CORRECTIVE ACTION PLAN

62-64 SCIO STREET
ROCHESTER, NEW YORK

NYSDEC Spill #0650898
USEPA Assistance ID No. BF97219700

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1.0 Introduction

Lu Engineers (Lu) has prepared this Corrective Action Plan (CAP) to be implemented at the vacant parcel located at 62-64 Scio Street, City of Rochester, and County of Monroe, New York (Site). The location of the Site is shown on Figure 1 (Project Location Map).

The Project is being performed as part of the City of Rochester's (City's) 2010 Brownfield Cleanup Grant from the United States Environmental Protection Agency (EPA). Site activities eligible for cleanup grant funding generally includes remedial work plans, remedial measures and cleanup activities, reports and documentation, community involvement, waste characterization, and waste disposal. The Project activities and selected Consultant are subject to the conditions of the City's Brownfield Assessment Cooperative Agreement with the EPA. This CAP will be conducted under a Stipulation Agreement between the City of Rochester (City) and the New York State Department of Environmental Conservation (NYSDEC).

1.1 Background

The Site is located in the City's desirable East End District, and is owned by the City of Rochester. The Site measures approximately 55 ft x 200 ft (~0.25 acres) and is currently vacant (Figure 2). A 22,000 square foot, two-story, brick building constructed around 1920 occupied the Site until 2002. The building was primarily used as a warehouse from the date of construction, until approximately 1990. The City of Rochester took ownership of the property in 1996, at which time the building was used for storage until it was demolished in November 2002. The Site has remained vacant since demolition.

Several Environmental Studies have been completed on behalf of the City of Rochester at the Site including:

- Rizzo Associates Inc. Preliminary Site Assessment Update/Limited Subsurface Investigation Report, dated May 1993;
- Day Environmental Inc. (DAY) Phase I Environmental Site Assessment Report, dated May 1995;
- Day Environmental Inc. (DAY) Phase II Environmental Site Assessment Report, dated August 1995;
- Day Environmental Inc. (DAY) Underground Storage Tank Closure and Limited Subsurface Study Report, dated December 2006;
- Day Environmental Inc. (DAY) Data Package Limited Groundwater Study Report dated June 2007; and
- Lu Engineers Phase I Environmental Site Assessment Report, dated October 2009.

The results of the previous Environmental Studies revealed the following Recognized Environmental Concerns (RECs) associated with the Site and/or adjacent properties that may be impacting the Site:

Underground Storage Tank(s)- Two underground storage tanks (USTs) were used on the Site in the past for storage of petroleum products including gasoline and diesel fuel/fuel oil. These tanks (5,000 gallon and 2,000 gallon) were removed in 2006 and 2003, respectively. Subsurface investigations that began in 2006 showed the presence of petroleum compounds in Site soils and groundwater.

Adjacent NYSDEC Active Spills- The NYSDEC's spills database was reviewed and identified eight active spills within a 0.5 mile radius of the Site. The distance and location of these spills from the Site suggest no environmental impact on the assessed properties.

Adjacent NYSDEC Inactive Spills- An Underground Storage Tank (UST) containing gasoline was removed from the adjacent property to the east, at 68-72 Scio Street, in 1991. Soils surrounding the tank were found to be contaminated. A soil venting system and three (3), groundwater monitoring wells were installed on the property. The only monitoring well to contain a detectable level of contamination was the well closest to 62-64 Scio Street. The spill was closed by the NYSDEC in 1995.

Groundwater Contamination at Adjacent Property Monitoring Wells- Petroleum contamination was identified at an adjacent property, located at 200 East Avenue, to the east of the Site, across Matthews Street. A north/northeastward groundwater flow direction has been documented for this location. Review of the NYSDEC Petroleum Bulk Storage (PBS) database identified six former storage tanks at 200 East Avenue including:

- one 4,000 gallon gasoline UST installed in 1986;
- three 1,000 gallon USTs with unknown contents;
- one 2,000 gallon gasoline UST installed in 1987, and;
- one 1,000 gallon Aboveground Storage Tank (AST) with unknown contents.

These tanks were closed and removed in 1997. A well located east/southeast of the Site contained seven VOCs ranging in concentrations from 1.1 µg/L to 4.3 µg/L or parts per billion (ppb).

Remedial Strategy for the Scio Street Site

The City has retained Lu Engineers (Lu) to implement the remediation of the Site, on behalf of the City. City Division of Environmental Quality (DEQ) staff will assist and supplement Lu in completing certain remedial tasks. Based upon the findings of the prior environmental subsurface investigations conducted at the Site, a preliminary remedial approach has been evaluated consisting of:

1. A targeted source removal program to excavate the remaining grossly contaminated soil and fractured shallow bedrock from specified areas of the Site.
2. Dewatering to be conducted as part of the targeted source removal program, to remove as much contaminant mass from the Site as possible and to facilitate excavation into the saturated zone.
3. Post-source removal groundwater monitoring for petroleum Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs).
4. Completion of a remedial design investigation.
5. Installation of an oxygen injection system for in-situ remediation of VOC impacted groundwater.
6. Minimum of one (1) year of quarterly groundwater monitoring, subsequent to installation of the oxygen injection system.

1.2 Proposed Future Use of Site

Detailed development plans for the Site have not been created. However, it is anticipated that the redevelopment of the Site will include both green/recreational space, commercial or a mixed use commercial facility and residential housing consistent with other development within the Center City District (CCD). If possible, the City would like to keep part of the Site as open space to provide possible bike parking and an access corridor from Mathews Street to Scio Street. This would potentially involve a paved walking trail, landscaped areas and bike parking.

1.3 Objectives

The objectives of the CAP are to implement remedial activities, engineering controls, institutional controls, and environmental monitoring activities that allow the redevelopment of the Site for the proposed future use while satisfying regulatory agencies' cleanup criteria and concerns to human health and the environment.

The property will be cleaned up under the NYSDEC Spills Program. Impacted soils will be excavated and removed from the site to meet standards as described in NYSDEC's "CP-51 Soil Cleanup Guidance" for petroleum spill sites dated October 21, 2010. Site groundwater requires remediation and monitoring due to BTEX concentrations exceeding NYSDEC standards as described in 6NYCRR Part 703.5.

Using the required cleanup criteria, it is estimated that a total of approximately 700 tons of non-hazardous petroleum-contaminated soil are present on the Site that will require remediation along with affected groundwater exceeding NYSDEC Part 703.5 standards. Impacted soils will be excavated and hauled off-site to an approved facility. Following soils removal, groundwater will be treated in-situ using a City-owned direct oxygen injection system for one year or until acceptable levels are observed in groundwater samples.

2.0 Remedial Activities

Remedial activities to be completed as part of the corrective actions for this Site will include:

- waste characterization;
- removal and off-site disposal of petroleum-contaminated soil and some potential fractured rock attributable to the former UST system at the Site;
- environmental monitoring and Community Air Monitoring during soil source area excavation;
- confirmatory soil sampling and analytical laboratory testing per DER-10, and;
- backfilling of excavations.
- In-situ treatment of groundwater following soils removal, using direct oxygen injection technology until acceptable levels are observed in groundwater samples.

These remedial activities are further described herein.

2.1 Waste Characterization

Based on previous site characterization data, approximately 700 tons of source area soil/fill/fractured rock will be removed from the Site for off-site disposal. Figure 3 illustrates the approximate limits of the anticipated source soil removal. Existing sample results cannot be used to facilitate waste characterization for profiling and disposal purposes. Therefore, additional sampling and analysis is necessary. Prior to conducting the soil removal work, a backhoe or equivalent piece of exploratory equipment will be mobilized to the Site to obtain representative samples for laboratory analysis and preparation of waste profiles.

It is estimated that two (2) test pits will be advanced to a depth of approximately twelve (12) feet below ground surface (bgs), in the areas of suspected highest contamination in order to obtain appropriate sample(s) for waste characterization analysis. The location of each test pit will be recorded using a hand-held Geo-XT (or similar) global positioning system (GPS) unit for data transfer to a Geographical Information System (GIS). Soils will be returned to the test pit from which they were excavated once the desired depth has been attained. To the extent possible, heavily contaminated soils will not be excavated. Air monitoring will be conducted in compliance with the NYSDOH Community Air Monitoring Plan (CAMP), (Appendix A) using aerosol particulate monitoring equipment.

A PID will be used to screen excavated soils. Based on the results of the soil screening and other observations at each location, soil samples collected from representative test pits will be submitted to Paradigm Environmental Services, Inc. (Paradigm), a New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP) certified analytical laboratory. A total of four samples will be analyzed for the following parameters:

- STARS Volatiles 8260;
- Total Lead; and
- Flashpoint.

Laboratory test results will be used in the preparation of a waste profile with assistance from the City in order to obtain approval from a regulated disposal facility.

2.2 Soil Remediation

This Section of the CAP describes the actions that will be implemented to remediate Site soils and groundwater. This includes site preparation and control, soil removal and air monitoring activities. All work completed under the CAP will be implemented in strict accordance with the CAMP, Health and Safety Plan (HASP), Quality Assurance Program Plan (QAPP), and all other applicable regulations and protocols.

2.2.1 Site Preparation and Control

It is anticipated that site preparation activities will be minimal, generally limited to the installation of temporary fencing around the excavation/work areas and site perimeter. Portable sanitary facilities will be mobilized to the Site and water service will be established under permit using a nearby fire hydrant. Prior to beginning any intrusive activities, Lu and its subcontracted remediation contractor will coordinate with Dig Safe of New York to identify all known utilities within the construction area.

Excavation equipment mobilized to the project Site will be capable of “ripping” the upper layers of weathered dolostone bedrock to remove all accessible source area contamination. This will include the use of a minimum 200-series excavator equipped with an appropriate bucket. Other equipment to be mobilized to the Site will include, but not be limited to dewatering equipment, an equipment storage container (POD or equivalent), vibratory compaction and related equipment.

Prior to beginning the soil source-removal excavation work the Site perimeter will be secured with approximately 275 linear feet of temporary six-foot high chain link fence equipped with two (2) 20-foot temporary six-foot high chain link gates with padlock (Figure 3). A hand-held Geo-XT (or similar) GPS unit may be used to assist in the layout of the fencing. The City will control the keys to the padlocks and may issue additional keys to consultant/ vendor representatives as necessary. The position of the fencing will be established on-site in consultation with the City Project Manager and will be placed such that as much petroleum-impacted soil can be safely removed without causing damage to adjacent properties, structures, and/ or underground utilities. If necessary, a right-of-way permit for fence installation or traffic control will be obtained. In the event improvements in the right-of-way are disturbed by implementation of the CAP, these improvements will be repaired to the extent deemed necessary by the City.

In addition, temporary four-foot to six-foot plastic barrier fencing (as directed by City) will be installed around specific areas (e.g. excavations) as the removal work commences. This fencing will be adjusted as needed during the source removal work, and will be used as a site control measure to limit access to the work area, including during nights and weekends. Adequate lighting for security purposes is provided by nearby street lights and the adjacent properties.

2.2.2 Soil Removal, Air Monitoring and Disposal

Based on previous site characterization data, approximately 700 tons of source area material consisting of soil, fill, and fractured rock will be excavated and removed from the Site for off-site disposal. The excavation contractor will be responsible for loading, transporting, and disposing of contaminated soils generated during the removal. Pre-profiling of waste soils will be completed prior to excavation to facilitate live-loading of trucks to Waste Management Incorporated's, High Acres Landfill in Perinton, New York, as non-hazardous petroleum-contaminated soil to be used as landfill cover. Existing sample results will be used to the extent possible to facilitate waste characterization for profiling and disposal purposes. As described in Section 2.1, soils will be sampled and tested prior to remedial excavation to facilitate pre-profiling for live-loading of soils. This will be done to maximize the use of the limited space available at the Site. Appropriate shipping documents will be prepared for each waste shipment, for execution by Lu Engineers on behalf of the City. Copies of disposal documentation will be maintained and will be available for on-site review. All documentation from the disposal facility for the weight of each shipment will be obtained by the excavation contractor. It is anticipated that soil will be a non-hazardous regulated solid waste. Hazardous waste is not anticipated to be encountered on this project.

In order to protect the integrity of adjacent property improvements, utilities and building foundations, the Site excavation will proceed in "cells" as illustrated in Figure 3.

Uncontaminated soils considered suitable for reuse as backfill will be removed using an excavator or equivalent heavy equipment, and staged separately on 6-mil polyethylene sheeting to avoid cross-contamination with other waste streams. Polyethylene sheeting (6-mil) will also be used to cover the pile(s) and protect soils from weather, and erosion. Uncontaminated soils are anticipated to be available from an area approximately 52-ft by 30-ft by 6.0-ft deep for a total of approximately 700 tons of potentially re-usable soil.

Figure 3 identifies the layout of the Site while work is in-progress. The inferred area of contamination requiring excavation is indicated and a 10 by 10-foot grid has been superimposed over the excavation area. This grid will be marked and staked out in the field to help identify the excavation limits.

Live-loading of soils will require trucks to be able to pass westward through the Site from Matthews Street to Scio Street where they will turn right and drive toward I-490 via Charlotte Street and the Inner Loop. The initial stage (Stage 1) of the excavation will include the northern edge of the contaminated area, identified by yellow shading on Figure 3. Trucks will pass through the Site to the south of the excavation during this stage of the excavation process. Once backfilling and compaction has been completed in the Stage 1 area, work will commence in the central portion (Stage 2) of the contaminated area as defined by blue shading on Figure 3. Trucks will be directed through the northern portion of the Site during Stage 2 and Stage 3 excavations. Stage 3 is defined by red shading on Figure 3 and will be completed once the Stage 2 area has been backfilled and compacted. Stage 3 is intended to access the edges of the contaminated area up to the southern and eastern property lines once Stage 2 is backfilled in order to avoid possible sidewall collapse and off-site structural impacts.

Prior to departing the Site, all vehicles will be broom-cleaned to prevent tacking of Site soils off-site. A decontamination station will be set up to remove soil from vehicles prior to departure. Water used for this process will be obtained from the closest City hydrant under permit with the City of Rochester Bureau of Water and Lighting. The decontamination station will be constructed by excavating a shallow basin that will be large enough to contain the full footprint of the trucks being used for waste hauling. The basin will be lined with sand, and heavy gauge HDPE to ensure that decontamination rinseate liquids do not impact the ground surface. A wastewater sump will be installed to capture decontamination rinseate, which will be containerized, sampled and discharged to the Monroe County sewer or disposed of off-Site as necessary. Appropriate measures will be taken to minimize the amount of soil tracked off-Site, however, it is anticipated that a minimal amount of uncontaminated soil may be inadvertently tracked on to adjacent sidewalk and roadway surfaces. Cleanup of any soils tracked will be completed as appropriate at the direction of the City and NYSDEC.

The anticipated contaminant levels and areal extent of contamination to be encountered during the excavation process will vary with depth. Figure 4 depicts the anticipated soil concentrations as identified during previous investigations. Figure 4 shows the PID levels previously observed at the 6-8, 8-10 and 10-12 foot depth increments. This figure and the superimposed grid, as indicated in Figure 3, will assist the field team in managing the limits of the excavation while work is in progress.

All excavated materials will be field screened with a photo-ionization detector (PID), calibrated daily, prior to the start of work. Excavated soils will be segregated based on PID readings taken during the excavation process to maximize the quantity of excavation-derived reusable materials. Soils exhibiting PID readings between 0 and 25 parts per million (ppm) will be staged for on-Site re-use. Soils exhibiting headspace readings between 25 and 100 ppm will be staged separately, on 6 mil polyethylene sheeting, and sampled in accordance with NYSDEC CP-51. Soils exhibiting headspace readings of greater than 100 ppm will be excavated and "live-loaded" into appropriately permitted trucks for disposal at Waste Management of New York. Excavation sidewall soils will be screened with a PID to determine the maximum extent of soil removal. Excavation bottoms will be screened if the excavation does not extend to bedrock.

Soils exhibiting PID readings less than 25 ppm will not be immediately removed from the Site, but will be analyzed in accordance with CP-51 guidelines to determine suitability for on-Site re-use. To the extent possible, soils will be segregated based solely on PID readings, but additional laboratory analysis may be considered as excavation progresses to ensure proper disposal parameters are met to comply with the waste profile requirements of the disposal facility. Impacted soils at the excavation limits will be addressed via in-situ treatment if warranted. Total depth of soil removal will vary based on the extent of impact, the depth of bedrock and accessibility to bedrock. Excavation depths will be carefully controlled such that dewatering will be minimized prior to backfilling.

Staging of soils for re-use will require covering the underlying ground surface with 6-mil polyethylene sheeting. Soil piles will be kept to easily managed sizes and will be placed conveniently close to the Stage 1 through 3 excavation areas to avoid excessive handling.

During excavation, all applicable OSHA standards (1910 and 1926) will be followed. The excavation contractor will be responsible for using safe excavation techniques (sloping, stepping, etc.) to complete the excavation, with special care due to close proximity of neighboring properties to remedial work. Onsite workers handling waste will be required to have valid OSHA 40-hour Hazardous Waste Operations (HAZWOPER) training. 10 hour OSHA cards will be required by all other onsite workers not handling waste.

Following excavation and removal of contaminated soils, cells will be backfilled on a periodic basis until the source removal is complete. The lower portions of each excavation area will be backfilled with 1-2 inch diameter crushed dolostone or equivalent, approved fill material. [Note: The organic content of the backfill material will be considered with regards to its suitability to promote the necessary aerobic activity needed during the in-situ groundwater treatment stage of the cleanup. If necessary, an approved organic amendment may be added to the backfill material]. Backfilling will be completed in 2 foot lifts. The upper layers will be backfilled with uncontaminated Site soils. Compaction will be verified to 95% in one-foot lifts in all backfilled areas. Polyethylene plastic sheeting will be used to temporarily line excavation walls prior to daily backfilling when additional soil removal is required in a specific direction. The source removal will be limited to the boundaries of the Site. Although not anticipated, if buried utilities are identified within the planned source removal area, the City will be consulted in order to achieve an acceptable approach that satisfies the goals and objectives of the project. Section 2.4 includes further detail on the backfilling process.

Continuous perimeter and work zone air monitoring will be conducted during all soil removal, soil staging, loading and/ or excavation using a MiniRAE 3000 PID, or equivalent, to ensure that workers and the public are not exposed to elevated concentrations of VOCs. In accordance with the NYSDOH-required Community Air Monitoring Plan (CAMP), continuous particulate monitoring will be conducted at upwind and downwind locations to ensure contaminants are not migrating off-site during excavation.

To address potential fugitive dust, odors, and vapors, emergency controls (dust and vapor suppression equipment) will be available for use during all earth moving activities. The requirements and procedures for use of these controls will be established in the CAMP. A copy of the CAMP is included in Appendix A.

2.2.3 Potential Dewatering of Excavation

It is anticipated that overburden groundwater will be encountered at the Site. The excavation contractor shall minimize liquid wastes through proper use of erosion and sediment control measures to mitigate surface water runoff into the excavation area. Water that is generated during the excavation activities, dewatering activities, and decontamination activities shall be collected and containerized. A 20,000-gallon capacity frac tank will be mobilized to the Site for temporary storage of all water removed from the excavation as necessary to allow excavation and backfilling to progress unimpeded. This water will be removed from the excavation using gas-powered pumps.

Once all water has been collected, sampling will be conducted and Lu Engineers will coordinate with Monroe County Division of Pure Waters to obtain a permit to discharge the water after treatment as necessary into the nearest sanitary sewer access point available in the area of the Site. Treatment, if necessary, will be conducted by means of carbon filtration during discharge and/or aeration while contaminated water remains in the tank. Any free-phase petroleum observed in the tank will be removed and handled and disposed of accordingly. The tank will be cleaned of residual sediment prior to demobilization from the Site.

2.3 Confirmatory Soil Sampling and Analysis

As stated in NYSDEC CP-51 Soil Cleanup Guidance, the goal of remediation within the Spills Program is to achieve, to the extent feasible, Unrestricted Use Soil Cleanup Objectives (SCOs) for petroleum-related contaminants listed in 6 NYCRR Part 375-6.8(a). Limits of excavation will be determined using a combination of previous analytical results, PID readings obtained during excavation and field observations made during the soil source removal activities.

Once it has been determined that all impacted source area soil has been removed, confirmation soil samples will be collected from excavation sidewalls, in accordance with NYSDEC CP-51 Soil Cleanup Guidance and DER-10 Technical Guidance for Site Investigation and Remediation. No bottom samples are proposed since excavation is expected to terminate on bedrock. Sidewall samples will be collected approximately every 30 feet. A total of 11 confirmatory sidewall soil samples are anticipated. An additional three (3) QA/QC samples will be obtained for VOCs (EPA Method 8260 STARS) and SVOCs (EPA Method 8270 B/Ns Only). The confirmation soil samples will be sent to Paradigm Environmental for analysis. A hand-held Geo-XT (or similar) GPS unit will be used to record the locations of confirmatory soil samples.

It is anticipated that soil exceeding Unrestricted Use SCOs will remain along the property boundary, sidewalks, trees, and adjacent buildings. Since some petroleum-impacted soil will be left in-place, other corrective actions such as in-situ remediation, engineering controls and/or institutional controls may be utilized in order to meet final Site cleanup objectives. The anticipated in-situ remediation approach is detailed further in Section 4.0 of this CAP.

2.4 Backfilling the Source Removal Excavation

Excavated areas will be backfilled and compacted with clean, soils previously excavated from the cells, as well as with additional clean material from a DER-approved source. It is assumed that the upper six feet of soil removed can be used as backfill. Compaction will be verified to ensure future redevelopment is not complicated. Upon completion of remedial activities, disturbed areas will be graded with topsoil and seeded.

As the excavation of the cells progresses, backfilling of completed excavations will be conducted concurrently to avoid excessive water infiltration and or slumping of excavation sidewalls. The use of ORC, fertilizers and/or other remedial nutrient mixtures will be considered based on the conditions observed while backfilling is in-progress. Care will be taken to ensure that whatever remedial agents may be added during the backfilling process will not create excessively basic or acidic conditions in the subsurface that could be toxic to indigenous microbial populations. Based on previous experience and available guidance, a pH of between 6 and 8 will be maintained to ensure optimal microbial activity.

The clean material generated from site excavations and the certified-clean backfill material from off site will be placed in the excavation and compacted in 2-foot lifts using vibratory compaction equipment. Special attention to safety of personnel in the excavation while excavation is occurring shall be taken and will include, but not be limited to a flag person observing activities with a clear line of site to all personnel at work. Flag personnel will also be utilized as necessary to ensure safe delivery and departure of equipment and vehicles while work is in progress.

High permeability crushed stone material will be used as backfill in the lower portions of the excavation. This will ensure the maximum permeability of soils within the saturated and vadose zone to facilitate planned in-situ remedial efforts. Preferential use of more permeable backfill materials at depth will also facilitate compaction and help to mitigate future subsidence once restoration has been completed. [Note: The organic content of the backfill material will be considered with regards to its suitability to promote the necessary aerobic activity needed during the in-situ groundwater treatment stage of the cleanup. If necessary, an approved organic amendment may be added to the backfill material].

Once all excavation work is complete, the work area will be rough-graded to the approximate current Site grade such that drilling equipment and in-situ remedial work will not be impeded by rough terrain. Construction fencing will remain to prevent pedestrian access as the project continues after source area removal is complete.

3.0 Groundwater Monitoring Program

Since contaminated groundwater is present, a groundwater monitoring program will be implemented at the Site after the soil source area removal. The effects of the source removal work on groundwater quality will be evaluated by testing groundwater Site monitoring wells. Currently, three (3) groundwater monitoring wells are present at the Site. To the extent feasible, the existing wells will be protected during the soil source removal. If the wells become damaged or are destroyed, the wells will be decommissioned in accordance with NYSDEC guidelines and replacement wells will be installed. A total of six (6) monitoring wells will be present on the Site following the soil source removal. The locations of the additional wells will be determined with the concurrence of the City and the NYSDEC once all remedial excavation has been completed. The results of the evaluation will provide a basis for design and implementation of an in-situ groundwater remediation and monitoring program.

The planned remedial approach will include the use of direct oxygen injection into the overburden and shallow bedrock saturated zone by means of network of injection points. Oxygen will be generated on site using the City of Rochester's Matrix, Inc. oxygen generation and injection system. On-going groundwater monitoring will take place on a quarterly basis for one year to verify groundwater remedial parameters and to confirm that remedial goals are being approached or attained. The design and layout of this system will be as specified in the City's RFP for this project and as warranted by existing Site data, findings and observations during the source removal process and baseline groundwater data to be obtained prior to remedial implementation.

