known as Lot 300, Block 312 at the Former Pratt Oil Works Site in Long Island City, Queens, New York (Property). The Acid Condition is the low pH groundwater and co-located acidic material depicted in Figure 2 of the July 2014 Acid Condition IRM Work Plan. The Treatment Area, also referred to as the IRM Site, is depicted in Figure 3 of the same document and consists of the Acid Condition and footprint of the Building Expansion. The IRM Work Plan identifies addition of alkalinity with *in situ* mixing to neutralize the Acid Condition in the Treatment area as the preferred approach. The IRM Work Plan also identifies a general site plan for IRM implementation and a performance and confirmation monitoring program.

1.0 Scope

The scope of work covered by this QAPP is the alkalinity addition with *in situ* mixing and the associated sampling.

The *in situ* mixing will involve the following steps for each of approximately 21 treatment cells:

- remove and stockpile the asphalt and non-acidic fill in the treatment cell;
- remove fill in the center of the treatment cell to the NAPL surface, water table, or top of acidic material (whichever is shallowest) and extract recoverable NAPL (greater than 6-inches thick) for off-site disposal;
- add hydrated lime into the treatment cell in batches and mix with a drum mixer attached to an excavator or equal until target pH is achieved throughout the treatment cell;
- use excavator bucket to compact treated acidic material;
- backfill remaining cell volume in 6-inch compacted lifts with stockpiled fill suitable to specifications of the geotechnical engineer for the building expansion;
- recycle removed asphalt and dispose of unused fill; and
- surface restoration to the specifications of the Transfer Station solid waste permit.

The IRM performance monitoring program will involve one composite acidic material performance/confirmation sample. The samples will be collected and analyzed on site. There are a total of approximately 21 treatment cells. If the composite acidic material performance/confirmation sample for a treatment cell does not meet the IRM performance objective (pH greater than 6.0 and less than 9.0), then lime addition and mixing in the treatment cell will continue and additional composite confirmation samples will be collected. The process for that treatment cell will be repeated until a composite sample meets the IRM performance objective.

2.0 Data Quality Objectives

The data quality objective of the IRM is to confirm the pH of the Acid Condition is increased to between 6.0 to 9.0. The specific analytical methods and QA/QC procedures are presented in Table 1, Analytical Methods/Quality Assurance Summary.

3.0 Analytical Laboratory

All analyses will be conducted on site.

4.0 Project Personnel

The project engineer will be Joseph Fiteni (NYSPE) of Savin Engineers, P.C. A representative of the construction contractor will be the Quality Assurance Manager. Doug Sutton, Ph.D. (PE New Jersey) of HydroGeoLogic, Inc. will be the Quality Control Manager. Mr. Fiteni's contact information is 914-769-3200. Dr. Sutton's contact information is 732-233-1161.

5.0 Analytical Methods/Quality Assurance

Analytical methods/quality assurance are as follows:

Field analysis of pH for alkalinity amended acidic material will be conducted using the Scientific Engineering Response and Analytical Services (SERAS) Standard Operating Procedure 1844 for Soil pH Determination (see Appendix 1) with the following notable exceptions:

- pH will be calibrated with 1.68, 4.0, and 7.0 commercially available pH buffers.
- Analyses will be conducted with the specified instrument or an equivalent and will follow the manufacturer's instructions for preparation, calibration, and use.
- Analyses will be conducted with the calcium chloride solution preparation only (not the deionized water preparation).
- Sample mass and the volume of calcium chloride solution can be scaled to allow for larger sample sizes (e.g., 100 g of sample mass and 100 mL of calcium chloride solution instead of 10 g and 10 mL).
- The samples will not be sieved. Non-representative sized particles will be removed by hand.
- As part of sample preparation, samples will stand for 15 minutes instead of 1 hour.
- Review of the results for quality assurance and quality control will be conducted Doug Sutton, Ph.D., PE.
- Unused material will returned to the treatment cell.

Field analysis for pH for groundwater will be conducted using a calibrated handheld pH meter following the manufacturer's instructions.

Alkalinity demand tests on acidic material be conducted by adding hydrated lime in 1 to 2 gram increments to 100 grams of acidic material. The mass of the acidic material will be recorded along with the mass of hydrated lime added to reach pH 6 or higher.

6.0 Sampling Methodology

The sampling methodologies for alkalinity amended acidic material and groundwater are described below.

6.1 Alkalinity Amended Acidic Material

Alkalinity amended acidic material samples for confirmation sampling will be the composite of material from four sample locations within a treatment cell. The material will be collected from two locations within the upper half of the treated acidic material and from two locations in the lower half of the treated acidic material. The material will be collected with the excavator bucket and/or a hand auger. The sample will be logged visually for consistent mixing and photo documented. The composite sample will be homogenized for pH analysis, and potentially alkalinity demand testing

6.2 Groundwater

Groundwater samples, if any, will be collected by collecting water leaching from alkalinity amended material collected for sampling.