3.1 Installation of Groundwater Monitoring Wells

Assessment of baseline Site groundwater conditions will include a detailed review of existing data supplemented with additional characterization including conditions at the newly installed groundwater monitoring wells. These wells will be installed through the bedrock-overburden interface and will be constructed such that the screened interval will be above the potential highest anticipated groundwater elevations to allow detection of light non-aqueous phase liquids that may be present.

A CME-75 or equivalent drill rig will be mobilized to the Site for the installation of the new permanent groundwater monitoring wells. The permanent wells will be installed in borings advanced using 4.25 ID hollow-stem augers. The borings will be advanced to bedrock refusal. Coring methods will be used to install the wells across the bedrock/overburden interface and at least 5 feet into Site bedrock. Wells will be installed such that well screens extend through the anticipated seasonal range of groundwater elevations at each location.

Pertinent information for the test borings will be recorded in field logs, whereupon portions of information will subsequently be transcribed onto final boring logs. The recorded information will include:

- Date, boring/well identification, and project identification.
- Name of individual developing the log.
- Name of drilling company.
- Drill make and model, auger size, core barrel.
- Identification of alternative drilling methods used and justification thereof (e.g., rotary drilling with a specific bit type to remove a sand plug from within the hollow stem augers).

- Depths recorded in feet and fractions thereof (tenths of inches) referenced to ground surface.
- Standard penetration test (ASTM D-1586) blow counts.
- The length of the sample interval and the percent of the sample recovered.
- The depth of the first encountered water table, along with the method of determination, referenced to ground surface.
- Drilling and borehole characteristics.
- Sequential stratigraphic boundaries.
- Visual and/or olfactory evidence of suspected impact (e.g., unusual odors, staining, etc.).
- Initial PID screening results of split-spoon samples, and/or PID screening results of ambient headspace air above selected samples.

Prior to initiating drilling activities, the rig, augers, rods, split spoons and related equipment will be decontaminated in accordance with the procedures outlined in the QAPP (Appendix D). All decontamination activities will be performed in a designated area and throughout and after the cleaning processes, direct contact between the equipment and the ground surface will be avoided. Plastic sheeting and/or clean support structures (i.e., pallets, sawhorses) will be used. The drilling rig and all equipment will be steam cleaned upon completion of the investigation and prior to leaving the Site. All decontamination fluids and solids will be containerized and profiled for proper disposal.

All permanent groundwater monitoring wells will be constructed according to the following specifications: 10 (or more) feet of 2-inch Schedule 40 polyvinyl chloride (PVC) machine-slotted screen (0.010-inch slot) installed five feet into groundwater followed by 2-inch ID schedule 40 PVC riser casing. A sand filter pack composed of chemically inert, coarse-grained sand will be placed from the bottom of the boring to 1 to 2 feet above the top of the screen. A 2-foot thick bentonite seal will be placed above the sand, followed by Portland cement/5% bentonite grout to surface. The wells will be completed with bolted flush-to-grade man-way well covers set in concrete drainage pads. Vented PVC well caps will be placed on each well upon completion. No glue will be used for completion of wells. Well head elevations will be obtained by Lu Engineers upon completion of well installations.

3.2 Well Development and Hydraulic Conductivity Testing

After construction of each well is complete, it will be developed using disposable PVC bailers or submersible pumps in accordance with well development procedures included in the QAPP. All field instrument measurements made during development will be recorded. The wells will initially be purged in order to draw sediments out of the sand pack and into the well for removal. If significant effort does not attain the proposed goal of 50 NTU, the NYSDEC will be consulted. Records of well development activities will be kept by Lu Engineers. Water generated from the development activities will be containerized for proper disposal.

Once groundwater elevations have stabilized slug testing will be performed on at least three of the Site wells. Aquifer testing will consist of the addition and withdrawal of a slug to determine the hydraulic conductivity and transmissivity of the soils in the immediate vicinity of each well screen. The hydraulic conductivities will be used to help design the groundwater treatment program by helping to determine the ability of oxygenated water to move through the affected areas of the subsurface and facilitate microbial degradation of residual contaminants. Evaluation of these parameters is critical in determining the effective radial influence for an oxygen injection program.

The tests will be performed using the methodology described below:

- Measure and record static water level in well;
- Insert the pre-decontaminated pressure transducer below the surface of the water table to a point that will allow clearance for the solid slug to be inserted. Attach the transducer to a laptop computer with data logging program;
- Insert the solid slug or bailer in the well and allow the well to equilibrate to the initial static level, and;
- Rapidly remove the slug or bailer and begin recording the rising head using the laptop computer as soon as the slug is completely out of the water column within the well.
- Record the rising head until it has returned to at least 90% of its initial static level or no significant change in head is recorded within one hour.

Groundwater depths will be used to prepare a contour map showing the hydraulic gradient and direction of flow at the Site. Aquasolve® and other modeling software will be used to calculate hydraulic conductivities based on the raw data.

3.3 Groundwater Sampling and Analysis

Baseline characteristic groundwater sampling will take place, following well development, but within two (2) weeks of well installation. Groundwater elevations will be measured at each location, which, along with surveyed well head elevations, will be used to determine groundwater flow patterns throughout the Site. Low-flow purging and sampling procedures to be utilized are outlined below:

- Prior to purging and sampling, static water level measurements will be taken from each well using an oil/water interface meter. Visual observations of LNAPL on the oil/water interface meter, if any, will be recorded.

- In order to minimize the potential re-suspension of solids in the bottom of the well, well construction depths will not be measured prior to or during low-flow purging and sampling. Well depth information will be obtained from: 1) measurements collected during well development; 2) from well logs; or 3) will be measured after sampling is completed.

- A portable bladder pump connected to new disposable polyethylene tubing will be lowered and positioned at or slightly above the mid-point of the well screen when the screened interval is set in relatively homogeneous material. When the screened interval is set in heterogeneous materials, the pump will be positioned adjacent to the zone of highest hydraulic conductivity (as defined by geologic samples). Care will be taken to install and lower the bladder pump slowly in order to minimize disturbance of the water column.

- The pump will be connected to a control box that is operated on compressed gas (nitrogen, air, etc.) and is capable of varying pumping rates. An in-line flow-through cell attached to a Horiba U-22 water quality meter (or similar equipment) will be connected to the bladder pump effluent tubing to measure water quality data.

- The pump will be started at a pumping rate of 100 ml/min. or less (for pumps that cannot achieve a flow rate this low, the pump will be started at the lowest pump rate possible). The water level in the well will be measured and the pump rate will be adjusted (i.e., increased or decreased) until the drawdown is stabilized. In order to establish the optimum flow-rate for purging and sampling, the water level in the well will be measured on a periodic basis (i.e., every one or two minutes) using an electronic water level meter or an oil/water interface meter. When the water level in the well has stabilized the water level measurements will be collected less frequently.

While purging the well at the stabilized water level, water quality indicator parameters will be monitored on a three to five minute basis with a Horiba U-22 water quality meter (or similar equipment). Water quality indicator parameters will be considered stabilized after three consecutive readings for each of the following parameters are generally achieved:

- pH (± 0.1);
- Specific conductance (±3%);
- Dissolved oxygen (±10 % for values greater than 0.5 mg/L);
- Oxidation-reduction potential (±10 mV);
- Temperature (±3%); and

- Turbidity (± l0%, for values greater than 5 NTUs)

Following stabilization of the water quality parameters, the flow-through cell will be disconnected and a groundwater sample will be collected from the bladder pump effluent tubing. The soluble samples require collection in the field through a 0.45-micron filter media. The pumping rate during sampling will remain at the established purging rate or it may be adjusted downward to minimize aeration, bubble formation, or turbulent filling of sample containers. A pumping rate below 250 ml/min will be used when collecting VOC samples.

The procedures and equipment used during the purging and groundwater sampling and the field measurement data will be documented in the field and recorded on Monitoring Well Sampling Logs.

One (1) groundwater sample from each well will be submitted for analytical laboratory testing by Paradigm Environmental for the following parameters:

- Volatile Organics – EPA 8260
- Biological and Chemical Oxygen Demand
- Total Organic Carbon (TOC)
- Dissolved Iron
- Bio-Trap (Microbial Insight Resources®) Benzene Degrading Bacteria

Laboratory analytical results for the groundwater samples will be compared to groundwater standards and guidance values as referenced in the NYSDEC Division of Water Technical and Operational Guidance Series 1.1.1 document titled *"Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations"* (TOGS 1.1.1) dated June 1998 (as amended by an April 2000 addendum).

3.4 Post Source Removal Well Monitoring-Derived Wastes

Post source removal groundwater monitoring well development and sampling investigation derived wastes (IDWs), (soil cuttings, development water, purge water, etc.) will be containerized in New York State Department of Transportation approved drums. IDW streams will be sampled, analyzed and profiled for appropriate disposal by a NYSDOH ELAP-certified analytical laboratory. IDWs will be disposed of after the appropriate handling and shipping methods are identified.

4.0 Remedial System Design

Post soil source removal groundwater treatment will be necessary in order to reduce residual groundwater contaminant levels to below NYSDEC groundwater standards. The planned remedial approach will include the use of direct oxygen injection into the overburden and shallow bedrock saturated zone by means of network of injection points. Oxygen will be generated on site using the City of Rochester's Matrix, Inc. oxygen generation and injection system. On-going groundwater monitoring will take place on a quarterly basis for the first year to verify groundwater remedial parameters and that remedial goals are being approached or attained. If additional monitoring is deemed necessary after the first year, bi-annual monitoring may be implemented. The design and layout of this system will be developed based on existing Site data, findings and observations during the source removal process and the baseline groundwater data. Appropriate engineering controls, institutional controls, or a combination of these approaches will also be instituted to address post-source removal groundwater contamination.

Identification of the contaminant mass remaining on the Site is a critical remedial system design element. A general rule of thumb used by various regulators and remedial managers is that oxygen must be made accessible to microbial populations at an approximate 3 to 1 ratio of available oxygen versus contaminant mass. While dissolved oxygen (DO) groundwater concentrations of up to 50 ppm are attainable, more realistic concentrations are likely to be closer to 10 ppm within the treatment area. Alternating injection points being used at a given time, varying injection rates and other system adjustments all help to maximize the mass of oxygen introduced into the groundwater and vadose zone.

Flow rates, injection pressures and the calculated total mass of oxygen necessary to degrade the residual contaminant mass at the Site will need to be used to determine the size design, number and placement of actual elements of the oxygen injection system. The final system design will be approved by both the City and NYSDEC and in general, the system design will be designed as follows:

- Injection points will be installed in across the affected area of the Site as determined by the groundwater baseline sampling program. Each point will be constructed as a vertical well using ¾-inch diameter schedule 40 PVC piping with a 1-foot section of micro porous screen at the bottom. The injection points will be installed using rotary drilling methods and will extend approximately 1 to 2 feet into Site bedrock. The wells will be completed with silica sand and a bentonite seal and will be manifolded to the oxygen generator using ½-inch diameter, 125 psi HDPE tubing. A special auger cutting head, the "Good Earth" bit, will be used to facilitate bedrock penetration. Supply tubing will be direct-buried in shallow trenches approximately 24-30 inches below grade. Hoses will be buried in a configuration as to minimize the amount of trenching and hose needed for the implementation. Common trenches will be used for multiple hoses as necessary.

All injection points will be completed with 8-inch diameter flush-mounted curb boxes set in 16-inch diameter concrete pads. The injection points will be accessible for use as groundwater monitoring points and will be fitted with a screw-down well plug at each location. Connections to the oxygen supply tubing will be configured with PVC threaded tee, barbed hose connection and clamp. For estimating purposes, it is assumed that a total of 24 or more oxygen injection points will be needed to adequately access the affected groundwater and vadose zone underlying the Site.

- Oxygen injection will be controlled from the injection system to be located at the Site. This system is equipped with all necessary pressure and flow adjustment capabilities to ensure that injection design criteria are met. Lu Engineers will coordinate and contract for the installation of an appropriate electrical service to supply power to the oxygen generator and injection system. The system will be configured in such a way as to facilitate preferential injection pressures at any given point, or set of points. The system will be set up to be as automated as possible to allow for example, the alternate pressurization of various points or sets of points at a predetermined time setting.

- System maintenance logs will be prepared to record operational status on a daily basis at startup. Weekly monitoring will be conducted for the first quarter. Bi-weekly system monitoring will be conducted for each following quarter up to one year. Based on similar projects, it is anticipated that approximately 95% of the contaminant mass will be removed within the first year. Lu Engineers will consult with the City of Rochester and NYSDEC as appropriate after one year of injection to determine the most appropriate course of action following the injection program. Site restoration will include rough grading topped with six inches of topsoil and then hydro seeded.

5.0 Health and Safety Plan

A site-specific health and safety plan (HASP) for the Site is included in Appendix B. The HASP outlines the policies and procedures necessary to protect workers and the public from potential environmental hazards posed during this project's activities at the Site.

6.0 Public Information Plan

A Public Information Plan (PIP) for the project is included in Appendix C. The PIP outlines the Site cleanup plans, and lists City, State and contractor project contacts to allow neighborhood concerns to be vocalized and addressed as they arise. Progress meetings will be convened throughout the cleanup process. All documentation regarding the project scope, including the remedial design, will be placed in the project document repository, and will be distributed at public meetings. Project updates will also be available through the City's Project Web Site (http://www.cityofrochester.gov/article.aspx?id=8589950995).

7.0 Quality Assurance Project Plan

As part of this CAP, Quality Assurance Project Plan (QAPP) protocols and procedures have been developed in accordance with the USEPA Region 2 Site Specific Brownfields guidance, and will be used during this project. An EPA Site-Specific Brownfields QAPP is included as Appendix D.

7.1 Operation and Calibration of On-Site Monitoring Equipment

Volatile vapor monitoring will be conducted using a PID. It is anticipated that a MiniRAE 3000 PID equipped with a 10.6 eV lamp, or equivalent, will be used during this project. The PID will be calibrated in accordance with the manufacturer's specifications using an isobutylene gas standard prior to use and as necessary during fieldwork. Measurements will be collected in accordance with the protocols outlined in the HASP.

Particulate monitoring will be conducted using a Dustrak particulate meter (or similar). The particulate meter will be calibrated prior to use and as necessary during fieldwork in accordance with the manufacturer's specifications. Measurements will be collected in accordance with the protocols outlined in the HASP and CAMP.

Other miscellaneous field equipment that may be used during this project includes:

- an electronic static water level indicator;
- a global positioning system (GPS);
- survey equipment;
- an oil/water interface meter;
- a particulate meter; and
- a Horiba U-22 water quality meter.

These meters will be calibrated, operated, and maintained in accordance with the manufacturer's recommendations.

7.2 Record Keeping

Lu Engineers will document project activities in a bound field book on a daily basis. Information that will be recorded in the field book will include:

- Dates and time work is performed;
- Details on work being performed;
- Details on field equipment being used;
- Visual and olfactory observations during monitoring activities;
- PID meter and particulate meter measurements collected during monitoring activities;
- Excavation and sampling locations and depths;
- Soil removal excavation measurements;
- Personnel and equipment on-site;
- Weather conditions; and
- Other pertinent information as warranted.

Additionally, Lu Engineers will record information from test borings and groundwater monitoring wells on designated logs. Well development data and well sampling data will also be presented on well development logs and well sampling logs, respectively.

7.3 Sampling and Laboratory Analysis Protocol

During sampling activities, personnel will wear disposable latex gloves. Sample personnel will discard used latex gloves and put on new gloves to preclude cross-contamination between samples.

New laboratory-grade sample containers will be used to collect soil and groundwater samples. Sufficient volume (i.e., as specified by the analytical laboratory) will be collected to ensure that the laboratory has adequate sample to perform the specified analyses

Samples will be preserved as specified by the analytical laboratory for the type of parameters and matrices being tested. Sample holding times and preservation protocols will be adhered to during this project. Analytical laboratory test results for soil samples will be reported on a dry-weight basis. Laboratories will analyze the samples using the lowest practical quantization limits (PQLs) possible.

Samples that are collected for subsequent testing as part of this project will be handled using chain-of-custody (COC) control. COC documentation will accompany samples from their inception to their analysis, and copies of COC documentation will be included with the laboratory's report. The COC will include the date and time the sample was collected, the sample identity and sampling location, and the requested analysis.

The analytical laboratory test results for confirmatory soil samples and groundwater monitoring samples will be reported in NYSDEC ASP Category B deliverable reports. The laboratory that performs the ASP analyses will provide internal quality assurance/quality control (QA/QC) data that are required by NYSDEC ASP protocol, such as analyses performed on method blanks, and surrogate recovery results.

QA/QC samples will be included as part of this project and will be collected in accordance with the requirements of the USEPA Region 2 Site Specific Brownfield Quality Assurance Project Plan (QAPP) (refer to Table 1 in Appendix D):

Eric Detweiler will be the quality assurance officer (QAO) that is responsible for the QAPP on this project.

7.4 Decontamination Procedures

In order to reduce the potential for cross-contamination of samples collected during this project, the following procedures will be implemented to ensure that the data collected (primarily the laboratory data) is acceptable.

It is anticipated that most of the materials used to assist in obtaining samples will be disposable one-use materials (e.g., sampling containers, bailers, rope, pump tubing, latex gloves, etc.). When equipment must be re-used (e.g., static water level indicator, oil/water interface meter, drilling equipment, etc.), it will he decontaminated by at least one of the following methods:

- Steam clean the equipment; or
- Rough wash in tap water; wash in mixture of tap water and Alconox-type soap; double rinse with deionized or distilled water; and air dry and/or dry with clean paper towel.

Split spoons and other re-usable equipment will be decontaminated between each use. When deemed necessary, a temporary decontamination pad will be constructed for decontamination of equipment. Decontamination rinseate will be containerized, sampled and discharged to the Monroe County sewer or disposed of off-Site as necessary. Any decontamination pad will be removed following completion of associated activities. Disposable materials and personal protective equipment (PPE) will be containerized in NYSDOT-approved 55-gallon drums and staged on-site. Once a proper disposal method is determined, these materials will be disposed of in accordance with applicable regulations.

8.0 Remedial Construction Closure Report

A Remedial Construction/Closure Report will be developed for the project and a draft report will be submitted for review and comment by the NYSDEC after the source removal and one round of groundwater monitoring has been performed. The report will be prepared in accordance with Section 5.8 of DER-10 and any other contractual requirements. The report will include the following:

- A description of remedial activities;
- A data usability summary report (DUSR) for final delineation samples (i.e., closure samples);
- Drawings showing all remedial work;
- Site survey map with metes and bounds description. The limits of excavation, sample locations, well locations and remedial system components will be reported using the US State Plain 1983 (New York Western Zone);
- Description of any institutional controls;
- Environmental easement, if required; and;
- Site Management Plan for future development, if required, and;
- NYSPE Certification.

After one year of operation of the groundwater remediation system, a separate groundwater report will be completed.

9.0 Environmental Management Plan

Subsequent to completing the soil source removal and disposal work, an Environmental Management Plan (EMP) will be developed for the Site. The purpose of the EMP is to address the handling, management, disposal or re-use of impacted soil, fill material and groundwater remaining in the subsurface at the Site. Specifically, the EMP will address how to identify, characterize, handle, and dispose or re-use these media during construction or post-development activities. The EMP will establish goals, procedures, and appropriate response actions to be used by on-site personnel should petroleum contaminated soil, fill material, or groundwater be encountered and disturbed.

The plan will be prepared in accordance with NYSDEC guidance and will follow the general template established by the Department. The following list contains the minimum information required to be included within a Soil and Groundwater Management Plan as recommended by the NYSDEC Region 8 Spills Unit:

- A brief description/ summary of what was at the site (tanks, pumps, etc) and what remedial work was already done at the site;
- A data summary table which includes historic and current contaminant levels for both soil and groundwater must be included;
- A site diagram which identifies soil boring/ sample locations, monitoring well locations and the known limits of the contaminant plume;

- A brief description of geology and groundwater flow direction;
- What type of monitoring should be performed if in the future, site work will be taking place in the vicinity of the residual contamination;
- Mentioning that DEC Spills Unit must be notified should the residual contamination be encountered;
- Who will be responsible for that contamination should it be Disturbed/ encountered;
- An outline of how the material should be handled if it is encountered in the future;
- What follow up sampling should be performed;
- Mention how contaminated materials must be properly handled and properly disposed of or treated;
- An appropriate site health and safety plan should be developed for any excavation/ dewatering activities conducted in the suspected areas of contamination to protect worker safety. The responsibility for the HASP exists with the party(ies) conducting the excavation/ dewatering activities.

9.1 Engineering Controls

In order to mitigate exposure pathways to future residential occupants at the Site, the EMP will include engineering controls (ECs) to be incorporated into the redevelopment of this Site. The purpose of the ECs is to preclude the following contaminant exposure pathways:

- surface soil inhalation, ingestion, and dermal contact;
- soil volatilization to indoor air; and,
- groundwater volatilization to indoor air.

Detailed development plans for the Site have not been developed. However, it is anticipated that the redevelopment of the Site will include both green/recreational space and/or commercial expansion with a mixed use commercial facility and residential housing consistent with other development within the Center City District (CCD).

The following ECs are anticipated for the Site; however, the actual ECs will depend on confirmatory soil sampling results, post-removal groundwater sampling results, and actual redevelopment design plans.

- In order to preclude exposure pathways to future Site occupants depending upon the specific building design, it is anticipated that the first floor of the building(s) will be underlain with an active soil venting system and an associated vapor barrier (vapor barrier venting system). Once redevelopment plans are made available, detailed engineering calculations, equipment and material specifications and construction drawings (including a site plan, notes, details, etc.) associated with the vapor barrier venting system would be provided to the City and regulatory agencies for review and comment. Any sub-slab depressurization system (SSDS) and operation of the SSDS would be done in accordance with NYSDOH guidelines.

- The Site will be covered by the building(s), paved surfaces or a layer of "clean" soil/select fill to preclude direct exposure to underlying existing fill material at the Site that may contain elevated concentrations of petroleum contamination.

9.2 Institutional Control

As an institutional control (IC), the Site will be "flagged" in the City's building information system so that environmental conditions are evaluated and addressed prior to issuing new permits that involve potentially disturbing contaminated materials. The process identifies environmental conditions at the Site and ensures that the existing environmental conditions are considered prior to issuing a permit. Furthermore, the process ensures that the proposed permit action does not result in disturbances to the planned ECs, and that the proposed permit does not result in an unacceptable exposure to Site contamination by on-site construction workers, on-site occupants or the nearby community. This process also allows regulatory agencies the opportunity to require:

1. Implementation of a site-specific health and safety plan or environmental management plan for the proposed work;
2. Modifications to environmental monitoring points; and
3. Modifications to ECs; etc. prior to issuing the permit.

10.0 CAP Schedule

The project schedule is currently being developed. The anticipated start date is August 13, 2012. It is anticipated that the excavation process will require two (2) weeks to complete. Wells and remedial equipment will be installed once the backfilling process is completed. The In-situ portion of the project will require approximately one year to complete.

The schedule for development of an EMP, ECs and IC is dependent upon variables such as the availability of actual redevelopment plans, etc.