6.3 Field Sample Storage and Handling Time Restrictions

Samples will be analyzed for pH with 4 hours of collection.

7.0 Field Analytical Instrumentation

The field analytical instruments to be used in this IRM are a handheld pH meter, such as the Oakton pH 5+ or 6+ meter or YSI 60 pH Meter. The instruments will be calibrated and maintained in accordance with the manufacturer's instructions, including each day before work commences. Calibration information will be recorded in the site logbook or field sheets.

8.0 Duplicate and Split Samples

One duplicate pH sample will be collected at a rate of one duplicate per 20 samples.

9.0 Chain of Custody

No samples are being sent off-site for analysis.

10.0 Reporting of Sampling Data

The IRM Report will include a detailed description of the sampling, data summary tables, site map showing sample locations, and pH results.

Table 1. Analytical Methods / Quality Assurance Summary

Sample Type	Number of Samples	Duplicate Frequency	Analytical Method	Preservation	Container	Holding Time
Field pH Groundwater	~21	1/20	Handheld meter	N/A	100 mL glass	Immediate
Field pH Alkalinity Amended Acidic Material	~21	1/20	SERAS 1844	N/A	100 mL glass	4 hrs
Field Acidity Titration	as needed	N/A	See Text	N/A	125 mL glass	< 24 hrs

APPENDIX 1

STANDARD OPERATING PROCEDURES

SOIL pH DETERMINATION

CONTENTS

1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the measurement of pH (the ratio of hydrogen [H^+] and hydroxyl [OH^-] ion activities at a given temperature) of soils using a Cole-Palmer Digi-Sense® digital pH/millivolt/oxidation reduction potential (pH/mV/ORP) meter.

Mention of trade names or commercial products does not constitute United States Environmental Protection Agency (U.S. EPA) or Lockheed Martin endorsement or recommendation for use.

2.0 METHOD SUMMARY

Measurement of soil pH using a potentiometer determines the degree of acidity or alkalinity in soils suspended in water and in 0.01Molar (M) calcium chloride solution. The potentiometer is calibrated with buffer solutions of known pH prior to the analysis of samples.

pH measurements are determined in both water and a calcium chloride solution because the calcium displaces some of the exchangeable aluminum. The low ionic strength counters the dilution effect on the exchange equilibrium by setting the salt concentration of the solution closer to that expected in the soil solution. The pH values obtained from the measurement of the calcium chloride solution are slightly lower than those measured in water due to the release of additional aluminum ions that hydrolyze. Therefore, both measurements are required to fully define the character of the soil.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING AND STORAGE

Soil samples should be collected in wide-mouth glass containers with Teflon-lined caps. From the time of sample collection until after analysis, samples must be refrigerated at 4 ± 2 degrees Celsius (°C) for periods specified by the Scientific, Engineering Response and Analytical Services (SERAS) Task Leader or the U.S. EPA/Environmental Response Team (ERT) Work Assignment Manager (WAM). Samples must be analyzed immediately (within 15 minutes) after the soil sample is suspended in water or calcium chloride solution according to the procedures listed in Section 7.0. Laboratory analyses are typically performed at room temperature (15 to 25 °C). All samples and calibration buffers should be allowed to equilibrate to ambient temperature prior to analysis.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The combination electrode is relatively free from interference from color, turbidity, colloidal matter, oxidants, reductants, and high salinity. Refer to pH/mV/ORP meter manufacturer's instructions for any possible interference and limitations.

Measurements of pH are affected by temperature in two ways: mechanical effects that are caused by changes in the properties of the electrodes, and chemical effects caused by equilibrium changes. Standard pH buffers have a specific pH at indicated temperatures.

5.0 EQUIPMENT/APPARATUS

The following are standard materials and equipment required for soil pH determination:

- pH meter, Cole-Parmer Digi-Sense® Model No. 5938-00 or equivalent
- Combination pH electrode
- 9-volt battery
- Thermometer, capable of reading between 0°C and 100°C
- Balance, capable of weighing 10 grams (g) of soil
- No. 10 sieve, 2 millimeter (mm) openings
- Small griffin beaker
- pH paper
- Kimwipes or equivalent

6.0 REAGENTS

- pH Buffers, 4.00, 7.00 and 10.00, commercially available
- Potassium chloride (KCl) solution, saturated, used for filling the combination electrode. If separate glass and reference electrodes are used, the reference electrode is filled with saturated aqueous KCl.
- Reagent Water, distilled or deionized water, pH 6.5 to 7.5. Deionized or distilled water should be used for rinsing the probe between samples.
- Calcium Chloride Solution, 0.01M - Dilute 20.0 milliliters (mL) of stock 1.0 M calcium chloride solution to 2 liters (L) with deionized water. The pH of this solution should be between 5 and 7. Adjust pH of this solution if necessary.