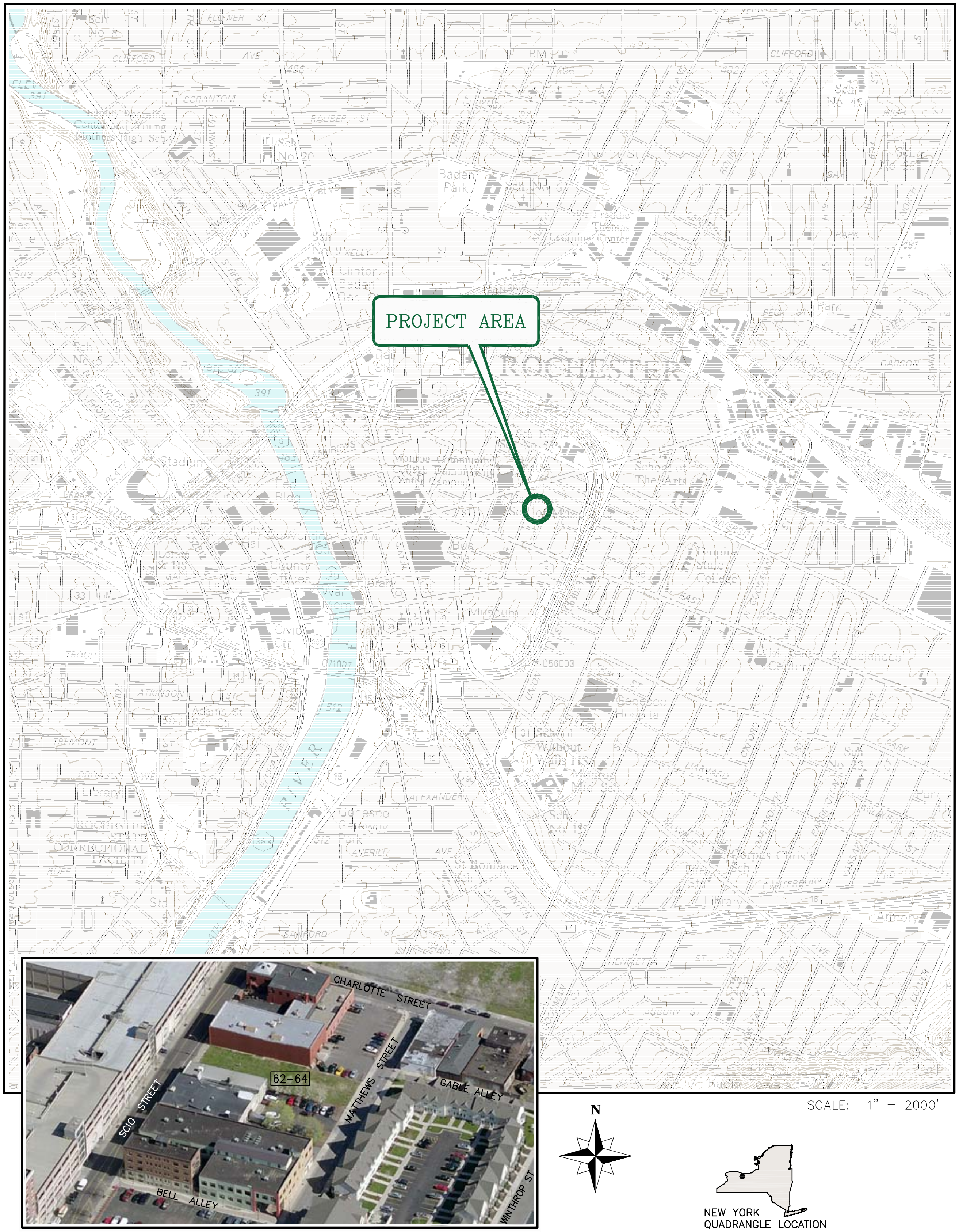
The first round of post-source removal groundwater monitoring results will be included in the remedial construction/closure report. Subsequent rounds of post-source removal groundwater monitoring results will be provided in monitoring reports.

11.0 Abbreviations

ASP	Analytical Services Protocol
ASTM	American Society for Testing and Materials
BOD	Biological Oxygen Demand
CAMP	Community Air Monitoring Plan
CAP	Corrective Action Plan
City	City of Rochester
COC	Chain of Custody
COD	Chemical Oxygen Demand
LU ENGINEERS	Lu Engineers Environmental, Inc.
EC	Engineering Control
ELAP	Environmental Laboratory Approval Program
EMP	Environmental Management Plan
GPS	Global Positioning System
I-IASP	Health and Safety Plan
HS A	Hollow Stem Auger
IC	Institutional Control
I.D.	Inner Diameter
BP	Lead-Based Paint
LNAPL	Light Non-Aqueous Phase Liquid
MSIMSD	Matrix Spike/Matrix Spike Duplicate
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
Paradigm	Paradigm Environmental Services, Inc.
Phase I ESA	Phase I Environmental Site Assessment
Phase IS ESA	Phase II Environmental Site Assessment
PID	Photoionization Detector
PPE	Personal Protective Equipment
PPM	Parts Per Million
PQL	Practical Quantization Limit
PVC	Polyvinyl Chloride
QAQC	Quality Assurance1 Quality Control
REC	Recognized Environmental Condition
RSCO	Recommended Soil Cleanup Objective
SACM	Suspect Asbestos Containing Material
SCG	Standards, Criteria and Guidance
STARS	Spill Technology and Remediation Series
SVOC	Semi-volatile Organic Compound
TAGM	Technical and Administrative Guidance Memorandum

TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compounds
TPH	Total Petroleum Hydrocarbons
TOGS	Technical and Operational Guidance Series
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound

FIGURES



SCALE: 1" = 2000'

N

NEW YORK
QUADRANGLE LOCATION

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FIGURE 1. SITE LOCATION MAP

CITY OF ROCHESTER | BROWNFIELD SITE CLEAN-UP
62–64 SCIO STREET
ROCHESTER – MONROE COUNTY – NEW YORK

DATE:	JANUARY 2012
SCALE:	1:24,000
DRAWN BY:	DLS

MAP SOURCE: NYS DOT RASTER QUADRANGLES – ROCHESTER WEST & ROCHESTER EAST / NEW YORK, MONROE COUNTY DOT EDITION DATE: 1997 / USGS CONTOUR DATA: 1971. 2009 MICROSOFT CORPORATION, 2009 NAVTEQ AND 2009 PICTOMETRY INTERNATIONAL CORP.

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FIGURE 2. SITE PLAN (AERIAL)

CITY OF ROCHESTER | BROWNFIELD SITE CLEAN-UP
62-64 SCIO STREET
ROCHESTER – MONROE COUNTY – NEW YORK

DATE:	JANUARY 2012
SCALE:	1" = 40'
DRAWN BY:	DLS

MAP SOURCE:
NEW YORK STATE GIS CLEARINGHOUSE
NYSDOP HIGH RESOLUTION IMAGERY 2000 – 2010

DESIGNED BY	DATE	DRAWN BY	DATE DRAWN	SCALE	DATE ISSUED
GLA	07-2012	CAC/JSB	07-2012	1 inch = 20 feet	07-20-2012 REV. 8/8/12

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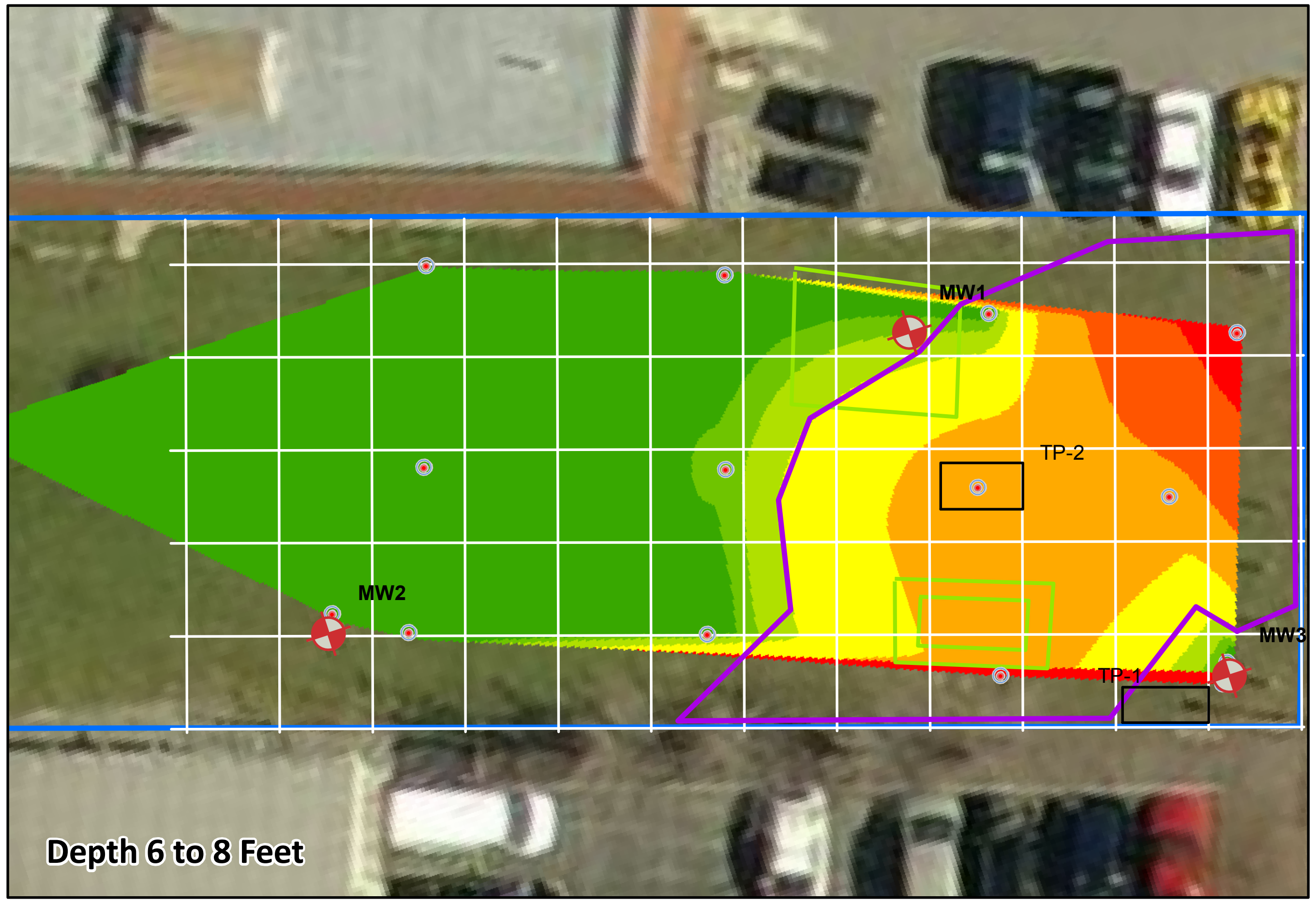
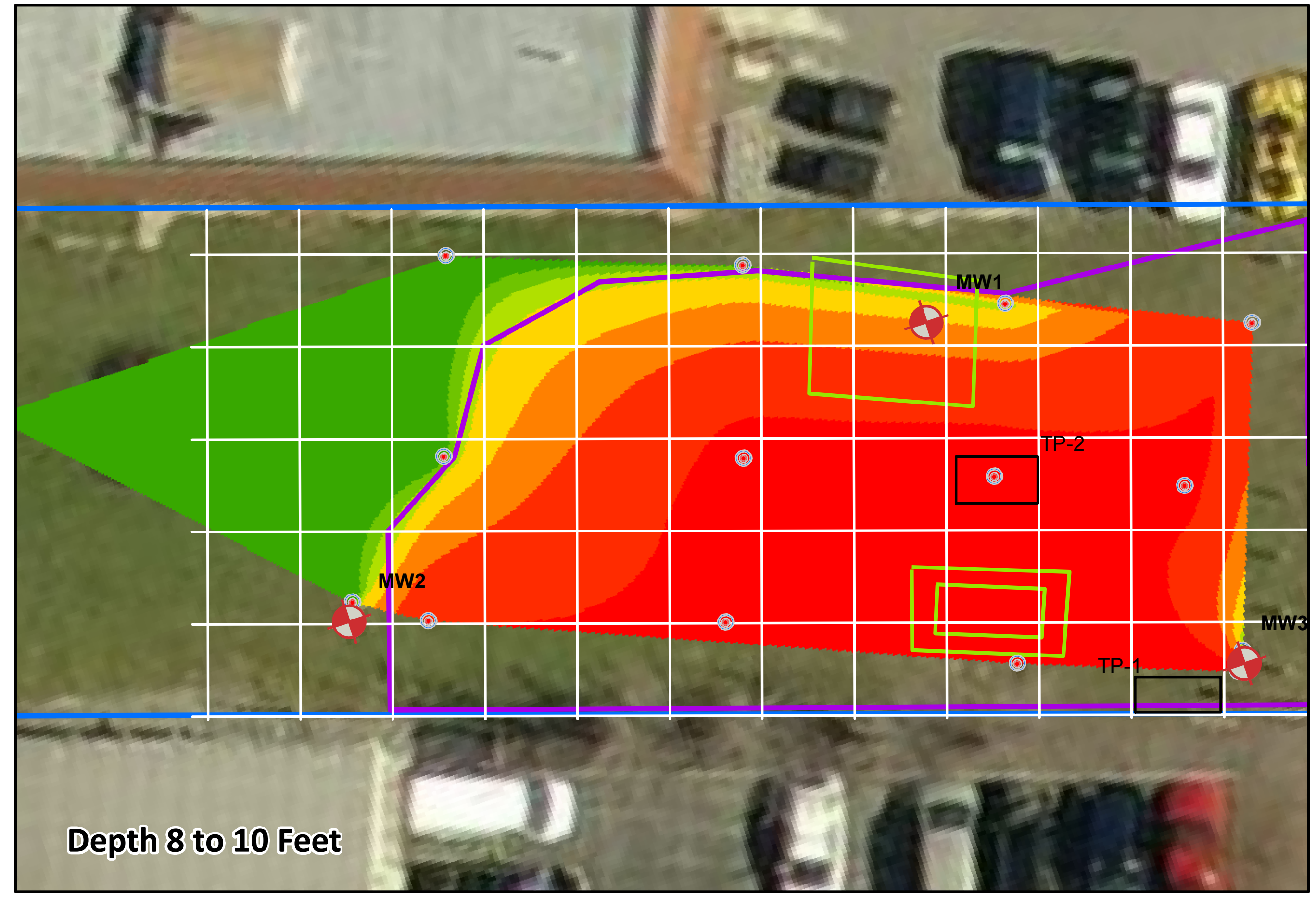
175 Sullys Trail, Suite 202
Pitsford, New York 14534

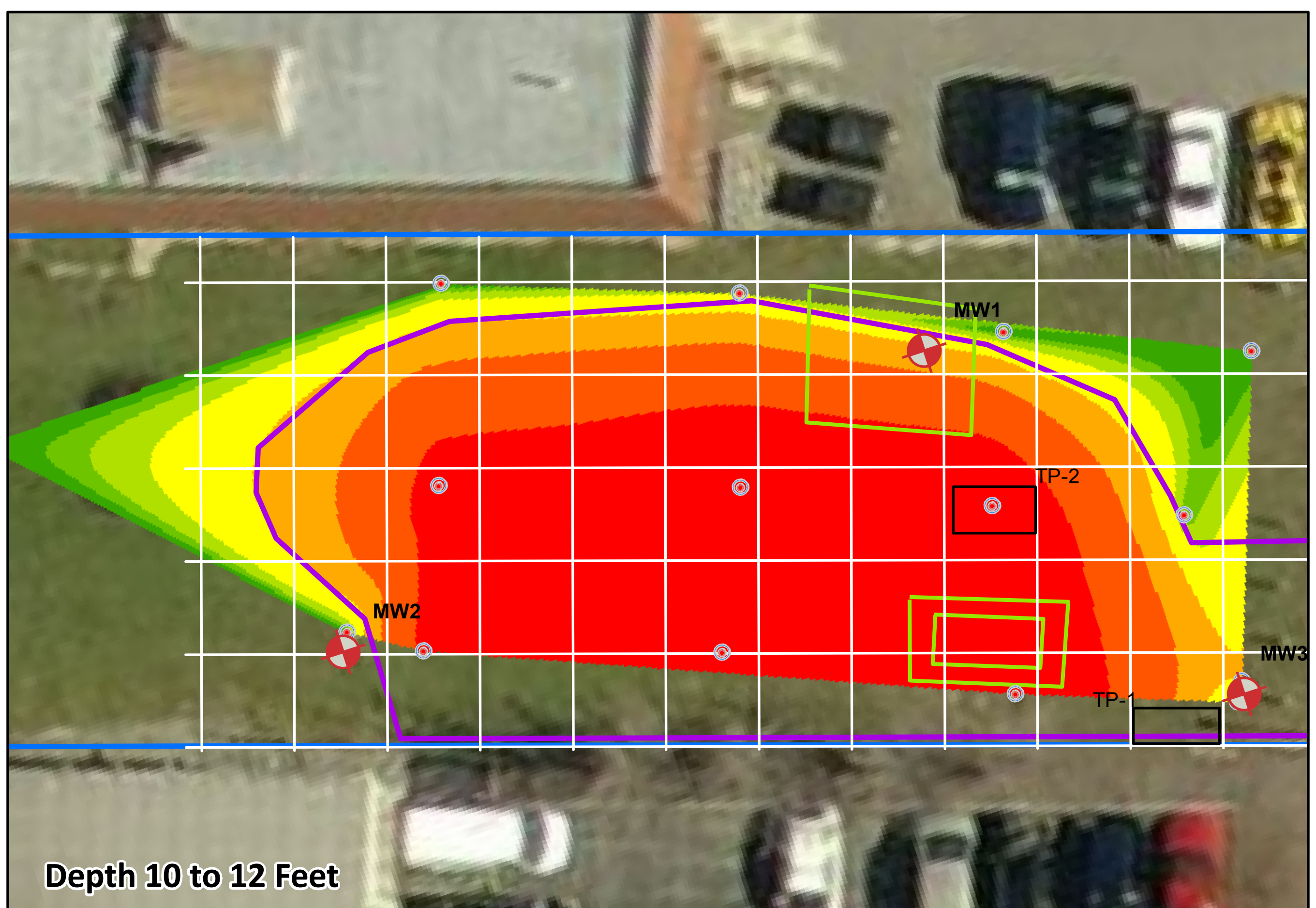
PROJECT TITLE

BROWNFIELD SITE CLEAN-UP
62-64 SCIO STREET
CITY OF ROCHESTER, MONROE COUNTY

FIGURE 3
SITE LAYOUT AND EXCAVATION SEQUENCING







LEGEND

- MONITORING WELL
- GEOPROBE
- EXCAVATION GRID
- FORMER UST & EXCAVATIONS
- PARCEL
- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 250
- 250 - 500
- 500 - 1,000
- 1,000 - 1,250

NOTE:
Excavation limits determined through the use of PID data.

DESIGNED BY	DATE	DRAWN BY	DATE DRAWN	SCALE	DATE ISSUED
GLA	07-2012	JSB/CAC	07-2012	1 inch = 20 feet	07-31-2012

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PROJECT TITLE

BROWNFIELD SITE CLEAN-UP
62-64 SCIO STREET
CITY OF ROCHESTER, MONROE COUNTY

FIGURE 4
PROPOSED SOURCE AREA REMOVAL (BY DEPTH)

APPENDIX A

Community Air Monitoring Plan

New York State Department of Health
Generic Community Air Monitoring Plan

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for volatile organic compounds (VOCs) and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate NYSDEC/NYSDOH staff.

Continuous monitoring will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

Periodic monitoring for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should 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 at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

- If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 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 5 ppm over background for the 15-minute average.

- If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

All 15-minute readings must be recorded and be available for State (DEC and DOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should 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 must 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 (mcg/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 must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m_3 above the upwind level and provided that no visible dust is migrating from the work area.

- If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m_3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m_3 of the upwind level and in preventing visible dust migration.

All readings must be recorded and be available for State (DEC and DOH) personnel to review.

Source: DRAFT DER-10 Technical Guidance for Site Investigation and Remediation, December 2002- Appendix 1A

Scio Street Petroleum Contaminated Soil Removal - City of Rochester

Community Air Monitoring Daily Log

Date: ______________

				Time	
Site Representative:	______________			**On-Site:** ______	**Off-Site:** ______
Appr. Wind Direction:	______________	**Appr. Wind Speed:**	__	**On-Site:** ______	**Off-Site:** ______
Weather Conditions:	______________			**On-Site:** ______	**Off-Site:** ______

Description of Daily Work Tasks:

Action Level Exceedance:	**None**	**Yes**: (description)

Notes:

Action Level: Downwind particulate level that exceeds the upwind particulate level by 100 ug/m3. If the action level is exceeded, the Site Representative will imediately notify the Site Safety Officer.

Action Level: Downwind VOC levels exceed upwind VOC levels. If action level exceeded, the Site Representative will immediately notify the Site Safety Officer implement minor or major emission monitoring.

	Particulates (ug/m^3)					Volatile Organic Compounds (VOCs) (ppm)			
		Upwind	**BZ**	**Downwind**			**Upwind**	**BZ**	**Downwind**
Time 0730									
0745									
0800									
0815									
0830									
0845									
0900									
0915									
0930									
0945									
1000									
1015									
1030									
1045									
1100									
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1615									
1630									

APPENDIX B

Health and Safety Plan

Brownfield Cleanup Program
USEPA Assistance ID No. BF97219700

62-64 Scio Street
Rochester, New York 14604

HEALTH AND SAFETY PLAN

Prepared For:

City of Rochester
Department of Environmental Services
Division of Environmental Quality
30 Church Street, Room 300B
Rochester, New York 14614

Prepared By:

Lu Engineers
ENVIRONMENTAL • TRANSPORTATION • CIVIL

175 Sully's Trail, Suite 202
Pittsford, New York 14534

August 2012

Lu Project No: 4226

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HEALTH AND SAFETY PLAN

A. GENERAL INFORMATION

Project Title: 62-64 Scio Street
Monroe County, New York
Corrective Action Plan
USEPA Assistance ID No. BF97219700

Project Manager: Jane MH Forbes (City) Project Manager: Greg Andrus (Lu Engineers)

Location: 62-64 Scio Street
City of Rochester, Monroe County, New York

Prepared by: City DEQ/ Lu Engineers Date Prepared: July 2012
Date Revised: ______
Approved by: ______ Date Approved: ______

Site Safety Officer Review: ______ Date Reviewed: ______

Introduction:
The Project is being performed as part of the City of Rochester's (City's) 2010 Brownfield Cleanup Grant from the United States Environmental Protection Agency (EPA). Lu Engineers and the City prepared this Health and Safety Plan (HASP) to outline the policies and procedures to protect workers and the public from potential environmental hazards during the Corrective Action described in the Corrective Action Plan (CAP). The Project will be conducted under a Stipulation Agreement between the City of Rochester (City) and the New York State Department of Environmental Conservation (NYSDEC). The Site is comprised of a 0.25 acre parcel addressed as 62-64 Scio Street, City of Rochester, County of Monroe, New York (Site). Figure 1 included in the work plan depicts the general Site location.

Scope/Objective of Work:
Soil removal and off-Site disposal combined with In-Situ Groundwater Treatment through Direct Oxygen Injection will be used to remediate the Site. These methods are proven remedial methods that will immediately and permanently remove significant petroleum-contaminated soils, followed by biodegradation of organic contaminants, such as petroleum hydrocarbons, via oxygen injection. The Oxygen Injection system is designed to remediate groundwater preset in the overburden and within the upper 5 feet of bedrock. The oxygen injection does not require groundwater extraction and/ or off-Site treatment, and disposal does not generate any vapors or odors.

Proposed Date of Field Activities: August 2012 through September 2013

Background Information: [X] Complete [ ] Preliminary (limited analytical data)

Overall Chemical Hazard:	[ ] Serious	[X] Moderate
	[ ] Low	[ ] Unknown
Overall Physical Hazard:	[ ] Serious	[X] Moderate
	[ ]Low	[ ] Unknown

B. SITE/WASTE CHARACTERISTICS

Waste Type(s):

[X] Liquid [X] Solid [X] Sludge [X] Gas/Vapor

Characteristic(s):

[ ] Flammable/Ignitable [X] Volatile [ ] Corrosive [ ] Acutely Toxic
[ ] Explosive (moderate) [ ] Reactive [X] Carcinogen [ ] Radioactive
Other: ____________________

Physical Hazards:

[X] Overhead [X] Confined Space [X] Below Grade [X] Trip/Fall
[X] Puncture [ ] Burn [X] Cut [ ] Splash
[X] Noise [X] Other: Heat Stress

Site History/Description and Unusual Features:

The Site is located in the City's desirable East End District. A 22,000 square-foot, two-story, brick building was constructed around 1920. The building was mainly used as a warehouse from the date of construction until approximately 1990. The City took ownership of the property in 1996, and the building was demolished in November 2002. The Site has remained vacant since demolition.

A Phase I Environmental Site Assessment (ESA) was completed in 1995 and identified recognized environmental conditions due to the presence of petroleum underground storage tanks (USTs). An abandoned UST was removed in 2002. An abandoned 5,000 gallon UST was removed in 2003, following building demolition. This tank contained a mixture of gasoline and oil. Petroleum contaminated soil was observed underneath the tank and a soil sample was obtained for testing. Spill file # 027052 was opened for this Site. In 2004, a groundwater monitoring well was installed adjacent to the former tank location and groundwater sampled showed gasoline related volatile organic compounds (VOCs) including benzene, ethylbenzene, toluene, and xylene exceeding NYSDEC groundwater quality standards. Another abandoned 2,000 gallon UST suspected of containing gasoline was removed. A total of 30.27 tons of grossly contaminated soil was removed during the tank excavation and disposed of off-Site at a permitted landfill. Upon observation of contaminated soil, NYSDEC Spill File # 0650898 was generated for the Site.

Following closure of the USTs, a subsurface investigation was completed to evaluate subsurface conditions at the Site. A total of 14 test borings were advanced using direct-push drilling in October 2006. The test borings were advanced to depths of 9-14 feet below ground surface when refusal, presumed to be top of bedrock, was encountered. Nine of the fourteen test borings had PID readings exceeding 1,000 ppm and petroleum related odors were observed in most wells.

In 2007, two additional bedrock interface groundwater wells were installed to further evaluate groundwater flow direction groundwater contamination. One well was installed in close proximity to a former UST, and contained groundwater exceeding applicable regulatory levels for VOCs. The other well was installed 95 feet west, and did not contain detectable levels of VOCs.

Locations of Chemicals/Wastes: Soil and groundwater.

Estimated Volume of Chemicals/Wastes: There is an estimated volume of 700 tons of petroleum impacted soil in an area encompassing approximately 5,000 square feet at depths ranging from 8-12 feet below ground surface. The average thickness of contaminated soil is around 2 feet.

Site Currently in Operation: [ ] Yes [X] No [ ] Not Applicable

C. HAZARD EVALUATION

HAZARD EVALUATION:	
HAZARD(S)	**HAZARD PREVENTION**
General physical hazards associated with soil removal operations including excavation equipment (excavator, dump trucks), excavation safety, sloping/sidewall stability, slip/trip/fall. Also well installation safety including drill rig and geoprobe operations (overhead equipment, spinning augers, noise, drill rig movement).	Hard hats, eye protection, and steel-toed boots required at all times. Keep safe distance from excavation sidewalls, heavy equipment, machines and all moving parts. Only operator and helper are to be in "work zone". Do not enter excavations to screen soil or obtain soil samples.
Contact with or inhalation of contaminants, potentially in high concentration, in subsurface media	Direct reading instruments and/or olfactory indications will be used to monitor airborne contaminants. Respiratory protection will be used as appropriate. Standard safety procedures such as restricting eating, drinking, and smoking to the support zone and utilizing proper personal decontamination procedures will minimize ingestion as a potential route of exposure. Vapor suppression techniques may be implemented, as necessary.
Utilities (above and underground)	Identify location(s) prior to start of work, maintain 25-foot minimum distance to overhead utilities.
Slip/ trip/ fall	Observe terrain and equipment while walking to minimize slips and falls. Steel-toed boots provide additional support and stability. Use adequate lighting. Wear hard hat. Inspect all lifting equipment prior to use. Be aware of open excavation areas.
Back strain and muscle fatigue, ergonomic stress due to lifting	Use proper lifting techniques and limit load to prevent back strain. Lift with legs when possible.
Noise	Engineering controls will be used to the extent possible. Hearing protection will be made available to all workers on Site. Exposure to time-weighted average levels in excess of 85 dBA is not anticipated.
Heat/Cold stress	Implement heat/cold stress management techniques such as shifting work hours, increasing fluid intake, and monitoring employees**. See Appendix A.**
Sunburn	Apply sunscreen, and wear appropriate clothing.
Weather Extremes	Establish Site-specific contingencies for severe weather situations. Discontinue work in severe weather, including lightening.
Native wildlife presents the possibility of insect bites and associated diseases	Avoid wildlife when possible. Use insect repellant.

Compound	Exposure Limits (TWA)			Dermal Hazard (Y/N)	Route(s) of Exposure	Acute Symptoms	Odor Threshold/ Description	PID	
	OSHA PEL	NIOSH REL	IDLH					Relative Response	Ioniz. Poten. (eV)
Acetone	1000 ppm	250 ppm	500 ppm	Y	Inh, Ing, Con	Irritation to eyes, nose, or throat, skin, skin burns, loss of coordination and equilibrium	Sharp penetrating odor, mint like	140	9.69
Benzene*	1 ppm	0.1 ppm	500 ppm	Y	Inh, Abs, Ing, Con	Irritation to eyes, skin, nose, respiratory system; headache, nausea, dizziness, drowsiness, unconsciousness, harmful, fatal if aspirated into lungs	Colorless to light yellow liquid, sweet aromatic odor	200	9.24
Ethylbenzene	100 ppm	---	100 ppm	Y	Inh, Ing, Con	Irritation to eyes, skin, mucous membranes; dermatitis, narcosis, , trouble breathing, paralysis, headache, nausea, headache, dizziness, coma	Colorless liquid, aromatic odor	185	8.77
n-Propylbenzene (per mfg. Recommended exposure is 100 ppm)	N/A	N/A	N/A	Y	Inh, Ing, Con	Irritation to eyes, skin, respiratory tract, mucous membranes of nose & throat, depresses CNS, vertigo, fatigue, chest constriction, may invoke aspiration if swallowed	Clear colorless liquid, mild odor	---	---
Toluene	200 ppm	100 ppm	20 ppm	Y	Inh, Abs, Ing, Con	Irritation to eyes, skin, nose; upper respiratory tract, fatigue, weak, confusion, dizziness, headache, drowsiness, abdominal spasms, dilated pupils, euphoria	Colorless liquid, sweet pungent, benzene like odor	200	8.82

Compound	Exposure Limits (TWA)			Dermal Hazard (Y/N)	Route(s) of Exposure	Acute Symptoms	Odor Threshold/ Description	PID	
	OSHA PEL	NIOSH REL	IDLH					Relative Response	Ioniz. Poten. (eV)
1,2,4-Trimethylbenzene	---	25ppm	Not Determined	Y	Inh, Ing, Con	Irritation to eyes, skin nose throat, respiratory system, hypochromic anemia, headache, drowsiness, fatigue, dizziness, nausea, in-coordination, vomiting confusion, aspiration.	Clear colorless liquid, distinctive aromatic odor		8.27
1,3,5-Trimethylbenzene	---	25ppm	Not Determined	Y	Inh, Ing, Con	Irritation to eyes, skin nose throat, respiratory system, hypochromic anemia, headache, drowsiness, fatigue, dizziness, nausea, in-coordination, vomiting confusion, aspiration.	Clear colorless liquid, distinctive aromatic odor	300	8.39
Xylene(mixed)	100 ppm	100 ppm	900 ppm	Y	Inh, Ing, Abs, Con	Irritation to eyes, nose, throat, skin; nausea, vomiting, headache, ringing in ears, severe breathing difficulties (that may be delayed in onset), substernal pain, coughing hoarseness, dizziness, excited, burning in mouth, stomach, dermatitis (removes oils from skin), corneal burns	Colorless liquid, aromatic odor (solid below 56 F	140	8.44

Compound	Exposure Limits (TWA)			Dermal Hazard (Y/N)	Route(s) of Exposure	Acute Symptoms	Odor Threshold/ Description	PID	
	OSHA PEL	NIOSH REL	IDLH					Relative Response	Ioniz. Poten. (eV)
Isopropylbenzene	50 ppm	50 ppm	50 ppm	Y	Inh, Inj, Con	Irritation, nausea, difficulty breathing, headache, drowsiness, dizziness, and loss of coordination. Skin and eye irritation. Vomiting, stomach pain, drowsiness, aspiration, and central nervous system depression.	1.2 ppm Colorless liquid, distinct odor, pungent odor	---	---
Benzo(a)anthracene	N/A	N/A	N/A	Y	Inh,Ing, Con, Abs	Irritation to eyes, skin, digestive tract, respiratory tract (prevent contact to skin and eyes)	Yellow to green	---	---
Benzo (a) pyrene*	0.2 mg/m^3	---	A2	Y	Ing, Inh, Abs, Con	Irritation to eyes, skin, lungs harmful if swallowed (all hazards and toxic properties not fully known)	Yellow green powder	---	---
Benzo(b)fluoranthene*	0.2 mg/m^3	0.1 mg/m^3	A2	Y	Inh, Ing, Con	No signs or symptoms of acute exposure to benzo(b)fluoranthene have been reported in humans	Colorless	---	---

Compound	Exposure Limits (TWA)			Dermal Hazard (Y/N)	Route(s) of Exposure	Acute Symptoms	Odor Threshold/ Description	PID	
	OSHA PEL	NIOSH REL	IDLH					Relative Response	Ioniz. Poten. (eV)
Chrysene* (Polynuclear Aromatics)	0.2 mg/m^3	---	0.2 mg/m^3	Y	Inh, Ing, Con	Irritation to eyes, skin, GI with nausea; vomiting, diarrhea, respiratory irritation	Very light beige solid	---	---
Indeno (1,2,3-cd)pyrene	0.2 mg/m^3	0.1 mg/m^3	0.1 mg/m^3	Y	Inh, Ing,	N/A	Yellow Crystals	---	---
Naphthalene	10 ppm	10 ppm	10 ppm	Y	Inh, Ing, Abs, Con	Irritation to eyes; headache, confusion, excitement, nausea, vomiting, abdominal pain, irritation to bladder, profuse sweating, jaundice, corneal injury, blurred vision, renal shutdown	Colorless to brown solid/crystals, moth ball odor	230	8.12

Compound	Exposure Limits (TWA)			Dermal Hazard (Y/N)	Route(s) of Exposure	Acute Symptoms	Odor Threshold/ Description	PID	
	OSHA PEL	NIOSH REL	IDLH					Relative Response	Ioniz. Poten. (eV)
Lead	0.05 mg/m^3	0.05 mg/m^3	0.05 mg/m^3	Y	Inh, Ing, Con	Poison, abdominal pain, spasms, nausea, vomiting, headache, irritation to eyes; skin, weakness, metallic taste, anorexia/loss of appetite, insomnia, facial pallor, colic, anemia, tremor, "lead line" in gums, constipation, abdominal pain, paralysis in wrists and ankles, encephalopathy (inflammation of brain)	Odorless	---	---

KEY:
PEL = Permissible Exposure Limit
REL = Recommended Exposure Limit
--- = Information not available
TLV = Threshold Limit Value(ACGIH)

Inh = Inhalation
Ing = Ingestion
mg/m^3 = Milligrams per cubic meter
* = Chemical is a known or suspected carcinogen

Abs = Skin Absorption
Con = Skin and/or eye Contact
ppm = Parts per million
sk = Skin notation

D. SITE SAFETY WORK PLAN

Site Control: Temporary chain-link construction fencing and lockable gates.

Perimeter Identified?	**[Y]**	**Site Secured?**	**[Y]**
Work Areas Designated?	**[Y]**	**Zone(s) of contamination identified?**	**[Y]**

Anticipated Level of Protection (cross-reference task numbers in Section C):

A	B	C	D
		Available	X

Site work will be performed in Level D safety equipment (steel-toed boots, work clothes, eye protection, gloves, hard hats, and hearing protection(as necessary)) unless monitoring indicates otherwise. Gloves will be worn if contact with Site soil, sediment or water is anticipated, due to concerns of contamination.

If conditions are encountered that require Level A or Level B Personal Protective Equipment (PPE), the work will immediately be stopped. The appropriate government agencies (i.e., City, NYSDEC, NYSDOH, MCDPH, etc.) will be notified and the proper health and safety measures will be implemented (e.g., develop and implement engineering controls, upgrade in PPE, etc.). If conditions are encountered (as indicated by PID and particulate readings) that require Level C PPE, the work will be temporarily suspended and the work Site will be evaluated to limit exposure prior to implementing Level C PPE. Engineering controls may be implemented, as necessary, in an effort to maintain Level D PPE required Site conditions.

Respiratory Protection

Any respirator used will meet the requirements of the OSHA 29 CFR 1910.134. Both the respirator and cartridges specified shall be fit-tested prior to use in accordance with OSHA regulations (29 CFR 1910). Air purifying respirators shall not be worn if contaminant levels exceed designated use concentrations. The workers will wear respirators with approval for: organic vapors <1,000 ppm; and dusts, fumes and mists with a TWA < 0.05 milligrams per cubic meter (mg/m^3).

No personnel who have facial hair, which interferes with respirator sealing surface, will be permitted to wear a respirator and will not be permitted to work in areas requiring respirator use.

Only workers who have been certified by a physician as being physically capable of respirator usage shall be issued a respirator. Personnel unable to pass a respiratory fit test or without medical clearance for respirator use will not be permitted to enter or work in areas that require respiratory protection.

Air Monitoring*:

Contaminant	Monitoring Device	Frequency
Organic Vapors	MiniRAE 3000 PID	Continuous
Ignition Sources	O2/Explosimeter	Continuous
Particulate	Dustrak	Continuous

*Continuous perimeter air monitoring for VOCs and particulates will be performed during ground intrusive activities and is described in the New York State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP).

Lu will also conduct continuous air monitoring of worker breathing zone air during excavation activities. If action levels are exceeded during excavation, appropriate precautions will be taken, as described below.

VOCs

VOCs in worker's breathing zone air will be monitored with a PID during activities that have the potential to disturb contaminated material to aid in determining if respiratory protection and/or vapor suppression is necessary. This ensures that respiratory protection is adequate to protect personnel from the chemical vapors and particulates they may be exposed to. Readings will be recorded in the Site logbook or log sheets.

Action Levels:

PID readings of **25 ppm to 100 ppm** above background at breathing zone, sustained for greater than 5 minutes,

Action: Stop work and implement vapor suppression techniques, such as application of Biosolve. If vapors cannot be brought below 25 ppm, upgrade PPE to Level C.

PID readings of **>100 ppm** above background at breathing zone, sustained for greater than 5 minutes,

Action: Stop work, evaluate the use of engineering controls, upgrade PPE to Level B or Level A.

Depending on circumstances observed during excavation and related IRM activities, alternative action levels and corresponding PPE levels to those described above may be considered and implemented at the discretion of the field team leader and City project manager.

O_2

O_2 readings must remain between 19.5% and 22.0%. Explosivity must be above 10% lower explosive level (LEL). The area must be evacuated and ignition sources eliminated if levels are not within their standard. These atmosphere factors will be measured at a position that would give the earliest indication of a hazardous condition forming not at the breathing zone. Appropriate actions, initially evacuation of the immediate work area, will be taken if established action levels area exceeded.

Particulates

During activities where contaminated materials (i.e., soil, fill, etc.) may be disturbed, air monitoring will include real-time monitoring for particulates using a real-time aerosol monitor (RTAM) particulate meter at the perimeter of the work zone in accordance with the *Final DER-10 Technical Guidance for Site Investigation and Remediation* dated May 2010. DER-10 uses an action level of 100 g/m^3 (0.10 mg/m^3) over background conditions for an integrated period not to exceed 15 minutes. If the action level is exceeded, or if visible dust leaving the Site is observed, then work shall be discontinued until corrective actions are implemented. Corrective actions may include dust suppression, change in the way work is performed, and/or upgrade of personal protective equipment. If dust suppression is deemed necessary, clean water will be applied to excavation area.

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the work zone at temporary particulate monitoring stations. The particulate monitoring should be performed using RTAM 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 must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during work activities.

Action Levels:

If particulate levels exceed a level of 2.5 times background (upwind levels subtracted from downwind concentration) or a level of 150 mcg/m^3, dust control measures will be initiated and the dust generating activity suspended until levels decrease below the action level. Perimeter monitoring will be conducted if the action level is obtained at the work area. All air monitoring results as well as wind direction and speed (estimates) will be documented in the Site-specific log book or log sheets.

Decontamination Solutions and Procedures for Equipment, Sampling Gear, etc: Specified in the Work Plan.

Personnel Decon Protocol: Soap, water, and paper towels or baby wipes will be available for all personnel and will be used before eating, drinking or leaving the Site. Personnel will shower upon return to home or hotel. Disposable PPE will be rendered unusable and disposed of as stated in work plan.

Decon Solution Monitoring Procedures, if Applicable: Contractor's controlled/ decon waste container.

Special Site Equipment, Facilities or Procedures (Sanitary Facilities and Lighting Must Meet 29CFR 1910.120):

A restroom and bottled water are available for use on Site.

Site Entry Procedures and Special Considerations: Entry to the Site should be limited through west entrance located at 62-64 Scio Street. The Buddy System should be employed at all times on Site. All personnel entering the Site shall have current 40-hr OSHA HAZWOPER training.

Personnel admitted into the work zone shall be properly trained in health and safety techniques and equipment usage. No personnel shall be admitted into the work zone without the property safety equipment.

Work Limitations (time of day, weather conditions, etc.) and Heat/Cold Stress Requirements: All work will be completed during daylights hours. Heavy equipment, including drill rigs, will not be used during electrical storms.

General Spill Control, if applicable: N/A

Investigation Derived Material (i.e., Expendables, Decon Waste, Cuttings) Disposal: Specified in the Work Plan.

Sample Handling Procedures Including Protective Wear: Sample handling will be performed while wearing chemically-resistant gloves. To minimize hazards to lab personnel, sample volumes will be no larger than necessary, and the outside of all sample containers will be wiped clean prior to shipment. Additional sampling protocols and procedures are outlined in the QAPP.

Accident and Injury Reporting: Any work-related incident, accident, injury, illness, exposure, or property loss must be immediately reported to the Lu Engineers project manager, and the City of Rochester project manager. This includes:

- Accident, injury, illness, or exposure of an employee;
- Injury of a subcontractor;
- Damage, loss, or theft of property, and/or
- Any motor vehicle accident regardless of fault, which involves a company vehicle, rental vehicle, or personal vehicle while employee is acting in the course of employment.

E. TRAINING REQUIREMENTS

Personnel conducting field activities on Site are required to have completed training sessions in accordance with Occupational Safety and Health Administration (OSHA) for Parts 1926 and 1910 (Title 29 Code of Federal Regulations [CFR] Part 1926.65 and Part 1910.120 - Hazardous Waste Operations and Emergency Response- 'HazWOPER'). This training shall consist of a minimum of 40 hours of instruction off-Site and three days of actual field experience under the direct supervision of a trained, experienced supervisor. Each employer will maintain documentation stating that its on-Site personnel have complied with this regulation.

In addition, all personnel will have reviewed this HASP and received a Site-specific health and safety briefing prior to participating in field work.

Visitors entering the work area must review the HASP and be equipped with the proper PPE. All Site personnel and visitors shall sign the last page of the HASP as an acknowledgement that they have read and understand the Site health and safety requirements.

Medical Surveillance Requirements: All Lu Engineers field staff who engage in on Site activities for 30 days or more per year participate in a medical monitoring program and have completed applicable training per 29CFR 1910.120. Lu's Respiratory Protection Program meets requirements of 29CFR 1910.134.

Key Personnel and Management

The Project Manager (PM) and Site Safety Officer (SSO) are responsible for formulating health and safety requirements, and implementing the HASP.

Project Manager

The PM has the overall responsibility for the project and will coordinate with the SSO to ensure that the goals of the project are attained in a manner consistent with the HASP requirements.

Site Safety Officer

The SSO has responsibility for administering the HASP relative to Site activities, and will be in the field while activities are in progress. The SSO's operational responsibilities will be monitoring, including personal and environmental monitoring, ensuring personal protective equipment (PPE) maintenance, and identification of protection levels. The air monitoring data obtained by the SSO will be available for review by the City, regulatory agencies, and other on-Site personnel.

Employee Safety Responsibility

Each employee is responsible for personal safety as well as the safety of others in the area. The employee will use the equipment provided in a safe and responsible manner as directed by the SSO.

Key Safety Personnel

The following individuals are anticipated to share responsibility for health and safety of Lu representatives at the Site.

Team Member*	Responsibility
Gregory Andrus	Project Manager
Eric Detweiler	Field Team Leader/ Site Safety Officer/Geologist
Eric Detweiler	Quality Assurance Officer
Jon Becker	Team Member-Field Technician
Janet Bissi	Team Member- Field Technician

*Entries into the work zone require "Buddy System" use. Lu Engineers' field staff participated in a medical monitoring program and have completed applicable training per 29CFR 1910.120. Lu's Respiratory protection program meets requirements of 29CFR 1910.134.

F. EMERGENCY INFORMATION

The following telephone numbers are listed in case there is an emergency at the Site:

Fire/Police Department:	911
Poison Control Center:	(800) 222-1222
<u>NYSDEC</u>	
Mike Zamiarski	(585) 226-5438
Spills Hotline	(585) 226-2466
<u>NYSDOH</u>	
Deb McNaughton	(585) 423-8069
<u>MCDOH</u>	
Jeffrey Kosmala, P.E.	(585) 753-5470

City of Rochester	
Jane Forbes	(585) 428-7892; (585) 314-1719 (cell)
Joseph Biondolillo	(585) 428-6649; (585) 314-1617 (cell)
Lu Engineers	
Gregory Andrus	(585) 385-7417 x215/ (585) 732-5786 (cell)
Eric Detweiler	(585) 385-7417 x227/ (585) 278-8202 (cell)
Nearest Hospital	Highland Hospital 1000 South Avenue, Rochester, NY 14620 (585) 473-2200 (Main) (585) 341-6880 (Emergency Department)

SITE RESOURCES

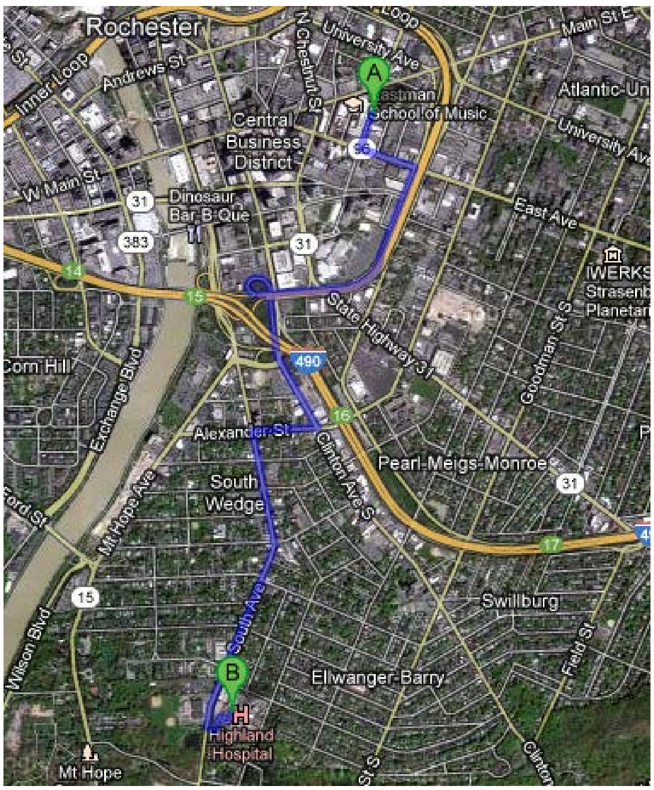
Site Emergency Evaluation Alarm Method:	Sound vehicle horn.
Water Supply Source:	Water will be available through a City issued Hydrant Permit.
Telephone Location, Number:	None available
Cellular Phone, if Available:	Greg Andrus (585) 732-5786
Radio:	TBD
Other:	TBD

EMERGENCY ROUTES

Note: Field team must know route(s) prior to start of work.

Directions from the Site to Highland Hospital:

Route is 2.4 miles, about 8 minutes. Turn left onto Scio St toward Bell Alley. Continue 0.2 miles and turn left onto East Ave. Continue 0.2 miles and turn right onto Pitkin St. Take the ramp on left onto the Inner Loop. Exit after 0.4 miles onto Clinton Ave S. Continue 0.2 miles and turn right onto Alexander St. Follow signs to Emergency Medical Services (Refer to the map shown below).



On-Site Assembly Area: At Site entry point.

Off-Site Assembly Area: 80 – 100 Charlotte Street (located 200 yards northeast of the Site).

Emergency egress routes to get off-Site: Follow Scio Street, north or south.

Personnel shall exit the Site and shall congregate in an area designated by the SSO. The SSO shall ensure that all personnel are accounted for. If someone is missing, the SSO will alert emergency personnel. The appropriate government agencies will be notified as soon as possible regarding the evacuation, and any necessary measures that may be required to mitigate the reason for the evacuation.

G. Additional Information

Contamination Emergency
It is unlikely that a contamination emergency will occur; however, if such an emergency does occur, the specific work area shall be shut down and immediately secured. If an emergency rescue is needed, notify Police, Fire Department and EMS units immediately. Advise them of the situation and request an expedient response. The appropriate government agencies shall be notified immediately. The area in which the contamination occurred shall not be entered until the arrival of trained personnel who are properly equipped with the appropriate PPE and monitoring instrumentation as outlined in Section D of this HASP.