7.0 PROCEDURES

7.1 pH Calibration Procedure

The pH/mV/ORP meter must be standardized with a known buffer solution every three hours of operation. Refer to SERAS SOP #2077, *pH/mV/ORP Determination Using a Cole-Parmer Digi-Sense Meter* for specific calibration procedures. The buffers selected should bracket the pH of the samples.

7.2 pH Meter Operation

Refer to SERAS SOP #2077, *pH Determination Using a Cole-Parmer Digi-Sense Meter.*

7.3 Temperature Compensation

Temperature compensation can be set manually by the temperature (°C) adjustment over a range of 0°C to 100°C.

7.4 Sample Preparation with Reagent Water

1 Air dry the soil sample.

2 Sieve the soil sample through a No. 10 sieve (2 mm mesh) to remove the coarser soil fraction.

3 Weigh out approximately 10 g of the air-dried and sieved soil sample.

4 Place the soil into a glass container and add approximately 10 mL of distilled or deionized water.

5 Mix thoroughly and let stand for 1 hour.

6 Proceed to Section 7.6 for sample measurement.

7.5 Sample Preparation with Calcium Chloride Solution

1 Weigh out approximately 10 g of the air-dried and sieved soil sample.

2 Place the soil into a glass container and add approximately 10 mL of 0.01 M calcium chloride solution.

3 Mix thoroughly and let stand for 1 hour.

4 Proceed to Section 7.6 for sample measurement.

7.6 Sample Measurement

Samples should be analyzed immediately (within 15 minutes after preparing sample in Section 7.4 or 7.5).

1 Measure the temperature of the suspended soil sample. Set the temperature dial on the pH meter to match the measured temperature in □C.

2 Rinse the probes with distilled or deionized water. Blot dry.

3 With the meter on, place the electrode in the partially settled sample suspension to be measured.

4. If the meter is calibrated using pH 4.00 and pH 7.00 buffers and the sample reading is >7.00, the meter must be recalibrated using pH 7.00 and 10.00 buffers. Likewise, if the meter is calibrated using 7.00 and 10.00 buffers and the pH reading is <7.00, the meter must be recalibrated using the 4.00 and 7.00 buffers. The sample pH will be displayed. Record the reading once the meter has stabilized.

Alternatively, the pH may be determined using wide range pH paper if there appears to be interferences with the electrode from the matrix.

7.7 Battery Replacement

The pH meter uses a 9-volt battery with a life of 2,000 hours. If the low battery indicator is on, immediately stop operation and replace the internal battery with a new 9-volt battery.

7.8 Cleaning the Probe

The glass bulb is the sensitive part of the probe, it should always be kept clean. Rinse the probe with deionized or distilled water after use. Before storage, rinse the probe with tap or distilled water, shake dry, and place the probe in the protective cap, which should be filled with a calcium chloride solution or equivalent probe storage solution.

If calcium chloride solution or equivalent storage solution is not available, use a 4.00 pH buffer, 7.00 pH buffer, or tap water. Distilled water should never be used.

8.0 CALCULATIONS

The value displayed is read directly as pH. The temperature of the samples and calibration buffers should be identical to ensure accuracy. Record the sample temperature with the pH value obtained.

Report the pH of the soil to the first decimal place. Specify the medium used (water or calcium chloride) for each pH measurement.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

The following general QA procedures apply:

All data must be documented on field data sheets or in site or laboratory notebooks.

All instrumentation must be operated in accordance with the manufacturer’s instructions. Equipment check-out procedures and calibration activities must be performed in Section 7.1.

Duplicate samples should be processed with the frequency of one in twenty samples. Duplicate samples will be used to determine precision.

Ensure pH buffers are within expiration dates.

The balance used to weigh out the samples must be calibrated using a Class - S weight each time samples are weighed out.

10.0 DATA VALIDATION

For the pH meter, ± 0.1 pH unit represents the limit of accuracy under normal conditions, especially for measurement of water and poorly buffered solutions(1).

Results will be reviewed by the Engineering Evaluation Unit (EEU) prior to release. This information will be utilized to qualify the environmental sample results accordingly with the project’s data quality objectives.

11.0 HEALTH AND SAFETY

General laboratory and field safety practices should be followed. Waste samples should be handled with care due to the uncertainty of the properties and contents involved. Refer to the specific material safety data sheet (MSDS) for the hazardous properties of any chemical or reagent utilized in this analysis. All excess samples, used samples, and waste material generated during analysis must be disposed in accordance with SERAS SOP #1501, *Hazardous Waste Management.*

When working with potentially hazardous materials, follow U.S. EPA, Occupational Safety and Health Association (OSHA), and Corporate health and safety procedures. More specifically, refer to SERAS SOP #3013, *Laboratory Safety Program.*

12.0 REFERENCES

[1] American Society of Testing and Materials (ASTM). 1995. *Annual Book of ASTM Standards*, Designation D4972 - 95a: Standard Test Method for pH of Soils.

13.0 APPENDICES

This section is not applicable to this SOP.

APPENDIX D

To be submitted under separate cover.