Spill or Air Release
In the event of a spill or air release of hazardous materials on-Site, the specific area of the spill or release shall be shut down and immediately secured. The area in which the spill or release occurred shall not be entered until the cause can be determined and Site safety can be evaluated. Non-essential Site personnel shall be evacuated to a safe and secure area. The appropriate government agencies shall be notified as soon as possible. The spilled or released material shall be immediately identified and appropriate containment measures shall be implemented, if possible. Real-time air monitoring shall be implemented as outlined in Section 8.0 of this HASP. If the materials are unknown, Level B protection is mandatory. If warranted, samples of the materials shall be acquired to facilitate identification.

Locating Containerized Waste and/or Underground Storage Tanks
In the event that unanticipated containerized waste (e.g., drums) and/or USTs are located during remedial activities, the work will be stopped in the specific area until Site safety can be evaluated and addressed. Non-essential Site personnel shall not work in the immediate area until conditions including possible exposure hazards are addressed. The appropriate government agencies shall be notified as soon as possible. The SSO shall monitor the area as outlined in Section D of this HASP.

Prior to any handling, unanticipated containers will be visually assessed by the SSO to gain as much information as possible about their contents. As a precautionary measure, personnel shall assume that unlabelled containers and/or tanks contain hazardous materials until their contents are characterized. To the extent possible based upon the nature of the containers encountered, actions may be taken to stabilize the area and prevent migration (e.g., placement of berms, etc.). Subsequent to initial visual assessment and any required stabilization, properly trained personnel will sample, test, remove, and dispose of any containers and/or tanks, and their contents. After visual assessment and air monitoring, if the material remains unknown, Level B protection is mandatory.

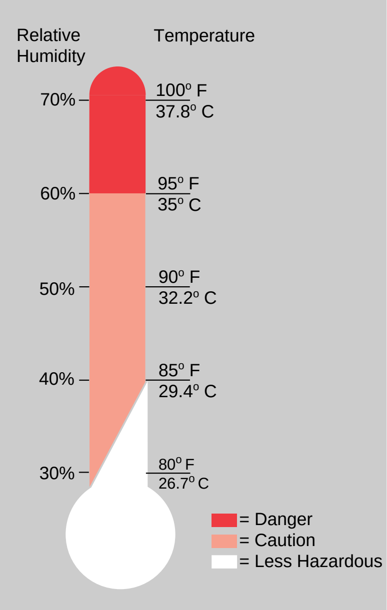
APPENDIX B-1

HEAT STRESS INFORMATION

THE HEAT EQUATION

HIGH TEMPERATURE + HIGH HUMIDITY + PHYSICAL WORK = HEAT ILLNESS

When the body is unable to cool itself through sweating, **serious** heat illnesses may occur. The most severe heat-induced illnesses are **heat exhaustion** and **heat stroke**. If actions are not taken to treat heat exhaustion, the illness could progress to heat stroke and possible **death**.



U.S. Department of Labor
Occupational Safety and Health Administration
OSHA 3154
1998

HEAT EXHAUSTION

What Happens to the Body:

HEADACHES, DIZZINESS/LIGHT HEADEDNESS, WEAKNESS, MOOD CHANGES (irritable, or confused/can't think straight), FEELING SICK TO YOUR STOMACH, VOMITING/THROWING UP, DECREASED and DARK COLORED URINE, FAINTING/PASSING OUT, and PALE CLAMMY SKIN.

What Should Be Done:

- Move the person to a cool shaded area to rest. Don't leave the person alone. If the person is dizzy or light headed, lay them on their back and raise their legs about 6-8 inches. If the person is sick to their stomach lay them on their side.
- Loosen and remove any heavy clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if they are not feeling sick to their stomach.
- Try to cool the person by fanning them. Cool the skin with a cool spray mist of water or wet cloth.
- If the person does not feel better in a few minutes call for emergency help (Ambulance or Call 911).

(If heat exhaustion is not treated, the illness may advance to heat stroke.)

HEAT STROKE—A MEDICAL EMERGENCY

What Happens to the Body:

DRY PALE SKIN (no sweating), HOT RED SKIN (looks like a sunburn), MOOD CHANGES (irritable, confused/not making any sense), SEIZURES/FITS, and COLLAPSE/PASSED OUT (will not respond).

What Should Be Done:

- Call for emergency help (Ambulance or Call 911).
- Move the person to a cool shaded area. Don't leave the person alone. Lay them on their back and if the person is having seizures/fits remove any objects close to them so they won't strike against them. If the person is sick to their stomach lay them on their side.
- Remove any heavy and outer clothing.
- Have the person drink some cool water (a small cup every 15 minutes) if they are alert enough to drink anything and not feeling sick to their stomach.
- Try to cool the person by fanning them. Cool the skin with a cool spray mist of water, wet cloth, or wet sheet.
- If ice is available, place ice packs under the arm pits and groin area.

How to Protect Workers

- Learn the signs and symptoms of heat-induced illnesses and what to do to help the worker.
- Train the workforce about heat-induced illnesses.
- Perform the heaviest work in the coolest part of the day.
- Slowly build up tolerance to the heat and the work activity (usually takes up to 2 weeks).
- Use the buddy system (work in pairs).
- Drink plenty of cool water (one small cup every 15-20 minutes)
- Wear light, loose-fitting, breathable (like cotton) clothing.
- Take frequent short breaks in cool shaded areas (allow your body to cool down).
- Avoid eating large meals before working in hot environments.
- Avoid caffeine and alcoholic beverages (these beverages make the body lose water and increase the risk for heat illnesses).

Workers Are at Increased Risk When

- They take certain medication (check with your doctor, nurse, or pharmacy and ask if any medicines you are taking affect you when working in hot environments).
- They have had a heat-induced illness in the past.
- They wear personal protective equipment (like respirators or suits).

APPENDIX C

Public Information Plan

CITIZEN PARTICIPATION PLAN

for

<u>62-64 Scio Street</u>

Rochester, NY
City of Rochester
Monroe County, New York
USEPA Assistance ID No. BF97219700

June 2012

Prepared By:

City of Rochester
Department of Environmental Services
Division of Environmental Quality
30 Church Street
Rochester, New York 14614-1278

PREFACE

This Citizen Participation Plan has been developed for the 62-64 Scio Street site under the United States Environmental Protection Agency's (USEPA) Brownfield Cleanup Program and the New York State Department of Environmental Conservation's (NYSDEC) Spills Program.

Brownfields are abandoned, idled, or under-used properties where expansion or redevelopment is complicated by real or perceived environmental contamination. They typically are former industrial or commercial properties where operations may have resulted in environmental contamination. They often pose not only environmental, but legal and financial burdens on communities. Left vacant, contaminated sites can diminish the property value of surrounding sites and potentially threaten the economic viability of adjoining properties.

Under the Brownfield Cleanup Program, the USEPA provides grants to municipalities to reimburse up to 80 percent of eligible costs for site investigation and remediation activities. The term "municipality" includes counties, cities, towns and villages as well as local public authorities, public benefit corporations, school and supervisory districts and improvement districts. The term also includes municipalities acting in partnership with a community based organizations.

Once remediated, the property may then be reused for commercial, industrial, residential or public use.

SECTION 1: INTRODUCTION

The City of Rochester, in cooperation with the NYSDEC and the New York State Department of Health (NYSDOH), are committed to informing and involving the public during the process to develop the Site Corrective Action Plan (CAP) for the Scio Street site. The Scio Street site (Site) is located at 62-64 Scio Street in the City of Rochester, New York. The site consists of one (1) parcel owned by the City of Rochester with an area of approximately 0.25 acres. The Site is located in a commercial area on the east side of Scio Street, near the intersection of Main Street and Scio Street in Rochester's East End District (see attached site location map).

The Site was formerly occupied by a 22,000 square foot, two-story, brick building, built in approximately 1920. The building was mainly used as a warehouse from the date of construction, until approximately 1990. The City of Rochester took ownership of the property in 1996, and the building was demolished in November 2002. The Site has remained vacant since demolition.

This Citizen Participation Plan (CPP) has been prepared by the City of Rochester's Department of Environmental Services, Division of Environmental Quality specifically for this Site. Definitions of some common terms used during the cleanup process may be found in Appendix 1.

The CPP seeks to assure an open process for the interested and possibly affected public. This includes public officials at all levels, citizen interest groups, commercial interests, individuals in the area of the Site, and the media. These parties can be a part of the decision-making process for this Site, and need to be informed about on-site activities. It also identifies locations where these parties can obtain additional information about the remedial program for this Site. Specific opportunities for public and community input into the decision-making process are indicated.

The CPP is a working document. It can be enhanced to accommodate major changes in either public attitude, or in the nature and scope of technical activities at the Site. The activities listed below are not intended to be an all-inclusive list, but an outline of possible activities which may be conducted in coordination with the site investigation and remedial process.

This CPP includes the following information:

- A description of the Site history, indicating possible types of contamination, any past studies, and any previous remedial measures that may have occurred at the Site;
- A description of the proposed Corrective Action activities to be conducted at the Site;
- Listing of contacts representing the affected and interested public agencies associated with this project;
- Identification of a local repository for information and reports generated during the course of completing the investigation activities; and
- Description of planned citizen participation activities.

SECTION 2: SITE LOCATION

The Site is located at 62-64 Scio Street in the City of Rochester, New York. The Site consists of one (1) parcel owned by the City of Rochester with an approximately area of 0.25 acres. The Site is located in a commercial area on the east side of Scio Street, near the intersection of Main Street and

Scio Street in Rochester's East End District.

SECTION 3: SITE HISTORY

The Site has been developed for various commercial uses since the early 1900's. The Site was formerly occupied by a 22,000 square foot, two-story, brick building, built in approximately 1920. The building was mainly used as a warehouse from the date of construction, until approximately 1990. The City of Rochester took ownership of the property in 1996, and the building was demolished in November 2002. The Site has remained vacant since demolition.

The following investigations have previously been completed at the site:

- Rizzo Associates Inc. Preliminary Site Assessment Update/Limited Subsurface Investigation Report, dated May 1993.
- DAY Environmental Inc. (DAY) Phase I Environmental Site Assessment Report, dated May 1995.
- DAY Environmental Inc. (DAY) Phase II Environmental Site Assessment Report, dated August 1995.
- DAY Underground Storage Tank Closure and Limited Subsurface Study Report, dated December 2006.
- DAY Data Package Limited Groundwater Study Report dated June 2007.
- Lu Engineers Phase I Environmental Site Assessment Report, dated October 2009.

Previous environmental studies performed at the site indicate that several Recognized Environmental Conditions (RECs) existed or may currently exist at the Site.

A Phase I Environmental Site Assessments (ESAs) was completed at the 62-64 Scio Street Site in May 1995 and also in October 2010. The Phase I ESAs identified RECs at the Site due the presence of former petroleum underground storage tanks (USTs) which resulted in subsurface soil and groundwater petroleum contamination at the Site.

An abandoned UST suspected of containing fuel oil was removed from the northeastern portion of the Site after the building was demolished in 2002. In January of 2003, an abandoned 5,000 gallon UST was excavated and removed from the Site following building demolition. This tank was used for gasoline storage and at the time of removal contained a mixture of gasoline and oil. Petroleum contaminated soil was observed beneath the removed UST and a soil sample was obtained from the bottom of the excavation for analytical testing. Analytical testing results indicated the presence of various gasoline constituents and the NYSDEC was notified and spill file #0270542 was opened for the Site. In May of 2004 a groundwater monitoring well was installed adjacent to the former UST location and a groundwater sample collected from the well showed numerous gasoline related volatile organic compounds (VOCs) including benzene, ethylbenzene, toluene, xylenes above NYSDEC groundwater quality standards. No semi-VOCs, chlorinated VOCs or PCBs were reported above laboratory detection limits.

A second abandoned 2,000-gallon UST suspected of containing gasoline was determined to be located on the southeast portion of the Site. The 2,000-gallon UST was permanently closed in accordance with applicable regulations and was found to be in poor condition. During the UST removal, petroleum-impacted soil was observed below and adjacent to the UST. Approximately 30.27 tons of grossly contaminated soil was removed from the tank excavation and disposed of off-site at a permitted landfill. Upon observation of impacted materials, a City of Rochester representative notified the NYSDEC, and the NYSDEC generated Spill File #0650898 for the Site.

Subsequent to the permanent closure of the two USTs, a subsurface investigation was completed to evaluate subsurface conditions at the Site, including the areas around the two former UST locations. A total of 14 test borings were advanced on the Site using direct-push drilling equipment on October 26, 2006. The test borings were advanced to depths between approximately 9.0 feet and 14.0 feet below the existing ground surface when equipment refusal, presumed to be the top of bedrock, was encountered. Indigenous soils generally consisting of sandy silts, clayey silts, and silty sands were encountered beneath the fill materials in each of the test borings advanced during this study. Peak PID readings in the test borings advanced during this study ranged from 0.0 ppm (i.e., TB-4, TB-5, and TB-6) to 1,848 ppm (i.e., TB-2). Nine of the fourteen test borings had PID readings exceeding 1,000 ppm, and petroleum-type odors and/or staining were noted on soils from most of the test borings. With the exception of acetone (generally used as a solvent) in two of the samples, laboratory testing of soil samples detected VOCs generally associated with petroleum products. The concentration of one or more VOC detected in each of the five soil samples exceeded their respective NYSDEC TAGM 4046 Recommended Soil Cleanup Objectives (RSCOs).

In general, petroleum-impacted soils are present on the eastern half of the Site encompassing an area of approximately 5,000 square feet and generally present at depths ranging from 8 to 12 feet below grade. The average thickness of petroleum contaminated soil over the eastern portion of the Site appears to be approximately two feet.

Two additional bedrock interface groundwater wells were installed at the Site in 2007 to further evaluate groundwater quality and the groundwater flow direction at the Site. Groundwater sampling and analysis from well MW-3 documented one area of relatively high VOC contaminated groundwater in the southeastern corner of the Site in relatively close proximity to the former gasoline UST. Total VOCs detected in well MW-3 were 11,019 ug/l (ppb) and benzene was detected at 1,660 ug/l in this well. A second monitoring well (MW-2) installed approximately 95 feet west of MW-3 did not contain any detectable VOCs, indicating the areal extent of VOC-contaminated groundwater appears defined in the southwestern direction.

SECTION 4: <u>PLANNED FUTURE USE OF THE SITE</u>

It is anticipated that the redevelopment of the Site will include both green space and/or recreational space with a potential for limited commercial expansion. Future uses may include bike parking and an access corridor from Matthews to Scio Street, which may potentially involve a paved walking trail, landscaped areas and bike parking facilities. At the current time the City is not partnering with any other public or private parties to facilitate the cleanup of the Site.

SECTION 5: <u>RECOMMENDED REMEDIAL ALTERNATIVE</u>

An Analysis of Brownfield Cleanup Alternatives (ABCA) was completed by the City, which evaluated several cleanup methods and the feasibility of a successful cleanup of the Site utilizing each method. The methods evaluated included:

- No Action;
- Soil Removal and Off-site Disposal;
- Soil Removal and Off-site Disposal and In-Situ Groundwater Treatment Through Direct Oxygen Injection; and
- In-Situ Air Sparging and Soil Vapor Extraction

For each method, the City considered subsurface conditions and environmental factors, various site characteristics, surrounding properties, land use restrictions, potential future uses of the Scio Street property, and the Site cleanup goals. The City evaluated each of the four alternatives based on established criteria, including the following:

- Technical feasibility, constructability, and implementability
- Short-term and long-term effectiveness
- Reduction in toxicity, mobility, and volume
- Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
- Protection of human health and the environment
- Duration
- Estimated cost

A soil management plan and environmental institutional and engineering controls were assumed to be implemented as part of each evaluated cleanup alternative.

The results of the ABCA indicated that No Action would not remediate contamination at the Site, would not meet ARARs, and would limit or prohibit redevelopment activities.

Soil Removal and Off-Site Disposal is a proven remedial option and is protective of human health and the environment. This approach permanently removes the greatest amount of contaminant mass and volume, which in turn immediately reduces contaminant toxicity and mobility. Soil Excavation and Disposal can be implemented in a relatively short period of time which facilitates the timely redevelopment and reuse of the Site. The Removal and Off-site Disposal approach effectively, physically removes the primary source of contamination leaching to groundwater, and ultimately assists in attenuation of contaminants in groundwater, and has the greatest potential to meet both soil and groundwater ARARs. However, the physical limitations of the Site, specifically, the proximity of neighboring buildings, necessitates incomplete removal of source area soils that could continue to impact groundwater and soil vapor at the Site and surrounding properties in the future.

In-Situ Air Sparging and Soil Vapor Extraction do not include the excavation and removal of grossly contaminated soils and instead employs a combination of In-Situ Air Sparging and Soil Vapor Extraction (AS/SVE). While this method is a proven remedial option, protective of human health and the environment, the effectiveness of the option may be limited by subsurface and/or other physical Site conditions. In addition, this approach requires a longer timeframe than Soil Removal and Disposal or Soil Removal and Disposal with In-Situ Groundwater Treatment through Direct Oxygen Injection, and may greatly increase the risk of soil vapor intrusion impacts at the neighboring buildings. The effectiveness of the approach to degrade source area contamination in the saturated zone may be limited, resulting in pockets of contamination being left in-place. The uncertainty of the effectiveness of this method could necessitate that additional remedial measures be completed increasing the final cost of Site remediation.

Based on the location and extent of contamination, the remedial objectives and the intended future use of the Site, the City determined that Soil Removal and Off-site Disposal combined with In-Situ Groundwater Treatment through Direct Oxygen Injection would be the most appropriate cleanup method to utilize at the Site.

Soil removal and off-site disposal is a proven remedial method that will immediately and permanently removed significant contaminant mass and volume, and will effectively remove petroleum-contaminated soils present in the unsaturated zone leaching to groundwater. Oxygen injection is also a proven remedial alternative, documented to rapidly enhance the biodegradation of organic contaminants such as petroleum hydrocarbons. The approach utilizes a system which produces oxygen at purity up to 95%, which is injected at low pressure into the subsurface to disperse oxygen into the formation without causing contaminant volatilization and which does not require the pumping or evacuation of groundwater. The primary mechanisms of oxygen transport are advection and dispersion, the same mechanisms that facilitated contaminant migration. This approach is suitable for shallow groundwater conditions since there is no generation of hazardous vapors or the need for vapor control, and does not require the disposal of contaminated groundwater. This method will effectively reduce the toxicity, mobility and the volume of contamination, will meet ARARs, and therefore will be protective of the environment and human health

5.1 Project Schedule

Soil Removal activities are expected to begin at the Site by August 2012. The initial field activities will take approximately two (2) weeks to complete. A Remedial Construction/Closure Report will be developed for the project by Lu Engineers, the City's Project Consultant and a draft report will be submitted for review and comment by the City and NYSDEC after the source removal and one round of groundwater monitoring has been performed. The report will include the following:

- A description of remedial activities;
- A data usability summary report (DUSR) for final delineation samples (i.e., closure samples);
- Drawings showing all remedial work;
- Site survey map with metes and bounds description. The limits of excavation, sample locations, well locations and remedial system components will be reported using the US State Plain 1983 (New York Western Zone);
- Description of any institutional controls;
- Environmental easement, if required; and;
- Site Management Plan for future development, if required, and;
- NYSPE Certification.

System design and installation of the Oxygen Injection system will follow the initial groundwater evaluation. It is anticipated that system installation will take place in late August or early September 2012. The system will be in operation at the Site for a period of 12 to 18 months following installation and depending upon the system efficiency.

SECTION 6: CITIZEN PARTICIPATION ACTIVITIES

It is the expressed intent of the City of Rochester to provide information to the public in a timely, complete, and accurate manner. To this end, the City of Rochester has compiled a list of individuals to whom the public can address specific requests for information. The contacts are both local and state public officials and are knowledgeable of the proposed project activities. Table 1 provides the contact information for Public Agency representatives for this project.

Table 1 – Public Agency Contacts

City of Rochester Contacts		
Jane MH Forbes Project Manager	DIV OF ENVIRONMENTAL QUALITY CITY OF ROCHESTER CITY HALL RM 300B ROCHESTER NY 14614	585-428-7892
NYS Department of Environmental Conservation		
Michael Zamiarski NYSDEC Project Manager (Technical Assistance)	NYSDEC REGION 8 OFFICE 6274 EAST AVON-LIMA ROAD AVON, NY 14414-9519	585-226-5438
Bartholomew Putzig NYSDEC DER Regional Engineer (Technical Assistance)	NYSDEC REGION 8 OFFICE 6274 EAST AVON-LIMA ROAD AVON, NY 14414-9519	585-226-5349
New York State Department of Health		
Debby McNaughton NYSDOH Project Manager (Technical Assistance)	NYSDOH 335 EAST MAIN STREET ROCHESTER, NEW YORK 14604	585-423-8069
Monroe County Department of Health		
Joseph Albert (Technical Assistance)	PO BOX 92832 111 WESTFALL RD ROCHESTER NY 14692-8932	585-753-5904

A local repository has been established at the Rundell Memorial Library, 115 South Avenue. Additional repositories have been established at the NYSDEC Region 8 offices at 6274 East Avon-Lima Road. Copies of documents relevant to the project are also available on-line, at the City's web-site at www.cityofrochester.gov.

A Fact Sheet detailing the availability of the ABCA Report, Citizens Participation Plan and the draft Corrective Action Plan will be sent out to the local residents and other interested parties. Additional activities such as project status presentations at neighborhood association or public meetings and/or distribution of additional Fact Sheets will be added as appropriate.

The public is encouraged to review the documents related to the Site which are available for public review at the following locations:

6.1 Mailing List

A mailing list including local and State elected officials and owners of properties located within the immediate vicinity of the site is included as Appendix 2. (Property owners' addresses are not provided to the public, but are maintained confidentially by the NYSDEC Project Manager). The City of Rochester will produce and distribute Fact Sheets providing residents with timely information on project status, including notifications of upcoming activities on-site (e.g., fieldwork) or off-site (e.g., public availability sessions). Included in all Fact Sheets will be the list of individuals to be contacted by the public for additional information (see Table 1). In addition to property owners, Fact Sheets will be mailed to the elected officials/ representatives, environmental groups, and the media as listed in Tables 2 and 3.

Table 2: Elected Officials/Representatives and Environmental Groups

Elected Officials / Public Agency Representatives		
THE HONORABLE KIRSTEN GILLIBRAND UNITED STATES SENATE 100 STATE ST ROOM 3280 ROCHESTER NY 14614	THE HONORABLE CHARLES SCHUMER UNITED STATES SENATE FEDERAL BLDG 100 STATE ST ROCHESTER NY 14614	THE HONORABLE LOUISE M SLAUGHTER US HOUSE OF REPRESENTATIVES 3110 FEDERAL BLDG 100 STATE ST ROCHESTER NY 14614
DAVID GANTT NYS ASSEMBLY 74 UNIVERSITY AVE ROCHESTER NY 14605	THE HONORABLE JOSEPH E ROBACH NYS SENATE 2300 W RIDGE RD ROCHESTER NY 14626	MAYOR THOMAS S. RICHARDS CITY HALL 30 CHURCH STREET ROCHESTER NY 14614
MAGGIE BROOKS MONROE COUNTY EXECUTIVE COUNTY OFFICE BLDG RM 110 39 W MAIN ST ROCHESTER NY 14614-1476	ROCHESTER FIRE CHIEF SALVATORE MITRANO III ROCHESTER FIRE & RESCUE DEPT 185 EXCHANGE BLVD - SUITE 665 ROCHESTER NY 14614-2277	OFFICE OF THE POLICE CHIEF CIVIC CENTER PLAZA 185 EXCHANGE BLVD ROCHESTER NY 14614
MONROE COUNTY SHERIFF PATRICK O'FLYNN MONROE COUNTY PUBLIC SAFETY BLDG CIVIC CTR PLAZA 130 S PLYMOUTH AVE ROCHESTER NY 14614	LOVELY WARREN CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265	DANIEL KARIN CITY CLERK - CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265
LORETTA SCOTT CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265	ADAM MCFADDEN CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265	CARLA PALUMBO CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265
CAROLEE CONKLIN CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265	MATT HAAG CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265	DANA MILLER CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265
JACKLYN ORTIZ CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265	ELAINE SPAULL CITY COUNCIL OFFICE CITY HALL 30 CHURCH STREET ROOM 301 ROCHESTER NY 14614-1265	
CAPTAIN MIKE VAN DURME NYSDEC REGION 8 OFFICE 6274 EAST AVON-LIMA ROAD AVON, NY 14414-9519	LINDA VERA NYSDEC REGION 8 OFFICE 6274 EAST AVON-LIMA ROAD AVON, NY 14414-9519	

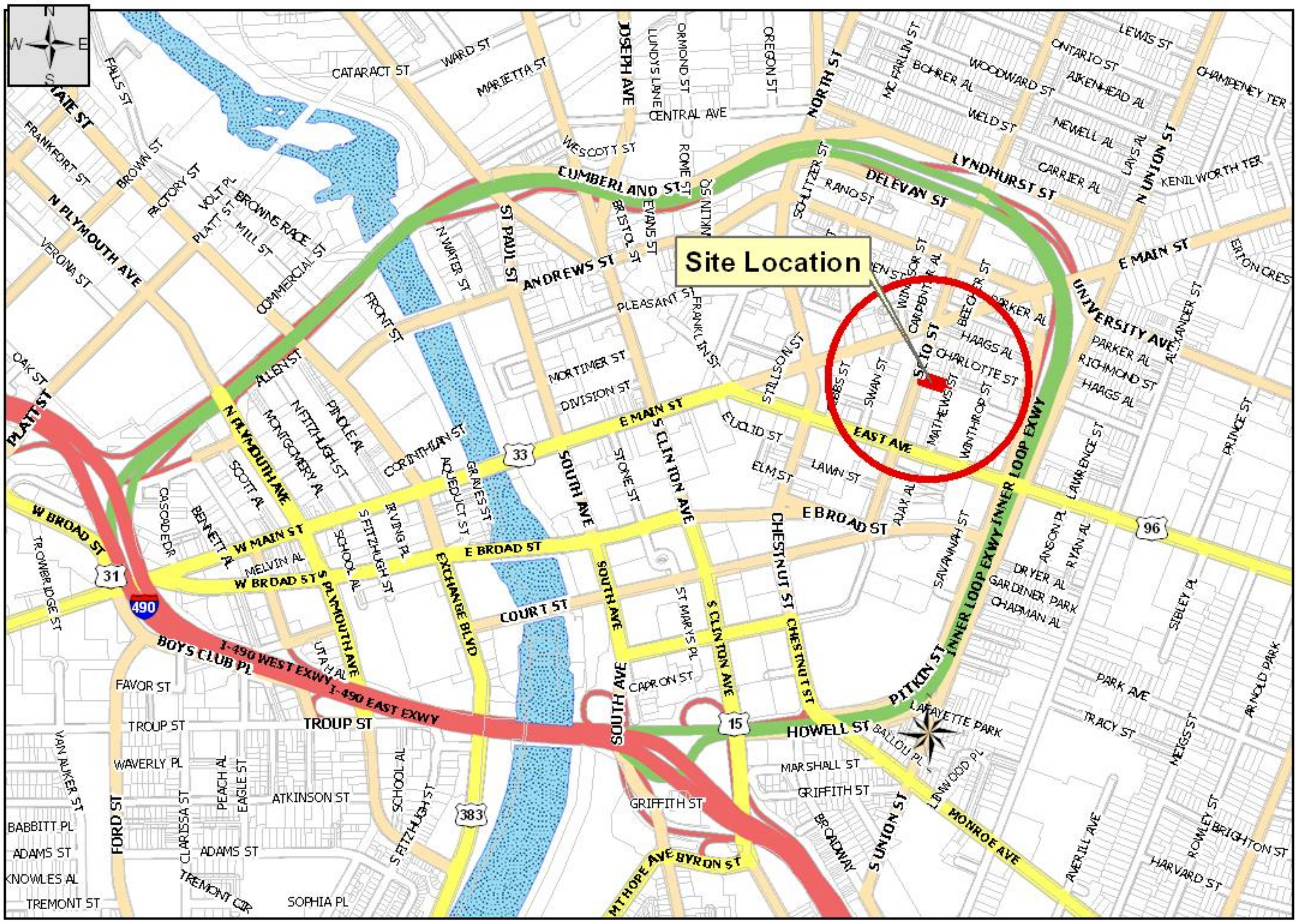


Figure 1 - Site Location Map - 62-64 Scio Street, Rochester, New York

Site Location Map

APPENDIX 1
Glossary and Acronyms

GLOSSARY

This glossary defines terms associated with New York's citizen participation program, and important elements of the Brownfield program. Words in **bold** in the definitions are defined elsewhere in the glossary.

Administrative Record Part of a site's **Record of Decision** which lists and defines documents used in the development of NYSDEC's decision about selection of a remedial action.

Availability Session A scheduled gathering of program staff and members of the public in a casual setting, without a formal presentation or agenda but usually focusing on a specific aspect of a site's remedial process.

Citizen Participation A program of planning and activities to encourage communication among people affected by or interested in Brownfield sites and the government agencies responsible for investigating and remediating them.

Citizen Participation Plan A document which must be developed at a site's **Site Investigation** stage. A CP Plan describes the citizen participation activities that will be conducted during a site's remedial process.

Citizen Participation Specialist A staff member from an NYSDEC central office or regional office who has specialized training and experience to assist a **project manager** and other staff to plan, conduct and evaluate a site-specific citizen participation program.

Comment Period A time period for the public to review and comment about various documents and DER actions. For example, a 45-day comment period is provided when DER issues a **Proposed Remedial Action Plan (PRAP)**.

Contact List Names, addresses and/or telephone numbers of individuals, groups, organizations, government officials and media affected by or interested in a particular Brownfield site. The size of a contact list and the categories included are influenced by population density, degree of interest in a site, the stage of the remedial process and other factors. It is an important tool needed to conduct outreach activities.

Division of Environmental Remediation A major program unit within the New York State Department of Environmental Conservation created to manage the hazardous waste site remedial program, the Brownfield program, and the Voluntary Cleanup program. Staff include: engineers, geologists, chemists, attorneys, citizen participation specialists, environmental program specialists and support staff.

Document Repository A file of documents pertaining to a site's remedial and citizen participation programs which is made available for public review. The file generally is maintained in a public building near the Brownfield site to provide access at times and a location convenient to the public.

Fact Sheet A written discussion about part or all of a site's remedial process, prepared and provided by DER to the public. A fact sheet may focus on: a particular element of the site's remedial program; opportunities for public involvement; availability of a report or other information, or announcement of a **public meeting** or **comment period**. A fact sheet may be mailed to all or part of a site's **contact list**, distributed at meetings, placed in a **document repository** and/or sent on an "as requested" basis.

Interim Remedial Measure (IRM) A discrete action which can be conducted at a site relatively quickly to reduce the risk to people's health and the environment from a well-defined contamination problem. An IRM can involve removing contaminated soil and drums, providing alternative water supplies or securing a site to prevent access.

New York State Department of Health Agency within the executive branch of New York State government which: performs health-related inspections at suspected contaminated sites; conducts health assessments to determine potential risk from environmental exposure; reviews Exposure Assessments prepared during the **Site Investigation/Remedial Alternatives Report**; conducts health-related community outreach around sites; and reviews remedial actions to assure that public health concerns are adequately addressed.

Operable Unit A discrete part of an entire site that produces a release, threat of release, or pathway of exposure. An Operable Unit can receive specific investigation, and a particular remedy may be proposed. A **Record of Decision** is prepared for each Operable Unit.

Operation and Maintenance A period in which remedial action may be conducted following construction at a site (for example, operation of a "pump and treat" system), or which is performed after a remedial action to assure its continued effectiveness and protection of people's health and the environment. Activities can include site inspections, well monitoring and other sampling.

Project Manager An NYSDEC staff member within the **Division of Environmental Remediation** (usually an engineer, geologist or hydro geologist) responsible for the day-today administration of remedial activities at, and ultimate disposition of, an Environmental Restoration site. The Project Manager works with legal, health, **citizen participation** and other staff to accomplish site-related goals and objectives.

Proposed Remedial Action Plan (PRAP) An analysis by DER of each alternative considered for the remediation of an Environmental Restoration site and a rationale for selection of the alternative it recommends. The PRAP is created based on information developed during the **Site Investigation/Remedial Alternatives Report**. The PRAP is reviewed by the public and other state agencies.

Public Meeting A scheduled gathering of **Division of Environmental Remediation** staff with the affected/interested public to give and receive information, ask questions and discuss concerns about a site's remedial program. Staff from other NYSDEC divisions, legal and health staff, and staff from consultants and a responsible party often also attend. A public meeting, unlike an **availability session**, generally features a formal presentation and a detailed agenda.

Record of Decision (ROD) A document which provides definitive record of the cleanup alternative that will be used to remediate an Environmental Restoration site. The ROD is based on information and analyses developed during the **Site Investigation/Remedial Alternatives Report** and public comment.

Remedial Construction The physical development, assembly and implementation of the remedial alternative selected to remediate a site. Construction follows the **Remedial Design** stage of a site's remedial program.

Remedial Design The process following finalization of a **Record of Decision** in which plans and specifications are developed for the **Remedial Construction** of the alternative selected to remediate a site.

Site Investigation/Remedial Alternatives Report (SI/RAR) The SI fully defines and characterizes the type and extent of contamination at the site. The RAR, which may be conducted during or after the SI, uses information developed during the SI to develop alternative remedial actions to eliminate or reduce the threat of contamination to public health and the environment.

Responsiveness Summary A written summary of major oral and written comments received by DER during a **comment period** about key elements of a site's remedial program, such as a **Proposed Remedial Action Plan**, and DER's response to those comments.

APPENDIX 2

MAILING LIST

ADJACENT PROPERTIES ARE INCLUDED IN MAILINGS BUT HAVE BEEN EXCLUDED FROM THE LISTING IN THIS DOCUMENT AS CONFIDENTIAL INFORMATION

APPENDIX D

Quality Assurance Project Plan

Appendix D

Brownfields Site-Specific Quality Assurance Project Plan

62-64 Scio Street
Rochester, New York 14604

NYSDEC Spill File #0650898

USEPA Assistance ID No. BF97219700

Brownfields QAPP Template #1
Title and Approval Page

Title: Scio Street Quality Assurance Project Plan (QAPP)
Project Name/Property Name: 62-64 Scio St.
Property/Site Location: Rochester, New York 14604
Revision Number:
Revision Date:

Brownfields Cooperative Agreement Number:___BF97219700_________________________

City of Rochester
Brownfields Recipient

Eric Detweiler / Lu Engineers, 175 Sully's Trail, Suite 202, Pittsford, NY 14534 (585) 385-7417
edetweiler@luengineers.com
Preparer's Name and Organizational Affiliation
Preparer's Address, Telephone Number, and E-mail Address

August 9, 2012
Preparation Date (Day/Month/Year)

Brownfields Recipient Program Manager: ______________________
Signature

Jane Forbes/ City of Rochester/
Printed Name/Organization/Date

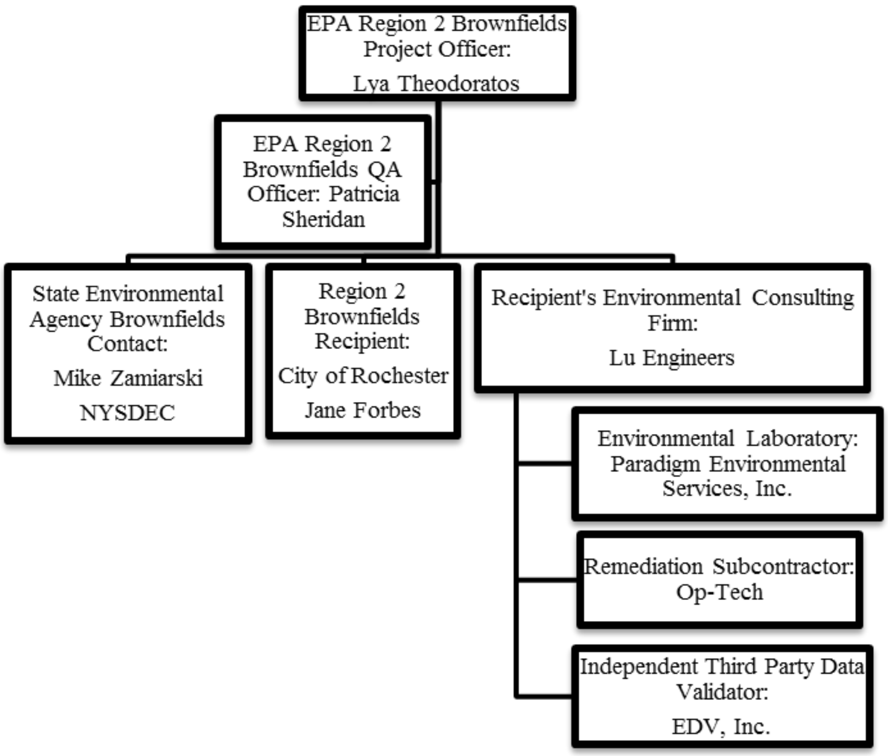
Environmental Consultant Quality Assurance Officer: (QAO) ______________________
Signature

Eric Detweiler/ Lu Engineers/ 8-9-12
Printed Name/Organization/Date

EPA Region 2 Brownfields Project Officer: ______________________
Signature

Lya Theodoratos/USEPA/
Printed Name/Organization/Date

Brownfields QAPP Template #2a
Project Organizational Chart



Brownfields QAPP Template #2b
Personnel Responsibilities

Name	Title	Telephone Number	Organizational Affiliation	Responsibilities[1]
Gregory Andrus*	Environmental Consultant Project Manager	(585) 385-7417	Lu Engineers	Overall responsibility for implementing the project and ensuring that objectives are met. Primary point of contact and control.
Jane Forbes	Brownfields Recipient Program Manager	(585) 428-7892	City of Rochester	Review of project documents, assist in key decisions, etc.
Mike Zamiarski	State Spill Engineer Contact	(585) 226-5433	NYSDEC	Provide regulatory oversight of the project; review/approval of documents.
Lya Theodoratos	EPA Brownfields Project Officer (BPO)	(212) 637-3260	EPA Region 2	Oversee and monitor the grant.
Patricia Sheridan	EPA Brownfields Quality Assurance Officer (QAO)	(732) 321-6780	EPA Region 2	Provide QA/QC technical assistance to the Project Manager and provide internal review/approval of the QAPP.
Marshall Shannon	Environmental Laboratory Contact	(585)647-2530	Paradigm Environmental Services	Work in conjunction with the lab QA unit regarding QA elements of specific analytical tasks.
Dr. Maxine Wright-Walters	Third Party Data Validator	412-341-5281	Environmental Data Validation Inc. (EDV)	Completion of a data usability summary report for data generated as part of the project.

Brownfields QAPP Template #3a
Problem Definition/Project Description

PROBLEM DEFINITION

Samples will be collected for laboratory analysis to determine concentrations of remaining petroleum-based contaminants following soil removal at the Site. The goal of the project is to remove the contaminant source by soil excavation and disposal, and to treat contaminated groundwater. This goal includes the following activities: excavation and disposal of approximately 700 tons of petroleum-impacted soil, dewatering/staging/treating petroleum-impacted groundwater as necessary during excavation, and subsequent installation of a direct oxygen injection groundwater treatment system. Post-excavation soil samples will be collected to determine the effectiveness of the source removal in meeting the NYSDEC Part 375 soil cleanup objectives (SCOs). Following soils removal, a groundwater monitoring program will be implemented to gauge the effectiveness of the soil removal on groundwater quality and establish baseline concentrations for in-situ remediation using a direct oxygen injection system. This treatment will presumably occur for one year or until applicable NYSDEC Part 703/TOGS 1.1.1 groundwater standards are met for the Site.

Sampling is also needed to determine appropriate on-site re-use or off-site disposal options for excavated material. This will be accomplished using a combination of field screening and laboratory analysis of soil.

PROJECT DESCRIPTION

The focus of this project is the removal of approximately 700 tons of petroleum-contaminated soil and treatment of contaminated groundwater at the Site. Based upon the findings of the prior environmental subsurface investigations, a preliminary remedial approach has been evaluated consisting of:

1. A targeted source removal program to excavate the remaining grossly contaminated soil and fractured shallow bedrock from specified areas of the Site;

2. Dewatering to be conducted as part of the targeted source removal program, to remove as much contaminant mass from the Site as possible;

3. Post-source removal groundwater monitoring for petroleum volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs);

4. Completion of a remedial design investigation;

5. Installation of an oxygen injection system for in-situ remediation of groundwater; and

6. One (1) year of quarterly groundwater monitoring, subsequent to installation of the oxygen injection system.

Subsequent to soil removal, Lu Engineers will collect approximately 11 soil samples from excavation sidewalls for confirmation of remaining soil concentrations. Sample locations will be selected based on the requirements in NYSDEC's *DER-10 Technical Guidance for Site Investigation and Remediation*, May 2010.

Samples will also be collected from excavated soil staged on-site to determine disposal and/or reuse options. Waste characterization sampling frequency and analyses will be determined based on the requirements of the selected disposal facility.

Groundwater samples will be collected from six (6) monitoring wells to be installed following the soil removal activities.

The samples will be analyzed by Paradigm Environmental Services, Inc. (Paradigm) of Rochester, New York. National Environmental Laboratory Accreditation Program (NELAP) #200530; NY ELAP Certification #10958.

Quality Assurance/Quality Control (QA/QC) samples including field duplicates, matrix spike/matrix spike duplicate (MS/MSD) samples, and equipment rinsate blanks will be collected for the post-excavation soil samples and groundwater samples. QA/QC samples are not deemed necessary for waste characterization sampling. Samples will be collected in accordance with established SOPs.

Site Location and Description

The Site is located in a mixed residential and commercial-use urban area in downtown Rochester, Monroe County, New York. Demolition of the on-site building was completed November 2002. The Site is currently vacant, slopes gently to the east and is covered with grass. Wooden posts block Site access at the west and east ends of the property. Access to the north and south is limited by the adjacent buildings. A Site locus map and a Site plan are provided as Figures 1 and 2, respectively.

Site History

The Site is located in the City's desirable East End District, and is owned by the City of Rochester. The Site measures approximately 55 ft x 200 ft (~0.25 acres) and is currently vacant (Figure 2). Formerly, a 22,000 square-foot, two-story, brick building constructed around 1920 occupied the Site. The building was mainly used as a warehouse from the date of construction, until approximately 1990. The City of Rochester took ownership of the property in 1996, at which time the building was mainly used as a storage unit until it was demolished in November 2002. The Site has remained vacant since demolition.

Several environmental studies have been completed on behalf of the City of Rochester at the Site including:

- Rizzo Associates Inc. Preliminary Site Assessment Update/Limited Subsurface Investigation Report, dated May 1993;
- DAY Environmental Inc. (DAY) Phase I Environmental Site Assessment Report, dated May 1995;
- DAY (DAY) Phase II Environmental Site Assessment Report, dated August 1995;
- DAY Underground Storage Tank Closure and Limited Subsurface Study Report, dated December 2006;
- DAY Data Package Limited Groundwater Study Report dated June 2007; and
- Lu Engineers Phase I Environmental Site Assessment Report, dated October 2009.

The results of the previous environmental studies revealed the following Recognized Environmental Concerns (RECs) associated with the Site and/ or adjacent properties that may be impacting the Site:

Underground Storage Tank(s)- Two underground storage tanks (USTs) were used on the Site to store petroleum products. These tanks (5,000 gallon and 2,000 gallon) were removed in 2006 and 2003, respectively. Subsurface investigations that began in 2006 showed the presence of petroleum compounds in Site soils and groundwater.

Adjacent NYSDEC Active Spills- The NYSDEC's spills database was reviewed and identified eight active spills within a 0.5 mile radius of the Site. The distance and location of four of these spills from the Site suggest no environmental impact on the assessed properties. However, a spill located at 86 Scio Street, which adjoins the Site to the north was active due to a gasoline spill from a tank failure.

Adjacent NYSDEC Spill – An active spill was identified at 86 Scio Street. An UST containing gasoline was removed in 1991, and the soil surrounding the tank was found to be contaminated. A soil venting system and three (3) groundwater monitoring wells were installed on the property. The only monitoring well to contain a detectable level of contamination was the well closest to 62-64 Scio Street. The spill was closed in 1995.

Groundwater Contamination at Adjacent Property Monitoring Wells- Petroleum contamination was identified at an adjacent property, located at 200 East Avenue, where groundwater flows north/northeast. Review of the NYSDEC Petroleum Bulk Storage (PBS) database identified six former storage tanks at 200 East Avenue. One 4,000-gallon gasoline UST installed in 1986, three 1,000 gallon USTs with unknown contents, one 2,000 gallon gasoline UST installed in 1987, and one 1,000 gallon Aboveground Storage Tank (AST) with unknown contents. The tanks were closed and removed in 1997. A well located east/southeast of the Site contained seven VOCs ranging in concentration from 1.1-4.3 µg/l or ppb.

Based on the investigation findings, the contaminants of concern are shown in the following table.

Contaminant(s) of Concern	Action Level
Acetone	NYSDEC Part 375-6.8a Unrestricted Use SCO (0.05 ppm)
Benzene	NYSDEC Part 703.5/TOGS 1.1.1, Class GA (1 ug/L)
Ethylbenzene	NYSDEC Part 375-6.8a Unrestricted Use SCO (1 mg/kg) / NYSDEC Part 703.5/TOGS 1.1.1, Class GA (5 ug/L)
n-Propylbenzene	NYSDEC Part 375-6.8a Unrestricted Use SCO (3.9 mg/kg) / NYSDEC Part 703.5/TOGS 1.1.1, Class GA (5 ug/L)
Toluene	NYSDEC Part 375-6.8a Unrestricted Use SCO (0.7 mg/kg) / NYSDEC Part 703.5/TOGS 1.1.1, Class GA (5 ug/L)
1,2,4-Trimethylbenzene	NYSDEC Part 375-6.8a Unrestricted Use SCO (3.6 mg/kg) / NYSDEC Part 703.5/TOGS 1.1.1, Class GA (5 ug/L)
1,3,5-Trimethylbenzene	NYSDEC Part 375-6.8a Unrestricted Use SCO (8.4 mg/kg) / NYSDEC Part 703.5/TOGS 1.1.1, Class GA (5 ug/L)
Xylene (mixed)	NYSDEC Part 375-6.8a Unrestricted Use SCO (0.26 mg/kg) / NYSDEC Part 703.5/TOGS 1.1.1, Class GA (5 ug/L)
Isopropylbenzene	NYSDEC Part 703.5/TOGS 1.1.1, Class GA (5 ug/L)
Benzo(a)anthracene	NYSDEC Part 375-6.8a Unrestricted Use SCO (1 mg/kg)
Benzo(a)pyrene	NYSDEC Part 375-6.8a Unrestricted Use SCO (1 mg/kg)
Benzo(b)fluoranthene	NYSDEC Part 375-6.8a Unrestricted Use SCO (1 mg/kg)
Chrysene	NYSDEC Part 375-6.8a Unrestricted Use SCO (1 mg/kg)
Indeno(1,2,3-cd)pyrene	NYSDEC Part 375-6.8a Unrestricted Use SCO (0.5 mg/kg)
Naphthalene	NYSDEC Part 703.5/TOGS 1.1.1, Class GA (10 ug/L)
Lead	NYSDEC Part 375-6.8a Unrestricted Use SCO (63 mg/kg)

PROJECT DECISION STATEMENTS

Future redevelopment is anticipated to include both green/recreational space and/or commercial expansion with a mixed use commercial facility and residential housing consistent with other development within the Center City District (CCD). If possible, the City would like to keep part of the Site as open space to provide possible bike parking and an access corridor from Mathews Street to Scio Street. This would potentially involve a paved walking trail, landscaped areas and bike parking.

1. If the concentration of VOCs and/or SVOCs in post-excavation soil samples is above the Unrestricted Use SCOs (specifically BTEX compounds), it will be addressed by the in-situ direct oxygen injection system to be installed following the soil removal phase.

2. If waste characterization soil samples pass applicable VOC and total lead analysis testing, then the soil will be considered non-hazardous waste and acceptable for beneficial use as landfill daily cover material.

3. If, based on PID readings, the staged soil VOC concentrations are <25 ppm, then the soil is considered suitable for re-use as backfill on-site.

4. If, based on PID readings, the staged soil VOC concentrations are between 25 and 100 ppm, then the soil will be staged and sampled to determine its disposition. If VOC and SVOC sample results are below the Unrestricted Use SCOs, then the soil is considered suitable for re-use as backfill on-site. If VOC and/or SVOC sample results are above the Unrestricted Use SCOs, then the soil will be disposed off-site.

5. If, based on PID readings, the staged soil VOC concentrations are >100 ppm, then the soil will be sent off-site for disposal.

6. If excavation water concentrations are below the sewer use permit limits established by Monroe County Pure Waters, then the water can be discharged directly to the municipal sewer system.

8. If excavation water concentrations are above the sewer use permit limits established by Monroe County Pure Waters, then the water must be treated/filtered prior to discharge to the municipal sewer system; or sent off-site for treatment and disposal at a permitted facility.

9. If groundwater VOC concentrations exceed NYSDEC standards in 6 NYCRR Part 703.5, then the groundwater will be treated using an in-situ direct oxygen injection system. Quarterly groundwater monitoring will take place for one year to verify groundwater remedial parameters and confirm that remedial goals are being approached or attained. If the remedial goals are not being approached or attained, additional remedial actions may be required.

Brownfields QAPP Template #3b
Project Quality Objectives/Systematic Planning Process Statements

Overall project objectives include:

- Obtain data to determine re-use and disposal options for excavated soil and groundwater.
- Obtain data representative of remaining levels of soil and groundwater contaminants following excavation to establish baseline conditions prior to installation of a direct oxygen injection treatment system.

Who will use the data?
Data will be used by the City of Rochester, Lu Engineers, and NYSDEC to determine additional remedial actions and appropriate re-development options for the Site. Waste characterization data will be utilized by the project team and the disposal facility(s) to determine appropriate waste disposal methods.

What will the data be used for?
The data will be used to confirm that remedial goals have been attained and determine disposal options. Post-excavation soil data will be compared to the NYSDEC Unrestricted Use SCO (6 NYCRR Part 375-6.8(b)) for the petroleum source area. Excavated soil meeting these cleanup objectives may be re-used as backfill on-site. Groundwater data will be used as a baseline for monitoring effectiveness of the direct oxygen injection system.

What types of data are needed?

- Petroleum-related VOCs and SVOCs in soil
- Off-site laboratory techniques and field screening via PID
- Soil composite and grab samples
- Groundwater and wastewater grab samples

How "good" do the data need to be in order to support the environmental decision?
Post-excavation soil samples and groundwater samples can be considered "delineation" samples; therefore, NYSDEC ASP Category B data deliverables are required (except for bacterial analysis of groundwater). QA/QC samples (duplicates, MS/MSD, blanks) will be necessary.

Soil re-use/waste characterization samples do not require Category B deliverables or QA/QC samples. NYSDEC ASP Category A deliverables are anticipated.

The quantitative analytical data quality objectives (DQOs) will be determined by the method detection limits (MDLs) and reporting limits (RLs) to be specified by the analytical laboratory. MDLs and RLs are highly dependent upon the sample matrix and concentrations of target constituents present. The MDL is a statistically derived value, representing the theoretical minimum level at which a particular analyte can be detected. MDL studies are performed annually by the laboratory. The RL (also referred to as the CRQL for CLP) is a detection limit that the laboratory is confident can be accurately achieved consistently over time.

How much data are needed?
The number of post-excavation soil samples is based on the requirements in DER-10 (i.e., one sidewall sample every 30 linear feet). It is estimated that eleven (11) post-excavation samples, plus three (3) QA/QC samples, will be collected for analysis VOCs by EPA Method 8260 + STARS and SVOCs by EPA Method 8270 Base/Neutrals.

The number of soil samples collected to determine on-site soil re-use applicability will be dependent on the amount of material excavated and staged on-site. The field team leader, with approval of NYSDEC, will determine the appropriate number of 'representative' samples for soil re-use. Soil sampling will be performed in accordance with guidance in DER-10 Section 5.4.

It is estimated that two (2) waste characterization soil samples will be required by the disposal facility. Required analyses will include VOCs by EPA Method 8260, total lead, and ignitability (flashpoint).

Wastewater characterization sampling will occur as needed and will be based on the sewer use permit requirements of Monroe County Pure Waters.

Following excavation, groundwater samples will be collected to determine post-remedial baseline conditions on-site. Because groundwater will be sampled quarterly for one year following installation of the oxygen injection system, it is estimated that a total of thirty-six (36) post-excavation groundwater samples, including QA/QC samples, will be collected for analysis of the following:

- VOCs
- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Organic Carbon (TOC)
- Dissolved Iron
- Quantitative Polymerase Chain Reaction (aPCR) analysis

In addition, field parameters including pH, dissolved oxygen (DO), and oxidation-reduction potential (ORP) will be collected from each well sampled.

Where, when, and how should the data be collected/generated?
The post-excavation sidewall soil samples will be collected from the identified contaminated zone every 30 linear feet around the excavation perimeter prior to backfilling and submitted to the laboratory as soon as possible after collection. Figure 3 shows approximate sidewall sample locations. It is anticipated that contaminated soil will be removed to the bedrock surface; therefore, confirmatory excavation floor samples will not be required. If PID readings indicate that soil can be left in place on the excavation floor, samples will be collected every 900 square

feet, per NYSDEC DER-10 protocols. Standard turnaround time (10 days) is anticipated for post-excavation samples.

Soil re-use samples will be collected during the excavation process. Grab samples will be collected from staged soil piles for analysis of VOCs (EPA Method 8260+STARS) and SVOCs (EPA Method 8270 Base/Neutrals). Waste characterization sample analysis will include VOCs (EPA Method 8260), total lead (EPA Method 6010), and ignitability/flashpoint (EPA Method 1030). Waste characterization samples will be collected from test pits completed prior to commencement of soil removal activities.

It is anticipated that wastewater characterization samples will be collected from within the frac tank following soil remediation. Groundwater samples will be collected quarterly from six (6) Site monitoring wells and will likely include three (3) additional QA/QC samples per event (field duplicate, MS/MSD). Samples will be collected using low-flow purging and sampling methods.

Who will collect and generate the data?
Lu Engineers will collect the soil and groundwater samples. City of Rochester personnel may collect additional post-excavation soil samples for informational purposes to aid in the redevelopment decision-making process. Lu Engineers personnel will be responsible for waste characterization sampling and profiling. Paradigm will generate the laboratory data, with the exception of the groundwater bacterial analysis. Microbial Insights in Rockford, Tennessee will be utilized for the qPCR bacterial DNA testing.

How will the data be reported?
Soil and groundwater lab data, with the exception of waste characterization samples and bacteria analysis, will be reported in accordance with the NYSDEC Analytical Services Protocol (ASP) Category B deliverable data package. Electronic data will be provided in the NYSDEC Equis Electronic Data Deliverable (EDD) format.

How will the data be archived?
Data will be archived in electronic and hard copy by Lu Engineers. EDDs will be loaded into the Equis database for the Site. Lab deliverables will be maintained on disc and in the project file.

Laboratory projects completed in the current year are maintained by Paradigm. All other analytical data, reports, and logbooks are kept in the Document Storage Area. The electronically scanned data are archived on LIMS Server. Levels of authorization limit access to Document Storage Area and the LIMS Server.

Brownfields QAPP Template #4
Project Schedule/Timeline

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Preparation of QAPP	Lu Engineers & City of Rochester	07/01/12	08/09/12	QAPP	
Review of QAPP	EPA Region 2 BPO – Lya Theodoratos, EPA QAO – Patricia Sheridan	08/13/12	TBD	Approved QAPP by EPA Region BPO	
Preparation of Health and Safety Plan	Lu Engineers & City of Rochester	07/01/12	07/31/12	HASP	
Procurement of Equipment	Lu Engineers	08/06/12	08/10/12	N/A	
Laboratory Request	Lu Engineers	07/16/12	08/03/12	N/A	
Field Reconnaissance/Access	Lu Engineers & City of Rochester	08/13/12	09/28/12	N/A	N/A
Collection of Field Samples	Lu Engineers & City of Rochester	08/13/12	09/28/12	N/A	N/A
Laboratory Package Received	Lu Engineers	08/24/12	10/12/12	Unvalidated data package	
Validation of Laboratory Results	EDV, Inc.	10/15/12	12/15/12	Validated data Packages	
Data Evaluation/ Preparation of Final Report	Lu Engineers & City of Rochester	12/15/12	12/31/13	Final Report	

Brownfields QAPP Template #5a
Sampling Methods and Locations

Matrix	Sampling Location(s)	Depth	Analytical Group	No. of Samples (*identify field duplicates*)	Sampling SOP Reference	Rationale for Sampling Location
Soil	CS-01 through CS-11	8-12 ft.	VOCs, SVOCs b/n	11 + 1 field duplicate + 1 MS/MSD	NYSDEC DER-10 Section 5.5(c)3	Post-excavation soil samples selected based on excavation size and field observations, in accordance with DER-10.
Soil	PileA# PileB#	N/A	VOCs, SVOCs b/n	TBD	NYSDEC DER-10 Section 5.5(c)3	Soil samples to determine re-use applicability/waste characterization
Soil	TP-01 TP-02	8-12 ft.	VOCs, lead, flashpoint	2	N/A	Waste characterization; based on landfill requirements.
Water	MW-01 through MW-06	TBD	VOCs, BOD, COD, TOC, Dissolved Iron, qPCR	6 + 1 field duplicate + 1 MS/MSD (quarterly=36 total)	EPA Low-Flow Purging and Sampling	Groundwater samples collected to establish baseline conditions and monitor remedial effectiveness.
Water	WW-01 (Frac tank)	N/A	VOCs (601/602 list), pH	TBD	N/A	Waste characterization; based on sewer use permit requirements.

Brownfields QAPP Template #5b
Analytical Methods and Requirements

Paradigm Environmental Services, Inc. of Rochester, New York will provide analytical services for the project. Bacterial analysis will be performed by Microbial Insight of Rockford, TN. On-site screening for VOCs via PID will be performed by Lu Engineers/City of Rochester personnel. Analytical methods, sample volumes, containers, and holding times for the project are shown in the following table.

Matrix	Analytical Group	Concentration Level[1]	Analytical & Preparation Method/ SOP Reference	Sample Volume	Containers (*number, size, type*)	Preservation Requirements (*chemical, temperature, light protected)*	Maximum Holding Time (*preparation/ analysis)*
Soil	VOCs	Low-Med	SW-846 Method 8260B/5035	4 oz.	Glass jar	Cool to 4°C	10 days from VTSR[2]
Soil	SVOCs	Low-Med	SW-846 Method 8270C	8 oz.	Glass jar	Cool to 4°C	10 days from VTSR for extraction; 40 days after extraction
Soil	Lead	Low-Med	SW-846 Method 6010	4 oz.	Glass jar	Cool to 4°C	14 days for extraction; 180 days after extraction
Soil	Flashpoint	n/a	SW-846 Method 1030	4 oz.	Glass jar	Cool to 4°C	14 days
Water	VOCs	Low-Med	EPA Method 601/602	40 ml	Glass VOA vial w/Teflon lined septum	1:1 HCl to pH<2; cool to 4°C	10 days from VTSR w/ preservative, 7 days without
Water	pH	n/a	EPA Method 150.1	Non-specific	Plastic jar	Cool to 4°C	ASAP
Groundwater	VOCs	Low-Med	EPA Method 8260B	120 ml	Glass VOA vials w/Teflon lined septum	1:1 HCl to pH<2; cool to 4°C	7 days from collection
Groundwater	BOD	Low-Med	Standard Method 5210B	1 L	HDPE bottle	Cool to 4°C	48 hours from collection
Groundwater	COD	Low-Med	EPA Method 410.4	250 ml	Glass	H_2SO_4; Cool to 4°C	28 days from collection
Groundwater	TOC	Low-Med	EPA Method 415.1	250 ml	Glass	H_2SO_4; Cool to 4°C	28 days from collection
Groundwater	Dissolved Iron	Low-Med	EPA Method 200.7	250 ml	Plastic bottle	HNO_3; Cool to 4°C	14 days for extraction; 180 days after extraction
Groundwater	qPCR	n/a	n/a	1 L	Plastic bottle	Cool to 4°C	24 hours

[1]Concentration Level refers to Low; Medium; High of the sample.
[2]VTSR= verified time of sample receipt at the laboratory

Brownfields QAPP Template #5c
Reference Limits and Evaluation Table

The target analytes/contaminants of concern, applicable state regulatory criteria (project-required action limits), and the published achievable detection and reporting limits for each analyte is shown below. Target analytes were determined based on laboratory data obtained to date for the IRM areas.

Matrix *Soil*
Analytical Group *VOCs*
Concentration Level *Low-Med*

Analyte	CAS Number	Name of State/Territory/Tribal: Regulatory Standards/Criteria	Analytical Method/Method Detection Limit	Achievable Laboratory Method Detection Limit/ Reporting Limit
Acetone	67-64-1	NYSDEC Unrestricted Use SCO/ 0.05 mg/kg	SW-846 Method 8260B/5035A .005mg/kg	.010/.020
Ethylbenzene	100-41-4	NYSDEC Unrestricted Use SCO/ 1 mg/kg	SW-846 Method 8260B/5035A .005mg/kg	.002/.004
n-Propylbenzene	103-65-1	NYSDEC Unrestricted Use SCO/ 3.9 mg/kg	SW-846 Method 8260B/5035A .005mg/kg	.002/.004
Toluene	108-88-3	NYSDEC Unrestricted Use SCO/ 0.7 mg/kg	SW-846 Method 8260B/5035A .005mg/kg	.002/.004
1,2,4-Trimethylbenzene	95-63-6	NYSDEC Unrestricted Use SCO/ 3.6 mg/kg	SW-846 Method 8260B/5035A .005 mg/kg	.002/.004
1,3,5-Trimethylbenzene	108-67-8	NYSDEC Unrestricted Use SCO/ 8.4 mg/kg	SW-846 Method 8260B/5035A .005 mg/kg	.002/.004
Xylene (mixed)	1330-20-7	NYSDEC Unrestricted Use SCO/ 0.26 mg/kg	SW-846 Method 8260B/5035A .005 mg/kg	.002/.004

Matrix *Soil*				
Analytical Group *SVOCs*				
Concentration Level *Low-Med*				
Analyte	**CAS Number**	**Name of State/Territory/Tribal: Regulatory Standards/Criteria**	**Analytical Method/Method Detection Limit**	**Achievable Laboratory Method Detection Limit/ Reporting Limit**
Benzo(a)anthracene	56-55-3	NYSDEC Unrestricted Use SCO/ 1 mg/kg	SW-846 Method 8270C/3550 .660mg/kg	.165/.330
Benzo(a)pyrene	50-32-8	NYSDEC Unrestricted Use SCO/ 1 mg/kg	SW-846 Method 8270C/3550 .660mg/kg	.165/.330
Benzo(b)fluoranthene	205-99-2	NYSDEC Unrestricted Use SCO/ 1 mg/kg	SW-846 Method 8270C/3550 .660mg/kg	.165/.330
Chrysene	218-01-9	NYSDEC Unrestricted Use SCO/ 1 mg/kg	SW-846 Method 8270C/3550 .660mg/kg	.165/.330
Indeno(1,2,3-cd)pyrene	193-39-5	NYSDEC Unrestricted Use SCO/ 0.5 mg/kg	SW-846 Method 8270C/3550 .660mg/kg	.165/.330

Matrix *Soil*				
Analytical Group *Total Lead*				
Concentration Level *Low*				
Analyte	**CAS Number**	**Name of State/Territory/Tribal: Regulatory Standards/Criteria**	**Analytical Method/Method Detection Limit**	**Achievable Laboratory Method Detection Limit/ Reporting Limit**
Lead	7439-92-1	NYSDEC Unrestricted Use SCO/ 63 mg/kg	SW-846 Method 6010B/3050B 1.0 mg/kg	0.5/1.0

Matrix *Water*
Analytical Group *VOCs*
Concentration Level *Low-Med*

Analyte	CAS Number	Name of State/Territory/Tribal: Regulatory Standards/Criteria	Analytical Method/Method Detection Limit	Achievable Laboratory Method Detection Limit/ Reporting Limit
Benzene	71-43-2	NYSDEC Part 703.5/ 1 ug/L	SW-846 Method 8260-low/5030B 5 ug/L	0.7/0.7
Toluene	108-88-3	NYSDEC Part 703.5/ 5 ug/L	SW-846 Method 8260-low/5030B 5ug/L	1.0/2.0
Ethylbenzene	100-41-4	NYSDEC Part 703.5/ 5 ug/L	SW-846 Method 8260-low/5030B 5ug/L	1.0/2.0
Xylene (total)	1330-20-7	NYSDEC Part 703.5/ 5 ug/L	SW-846 Method 8260-low/5030B 5ug/L	1.0/2.0
n-Propylbenzene	103-65-1	NYSDEC Part 703.5/ 5 ug/L	SW-846 Method 8260-low/5030B 5ug/L	1.0/2.0
Isopropylbenzene	98-82-8	NYSDEC Part 703.5/ 5 ug/L	SW-846 Method 8260-low/5030B 5ug/L	1.0/2.0
1,2,4-Trimethylbenzene	95-63-6	NYSDEC Part 703.5/ 5 ug/L	SW-846 Method 8260-low/5030B 5ug/L	1.0/2.0
1,3,5-Trimethylbenzene	108-67-8	NYSDEC Part 703.5/ 5 ug/L	SW-846 Method 8260-low/5030B 5ug/L	1.0/2.0

Matrix *Water*
Analytical Group *Dissolved Iron*
Concentration Level *Low-Med*

Analyte	CAS Number	Name of State/Territory/Tribal: Regulatory Standards/Criteria	Analytical Method/Method Detection Limit	Achievable Laboratory Method Detection Limit/ Reporting Limit
Dissolved Iron	7439-89-6	NYSDEC Part 703.5 Class GA Standard/ 300 ug/L	EPA Method 200.7 30 ug/L	30 ug/L / 60 ug/L

Matrix *Water*				
Analytical Group *BOD*				
Concentration Level *Low-Med*				
Analyte	**CAS Number**	**Name of State/Territory/Tribal: Regulatory Standards/Criteria**	**Analytical Method**	**Achievable Laboratory Method Reporting Limit**
BOD	n/a	n/a	Standard Method 5210B	4.0 mg/L

Matrix *Water*				
Analytical Group *COD*				
Concentration Level *Low-Med*				
Analyte	**CAS Number**	**Name of State/Territory/Tribal: Regulatory Standards/Criteria**	**Analytical Method**	**Achievable Laboratory Method Reporting Limit**
COD	n/a	n/a	EPA Method 410.4	5.0 mg/L

Matrix *Water*				
Analytical Group *TOC*				
Concentration Level *Low-Med*				
Analyte	**CAS Number**	**Name of State/Territory/Tribal: Regulatory Standards/Criteria**	**Analytical Method**	**Achievable Laboratory Method Reporting Limit**
TOC	n/a	n/a	EPA Method 415.1	2.0 mg/L

Brownfields QAPP Template #5d
Analytical Laboratory Sensitivity and Project Criteria

Matrix Soil				
Analytical Group VOCs				
Concentration Level Low-Med				
Analytical Method/SOP	**Data Quality Indicators**	**Performance Criteria (related to analytical method)**	**QC Sample such as Duplicate, Matrix Spike, Surrogates etc.) Used To Assess Performance Criteria**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
EPA Method 8260 VOCs	Precision	% RPD < 29	MS Duplicate	A
	Accuracy	Factor of two(-50% to + 100%) from the initial/continuing calibration	Internal standards	A
	Accuracy	Compound Specific (full range: 70-123%)	Matrix spike	A
	Accuracy	Compound Specific (full range 70%-118%	Surrogate Compounds	A
	Accuracy	< Reporting Limit	Method Blank	A

[1]Defined as Precision; Accuracy/Bias; Sensitivity/Quantitation Limits, Representativeness; Comparability, Completeness

Matrix Soil				
Analytical Group SVOCs				
Concentration Level Low- Med				
Analytical Method/SOP	**Data Quality Indicators**	**Performance Criteria (related to analytical method)**	**QC Sample such as Duplicate, Matrix Spike, Surrogates etc.) Used To Assess Performance Criteria**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
EPA Method 8270 SVOC BNs	Precision	Compound Specific (full range % RPD < 16-15)	LCS or MS Duplicate	A
	Accuracy	Factor of two(-50% to + 100%) from the initial/continuing calibration	Internal standards	A

	Accuracy	Compound Specific (full range: 55-100%)	Matrix spike	A
	Accuracy	Compound Specific (full range 60-102%)	Surrogate Compounds	A
	Accuracy	< Reporting Limit	Method Blank	A

Matrix Soil
Analytical Group Metals
Concentration Level Low

Analytical Method/SOP	Data Quality Indicators	Performance Criteria (related to analytical method)	QC Sample such as Duplicate, Matrix Spike, Surrogates etc.) Used To Assess Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
EPA 6010 Lead	Precision	% RPD < 20	Sample Duplicate	A
	Accuracy	Recovery Range 85-115%	Laboratory Control Sample	A
	Accuracy	Recovery Range 70-130%	Matrix spike	A
	Accuracy	< Reporting Limit	Method Blank	A

Matrix Water
Analytical Group VOCs
Concentration Level Low- Med

Analytical Method/SOP	Data Quality Indicators[1]	Performance Criteria (related to analytical method)	QC Sample such as Duplicate, Matrix Spike, Surrogates etc.) Used To Assess Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
EPA Method 8260	Precision	% RPD < 32.5	MS Duplicate	A
	Accuracy	Factor of two(-50% to + 100%) from the initial/continuing calibration	Internal standards	A
	Accuracy	Compound Specific (full range: 67-121%)	Matrix spike	A

	Accuracy	Compound Specific Full Range 53%-127%	Surrogate Compounds	A
	Accuracy	< Reporting Limit	Method Blank	A

Matrix Water
Analytical Group BOD
Concentration Level Low- Med

Analytical Method/SOP	**Data Quality Indicators**[1]	**Performance Criteria (related to analytical method)**	**QC Sample such as Duplicate, Matrix Spike, Surrogates etc.) Used To Assess Performance Criteria**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
SM 5210B	Precision	RPD < 20% for samples >5x CRDL; ± CRDL for samples <5x CRDL	Duplicate	A
	Accuracy	DO uptake 0.6 – 1.0 mg/L	Seed Control Standard	A
	Accuracy	Within lab control limits (mean ± 3 S.D.)	Standard Check Solution	A
	Accuracy	DO uptake <0.2 mg/L	Method Blank	A

Matrix Water
Analytical Group COD
Concentration Level Low- Med

Analytical Method/SOP	**Data Quality Indicators**[1]	**Performance Criteria (related to analytical method)**	**QC Sample such as Duplicate, Matrix Spike, Surrogates etc.) Used To Assess Performance Criteria**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
EPA Method 410.4	Precision	RPD < 20% for samples >5x CRDL; ± CRDL for samples <5x CRDL	Duplicate	A
	Accuracy	±15% from expected concentration	Demand Reference Samples	A
	Accuracy	±15% from expected value	Matrix spike	A
	Accuracy	< Reporting Limit	Method Blank	A

Matrix Water	
Analytical Group TOC	
Concentration Level Low- Med	

Analytical Method/SOP	Data Quality Indicators[1]	Performance Criteria (related to analytical method)	QC Sample such as Duplicate, Matrix Spike, Surrogates etc.) Used To Assess Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
EPA Method 415.1	Precision	RPD < 20% for samples >5x CRDL; ± CRDL for samples <5x CRDL	Duplicate	A
	Accuracy	±20% from expected concentration	Laboratory Control Sample	A
	Accuracy	± 25% from expected value	Matrix spike	A
	Accuracy	< Reporting Limit	Method Blank	A

Brownfields QAPP Template #5e
Secondary Data Criteria and Limitations Table

Data generated during previous investigations was used to delineate areas to be addressed during the source removal, and to identify contaminants of concern for post-excavation sampling. Secondary data sources are shown in the following table.

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Previous Investigation Sampling Results	Day Environmental Inc., Underground Storage Tank Closure and Limited Subsurface Study Report 62-64 Scio Street Rochester, NY, December 2006	Day Environmental Inc., STARS/TCL VOCs, STARS SVOCs, Total RCRA Metals, Paradigm Env. Services, 8/31/06 & 10/26/06	To delineate and assess existing soil contamination	1. Unvalidated data used to generate the report 2. Limited number of data points
Previous Investigation Sampling Results	Day Environmental Inc., Data Package Limited Groundwater Study 62-64 Scio Street Rochester, NY, June 2007	Day Environmental Inc., STARS/TCL VOCs, STARS SVOCs, Paradigm Env. Services, 5/30/07	To assess existing groundwater contamination	1. Unvalidated data used to generate the report 2. Limited number of data points

Brownfields QAPP Template #6
Project Specific Method and Standard Operating Procedures (SOPs) Reference Table

Field sampling SOPs, analytical method references (for preparation and analysis of the samples) and corresponding analytical laboratory SOPs that will be used for the Brownfields project are indicated below. Copies of field sampling SOPs are included in Appendix A-2.

ANALYTICAL METHOD REFERENCE (*Include document title, method name/number, revision number, date)*
1a. EPA SW-846 Test Methods for Evaluating Solids and Hazardous Waste, 3rd Ed.
2a. Standard Method 5210 B (5-day BOD Test), rev. 11/16/99
3a. EPA Method 410.4 Chemical Oxygen Demand, rev. 11/16/99
4a. EPA Method 415.1 Total Organic Carbon in Water, rev. 11/16/99
ANALYTICAL LABORATORY SOPs (*Include document title, date, revision number, and originator=s name)*
1b. * a listing of laboratory SOPs is included in Appendix A-2. Copies are available upon request.
2b.
3b.
4b.
FIELD SAMPLING SOPs (*Include document title, date, revision number, and originator=s name)*
1c. EPA Waste Pile Sampling SOP#2017, 11/17/94 rev.0.0
2c. Field Equipment Decontamination SOP, Lu Engineers
3c. NYSDEC DER-10 / Technical Guidance for Site Investigation and Remediation; May 3, 2010
4c. Well Installation Procedures, Lu Engineers
5c. EPA Well Development SOP# 2044, rev.0.0, 10/03/94
6c. Low-Flow (minimal Drawdown) Ground-Water Sampling Procedures, April 1996, Puls and Barcelona

Brownfields QAPP Template #7
Field Equipment Calibration, Maintenance, Testing, and Inspection

Field instruments to be used for health and safety monitoring include: MiniRAE PIDs for volatiles and DataRAMs (or equivalent) for particulates. A PID equipped with 10.6 eV lamp may also be used for field screening of volatiles in excavated material.

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Reference
MiniRAE 3000 PID, or equivalent	Zero calibration; Span calibrate with isobutylene standard gas	N/A	N/A	Prior to day's activities; anytime anomaly suspected	± 10%	Replace filter, blow-dry the sensor module, re-calibrate	MiniRAE 3000 User's Guide, 2010
DataRAM, or equivalent	Internal Span Check; Zero Calibration	Optical sensor chamber and cyclone cleaning, as needed.	N/A	Prior to day's activities; anytime anomaly suspected	"Calibration OK" output	Repair as necessary	Thermo Anderson DataRAM Operator Manual
Horriba U-22, or equivalent	Auto Cal; Span Cal	Wash probes; keep pH sensor moist with distilled water; replace reference solution every 2 months	N/A	Prior to day's activities; anytime anomaly suspected	Auto Cal- No error codes. Span Cal- ±20%	Flush probes and re-start auto cal. Clean sensors, replace defective probes, repair as needed.	Horriba U-22 Operation Manual

Brownfields QAPP Template #8
Analytical Laboratory Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing/Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	Analytical SOP Reference
ICP	As per instrument manufacturer's recommendations clean as needed	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable recalibration; see EPA 6010	Inspect the system, correct problem, recalibrate and/or reanalyze samples.	Laboratory ICP Technician	EPA 6010
GC-MS (VOA)	As per instrument manufacturer's recommendations clean as needed	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable recalibration; see EPA 8260	Inspect the system, correct problem, recalibrate and/or reanalyze samples.	Laboratory GC/MS Technician	EPA 8260
GC-MS (SVOA)	As per instrument manufacturer's recommendations clean as needed, clip column	As per instrument manufacturer's recommendations	As per instrument manufacturer's recommendations	Acceptable recalibration; see EPA 8270	Inspect the system, correct problem, recalibrate and/or reanalyze samples.	Laboratory GC-MS Technician	EPA 8270

Analytical Laboratory Instrument Calibration

Identify all analytical instrumentation that requires calibration and provide the SOP reference number for each. Document the frequency, acceptance criteria, and corrective action requirements on the template.

Instrument/Equipment	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Responsible Person	Analytical SOP Reference
ICP	See EPA 6010 Inductively coupled Plasma – atomic emission spectroscopy	ICP Initial calibration: daily or once every 24 hours and each time the instrument is set up. Continuing calibration: beginning and end of run, or every 10 samples	ICP: As per Method specifications, 0.997 linearity for ICAL, 90-110% for CCV.	ICP: inspect the system, correct problem, re-calibrate, re-analyze samples.	Laboratory ICP Technician	EPA 6010
GC-MS (VOA)	See EPA 8260 as per instrument manufacturer's recommended procedures	GC-MS Initial calibration: Each time the instrument is set up under new conditions Continuing calibration every 12 hours	GC-MS: As per Method specifications	GC-MS: inspect the system, correct problem, re-calibrate, re-analyze samples.	Laboratory GC-MS Technician	EPA 8260
GC-MS (SVOA)	See EPA 8270 Calibrate as needed to meet method specifications	GC-MS Initial calibration as needed to meet spec. CCV every 12 hours.	GC-MS: As per Method 8270 specifications,	GC-MS: inspect the system, correct problem, re-calibrate, re-analyze samples.	Laboratory GC-MS Technician	EPA 8270

Brownfields QAPP Template #9a
Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Environmental Specialist(s)/Lu Engineers, City of Rochester
Sample Packaging (Personnel/Organization): Environmental Specialist(s)/Lu Engineers, City of Rochester
Coordination of Shipment (Personnel/Organization): Environmental Specialist(s)/Lu Engineers, City of Rochester
Type of Shipment/Carrier: hand delivered
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custodian/Paradigm
Sample Custody and Storage (Personnel/Organization): Sample Custodian/Paradigm
Sample Preparation (Personnel/Organization): Sample Technician(s)/Paradigm
Sample Determinative Analysis (Personnel/Organization): Sample Technician(s)/Paradigm
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): Ideally, samples will be delivered daily for to the laboratory. All field samples will be stored on ice to a temperature of 4°C. Samples should be delivered no later than two days following collection.
Sample Extract/Digestate Storage (No. of days from extraction/digestion): As per analytical methodology; See Template #6.
SAMPLE DISPOSAL
Personnel/Organization: Sample Technician(s)/Paradigm
Number of Days from Analysis: Until analysis and QA/QC checks are completed; as per analytical methodology; See Template #6.

Brownfields QAPP Template #9b
Sample Custody Requirements

Sample Identification Procedures:

Post-excavation soil samples will have the following format: CS –sample number (depth)_date (mm/dd/yy)

Sample Number: a 2-digit number starting with 01; the remaining sample numbers will follow in sequential order (e.g., 01, 02, 03, etc).

Sample Depth: 2 digits indicating the depth in feet referenced from the ground surface. [Note: Do not use tic marks ‘ or “ to indicate sample depth on chain-of-custody or field notes. Tic marks are not an acceptable character in EQUIS.]

For example, if a soil sample was collected on August 20, 2012 from the excavation sidewall at 10 feet below ground and the next sample number is 04, the sample ID would be **CS-04 (10)_08-20-12.**

Waste characterization soil pile samples will have the following format: Pile[A or B]#_date. For example, two soil samples are collected on August 23, 2012 from staged pile B and no other samples have been collected from Pile B yet, the sample IDs would be **PileB1_08-23-12** and **PileB2_08-23-12.**

Pile A – soil expected to be re-used on-site (0 - 25 ppm PID)
Pile B – low-level contaminated soil (25 – 100 ppm PID)

Frac tank wastewater samples will have the format: WW-#_date (mm/dd/yy).

Groundwater samples will be designated by their well ID, for example: MW-02_date (mm/dd/yy)

Sample IDs will be recorded in the field logbook, on sample labels, and chain-of-custody forms.

Field Sample Custody/Tracking Procedures (sample collection, packaging, shipment, and delivery to laboratory):

All sample containers are obtained from the contract laboratory and are certified pre-cleaned by the manufacturer according to US EPA specifications.

Field samples will be in direct control of the environmental specialist(s) until hand delivered/relinquished directly to Paradigm labs. A sample is in custody if it is:

- -in someone's physical possession;
- -in someone's view;
- -locked up; or
- -kept in a secured area that is restricted to authorized personnel.

After samples are carefully collected, sample jars will be tightly sealed and the outside wiped clean before being placed inside the cooler. The samples will be packed in ice in coolers to maintain that the samples' integrity during delivery. Samples will be packaged carefully to avoid breakage or contamination and arrive at the laboratory at proper temperatures. Glass bottles or jars should be protected with bubble wrap or foam to prevent breakage during transport and delivery. A chain-of-custody will accompany the sample cooler during delivery until the samples are relinquished and received by the lab. As long as the sample custody is maintained by Lu Engineers or the City of Rochester during hand delivery, custody seals will not be necessary.

Laboratory Sample Custody/Tracking Procedures (receipt of samples, archiving, and disposal):

Laboratory Sample Management personnel sign for all sample deliveries received and relinquish samples to the Sample Custodian. Upon receipt, coolers are examined for damaged or broken custody seals and the condition is recorded on the Project Track Ticket Detail. Once the samples are accepted, a project ID is issued and documented on the CoC. Cooler temperature is recorded on the Laboratory Chronicle and CoC. Acceptable cooler temperature is 0-6^{o}C. Any discrepancies are recorded on the Project Track Ticket Detail and communicated to the Lab Project Manager, who will contact the client for instruction.

The laboratory Sample Custodian ensures that all samples are received in good condition, properly preserved, and that the information on the CoC matches the bottle labels. The Sample Custodian signs the CoC and other documentation upon receipt. All samples are assigned a unique lab number when they are logged in the Laboratory Information Management System (LIMS). Samples are stored in walk-in refrigerators on coded shelves. Only the Sample Custodians are permitted access to sample storage. The Sample Custodian issues samples to the laboratory analysts. Samples are placed back in the refrigerator when the analysts are finished.

Chain-of-Custody Procedures:
An entry will be made for each sample on the chain-of-custody (CoC) record. The custody record will include sampler names and signatures, sample ID numbers, date, time, type of sample, location, and analysis requested. The sample collector is personally responsible for the care and custody of samples collected until the samples are transferred to another person or dispatched properly under CoC. A CoC form will be used for all sample shipments. An example CoC is included as Appendix D-1.

Each cooler will be securely closed during delivery. The chain-of-custody forms will accompany the shipment. When delievered to the lab, the "Relinquished by" and "Received by" sections of each form will be signed and dated. One copy of the custody record will remain with the field team while the remaining copies will accompany the samples.

Upon arrival at the laboratory, Paradigm Environmental Services Inc. personnel will follow their Chain-of-Custody SOP.

Brownfields QAPP Template #10
Field and Analytical Laboratory Quality Control Summary

Matrix	Soils
Analytical Group	Volatiles
Concentration Level	Low-Med - ug/kg (ppb)
Sampling SOP(s)	
Analytical Method/SOP Reference	EPA SW-846 8260B/5035A
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	11

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Blank	Daily	No constituent > CRQL	Suspend analysis until source rectified; or flag data for common lab contaminants	Laboratory GC-MS Analyst	Accuracy	No constituent > CRQL
Field Duplicate	1 per ≤ 20 samples	± 20% RPD	Flag outliers	Laboratory GC-MS Analyst	Precision	± 20% RPD
Matrix Spike	1 per ≤ 20 samples	Range 70-123%	Qualify Data	GC/MS Analyst	Accuracy	Analyte specific
Matrix Spike Duplicate	1 per ≤ 20 samples	%RPD <29%	Qualify Data	GC/MS Analyst	Precision	Analyte Specific
Laboratory Control Samples	1 per 20 sample	Range 70-123%	Re-analyze samples	GC/MS Analyst	Accuracy	Analyte SPecific
Surrogate Spikes	Per sample	Range 70-118%	Qualify Matrix effect	GC/MS analyst	Accuracy	Analyte specific

Matrix	Soils
Analytical Group	Semi-volatiles
Concentration Level	Low-Med - ug/kg (ppb)
Sampling SOP(s)	
Analytical Method/SOP Reference	EPA SW-846 8270C
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	11

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Preparation Blank	1 per ≤ 20 samples	No constituent > CRQL	Re-prep if possible. Qualify data if needed	Laboratory GC-MS Analyst	Accuracy	No constituent > CRQL
Field Duplicate	1 per ≤ 20 samples	± 20% RPD	Flag outliers	Laboratory GC-MS Analyst	Precision	± 20% RPD
Matrix Spike	1 per ≤ 20 samples	Range 55-100%	Flag Outliers	GC/MS Analyst	Accuracy	Analyte specific
Matrix Spike Duplicate	1 per ≤ 20 samples	RPD< 16-25%	Flag Outliers	GC/MS analyst	Precision	Analyte specific
Laboratory Control Sample	1 per 20 samples	Range 55-100%	Re-run samples if possible, or flag data	GC/MS analyst	Accuracy	Analyte specific

Matrix	Soils
Analytical Group	Metals (Total Lead)
Concentration Level	Low-Med - mg/kg (ppm)
Sampling SOP(s)	
Analytical Method/SOP Reference	EPA SW-846 Method 6010B
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	TBD

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Preparation Blank	1 per ≤ 20 samples	No constituent > CRQL	Suspend analysis until source rectified; Qualify data as needed	Laboratory ICP Analyst	Accuracy	No constituent > CRQL
Laboratory Control Sample	1 per 20 samples	85-115 % Recovery	Re-analyze samples	ICP analysis	Accuracy	85-115%

Matrix	Water
Analytical Group	Volatiles
Concentration Level	Low-Med - ug/kg (ppb)
Sampling SOP(s)	
Analytical Method/SOP Reference	EPA Method 601/602
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	TBD

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Preparation Blank	1 per ≤ 20 samples	No constituent > CRQL	Re-prep if possible. Qualify data if needed	Laboratory GC-MS Analyst	Accuracy	No constituent > CRQL
Laboratory Control Sample	1 per 20 samples	Range 55-100%	Re-run samples if possible, or flag data	GC/MS analyst	Accuracy	Analyte specific

Matrix	Water
Analytical Group	Volatiles
Concentration Level	Low-Med - ug/kg (ppb)
Sampling SOP(s)	EPA Low-Flow Ground-Water Sampling Procedures
Analytical Method/SOP Reference	EPA 8260 + STARS
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	6

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Preparation Blank	1 per ≤ 20 samples	No constituent > CRQL	Re-prep if possible. Qualify data if needed	Laboratory GC-MS Analyst	Accuracy	No constituent > CRQL
Field Duplicate	1 per ≤ 20 samples	± 20% RPD	Flag outliers	Laboratory GC-MS Analyst	Precision	± 20% RPD
Matrix Spike	1 per ≤ 20 samples	Range 55-100%	Flag Outliers	GC/MS Analyst	Accuracy	Analyte specific
Matrix Spike Duplicate	1 per ≤ 20 samples	RPD< 16-25%	Flag Outliers	GC/MS analyst	Precision	Analyte specific
Laboratory Control Sample	1 per 20 samples	Range 55-100%	Re-run samples if possible, or flag data	GC/MS analyst	Accuracy	Analyte specific

Matrix	Water
Analytical Group	BOD
Concentration Level	mg/kg (ppm)
Sampling SOP(s)	EPA Low-Flow Ground-Water Sampling Procedures
Analytical Method/SOP Reference	Standard Method 5210B
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	6

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Preparation Blank	1 per ≤ 20 samples	DO uptake <0.2 mg/L	Re-prep if possible. Qualify data if needed	Laboratory Analyst	Accuracy	DO uptake <0.2 mg/L
Field Duplicate	1 per ≤ 20 samples	RPD < 20% for samples >5x DL; ± DL for samples <5x DL	Flag outliers *	Laboratory Analyst	Precision	RPD <20%
Matrix Spike	1 per ≤ 20 samples		Flag Outliers	Laboratory Analyst	Accuracy	
Matrix Spike Duplicate	1 per ≤ 20 samples		Flag Outliers	Laboratory Analyst	Precision	
Laboratory Control Sample	1 per 20 samples	± 3 standard deviations	Re-run samples if possible, or flag data	Laboratory Analyst	Accuracy	

Matrix	Water
Analytical Group	COD
Concentration Level	mg/kg (ppm)
Sampling SOP(s)	EPA Low-Flow Ground-Water Sampling Procedures
Analytical Method/SOP Reference	EPA Method 410.4
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	6

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per ≤ 20 samples	No constituent > CRQL	If samples are <10x blank conc., all associated samples must be prepared again with another blank and reanalyzed	Lab analyst	Accuracy	No constituent > CRQL
Field Duplicate	1 per ≤ 20 samples	RPD < 20% for samples >5x DL; ± DL for samples <5x DL	Flag outliers *	Laboratory Analyst	Precision	± 20% RPD
Matrix Spike	1 per ≤ 20 samples	±15% from expected value	Flag data with *	Lab Analyst	Accuracy	±15%
Matrix Spike Duplicate	1 per ≤ 20 samples		Qualify Data	Lab Analyst	Precision	
Demand Reference Samples	One set per ≤ 20 samples	±15% from expected concentration	Terminate analysis; identify problem; reanalyze affected samples	Lab analyst	Accuracy	±15%

Matrix	Water
Analytical Group	TOC
Concentration Level	mg/kg (ppm)
Sampling SOP(s)	EPA Low-Flow Ground-Water Sampling Procedures
Analytical Method/SOP Reference	EPA Method 415.1
Sampler's Name	TBD
Field Sampling Organization	Lu Engineers/ City of Rochester
Analytical Organization	Paradigm Environmental Services
No. of Sample Locations	6

Quality Control (QC) Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per ≤ 20 samples	No constituent > CRQL	If samples are <10x blank conc., all associated samples must be prepared again with another blank and reanalyzed	Lab analyst	Accuracy	No constituent > CRQL
Field Duplicate	1 per ≤ 20 samples	RPD < 20% for samples >5x DL; ± DL for samples <5x DL	Flag outliers *	Laboratory Analyst	Precision	± 20% RPD
Matrix Spike	1 per ≤ 20 samples	±25% from expected value	Flag data with an N	Lab Analyst	Accuracy	±25%
Matrix Spike Duplicate	1 per ≤ 20 samples		Qualify Data	Lab Analyst	Precision	
Lab Control Sample	One set per ≤ 20 samples	±20% from expected concentration	Terminate analysis; identify problem; reanalyze affected samples	Lab analyst	Accuracy	±20%

Brownfields QAPP Template #11a
Data Management and Documentation

Copies of CoC forms and air monitoring logs will be included in the final report. All field notes and the Site logbook will be maintained in the project file(s). All laboratory records will be included in the Category B Deliverable package to be submitted with the final report.

Field Sample Collection Documents and Records	Analytical Laboratory Documents and Records	Data Assessment Documents and Records	Project File
• Site and field logbook • Chain-of-Custody (CoC) forms • Air Monitoring Data Logs	• Sample receipt logs • Internal and external CoC forms • Equipment calibration logs • Sample preparation worksheets/logs • Sample analysis worksheets/run logs • Telephone/email logs • Corrective action documentation	• Data validation reports • Field inspection checklist(s) • Laboratory Audit checklist (if performed) • Review forms for electronic entry of data into database • Corrective action documentation	• Project files will be maintained and stored at the Environmental Contractors' offices for a minimum of 5 years after completion of the project. • Files will also be kept at the City of Rochester Division of Environmental Quality Office • Laboratory data, logbooks, and client reports are retained for 5 years unless specified otherwise.

Brownfields QAPP Template #11b
Project Reports

Identify the types of reports that will be routinely provided during the Brownfields project (e.g., status reports, final reports, etc.). Include the type of report, frequency of reporting, the project delivery dates, the personnel responsible for report preparation, and the report recipients.

Type of Report	Frequency (Daily, weekly, monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Data Usability Summary Report	Once. When all final SDGs are received from the laboratory.	10/31/2012	Dr. Maxine Wright-Walters, Environmental Data Validation Inc. (EDV)	Greg Andrus, Lu Engineers
Remedial Construction/ Closure Report	Upon project completion.	12/31/2013	Greg Andrus, Lu Engineers	Jane Forbes, City of Rochester / Mike Zamiarski, NYSDEC
Progress Reports	Quarterly		Vicki Brawn & Jane Forbes, City of Rochester	Lya Theodoratos, EPA Region 2 BPO

Brownfields QAPP Template #12a
Planned Project Assessments Table

This is a relatively short-term Brownfield project; therefore, assessment activities will be limited to oversight of the field team and subcontractors, and peer review of the final report.

Brownfields QAPP Template #12b
Assessment Findings and Corrective Action Responses

Not applicable to this project.

Brownfields QAPP Template #13a
Project Data Verification Process (Step I) [1]

Verification Input	Description	Internal/ External[2]	Responsible for Verification (Name, Organization)
Site/Field Logbooks	Field notes will be prepared daily by Lu Engineers and will be complete, appropriate, legible and pertinent. Upon completion of field work, logbooks will be placed in the project files.	Internal	Eric Detweiler, Lu Engineers
Chains of custody	CoC forms will be reviewed against the samples packed in the specific cooler prior to delivery. The reviewer will initial the form. An original CoC will be sent with the samples to the laboratory, while copies are retained for (1) the Sampling Trip Report and (2) the project files.	Internal	Eric Detweiler/Greg Andrus, Lu Engineers Jane Forbes, City of Rochester
Laboratory analytical data package	Data packages will be reviewed/verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	Paradigm Env. Services.
Laboratory analytical data package	Data packages will be reviewed as to content and sample information upon receipt by the Project Team and the Third Party Data Validation Personnel.	External	Greg Andrus, Lu Engineers Dr. Maxine Wright-Walters, EDV Inc.
Equis Electronic Data Deliverable (EDD)	Electronic data package will be reviewed using the Equis Electronic Data Processor (EDP) to check for errors and omissions prior to submission to NYSDEC.	Internal	Greg Andrus, Lu Engineers
Final Closure Report	The project data results will be compiled in a final report for the project. Entries will be reviewed/verified against hardcopy information.	Internal	Greg Andrus, Lu Engineers

[1] Step I – Completeness Check

[2] Internal or External is in relation to the data generator.

See Table 1 for additional examples of data elements.

Brownfields QAPP Template #13b
Project Data Validation Process (Steps IIa and IIb) [1]

Step IIa/IIb[1]	Validation Input	Description	Responsible for Validation (Name, Organization)
IIa	SOPs	Ensure that the sampling methods/procedures outlined in QAPP were followed, and that any deviations were noted/approved.	Greg Andrus, Lu Engineers
IIb	SOPs	Determine potential impacts from noted/approved deviations, in regard to PQOs.	Greg Andrus, Lu Engineers
IIa	Chains of custody	Examine CoC forms against QAPP and laboratory contract requirements (e.g., analytical methods, sample identification, etc.).	Dr. Maxine Wright-Walters, EDV Inc.
IIa	Laboratory data package	Examine packages against QAPP and laboratory contract requirements, and against COC forms (e.g., holding times, sample handling, analytical methods, sample identification, data qualifiers, QC samples, etc.).	Dr. Maxine Wright-Walters, EDV Inc.
IIb	Laboratory data package	Determine potential impacts from noted/approved deviations, in regard to PQOs. Examples include PQLs and QC sample limits (precision/accuracy).	Greg Andrus, Lu Engineers Dr. Maxine Wright-Walters, EDV Inc.
IIb	Field duplicates	Compare results of field duplicate (or replicate) analyses with RPD criteria	Greg Andrus, Lu Engineers Dr. Maxine Wright-Walters, EDV Inc.

[1]Step IIa – Compliance with Methods, Procedures, and Contracts
Step IIb – Comparison with Performance Criteria in QAPP

See Table 1 for additional examples of data elements.

Brownfields QAPP Template #13c
Project Matrix and Analytical Validation (Steps IIa and IIb)[1] Summary

This table identifies the matrices, analytical groups, and concentration levels that each entity performing validation will be responsible for, as well as criteria that will be used to validate those data.

Step IIa/IIb[1]	Matrix	Analytical Group	Concentration Level	Validation Criteria	Data Validator (title and organizational affiliation)
IIa / IIb	Soil	VOCs	Low-Med	National Functional Guidelines for Superfund Organic Methods Data Review-June 2008	Dr. Maxine Wright-Walters, EDV Inc.
IIa / IIb	Soil	SVOCs	Low-Med	National Functional Guidelines for Superfund Organic Methods Data Review-June 2008	Dr. Maxine Wright-Walters, EDV Inc.
IIa / IIb	Water	VOCs	Low-Med	National Functional Guidelines for Superfund Organic Methods Data Review-June	Dr. Maxine Wright-Walters, EDV Inc.
IIa / IIb	Water	Metals (Iron)	Low-Med	2008National Functional Guidelines for Superfund Inorganic Superfund Data Review-Jan2012	Dr. Maxine Wright-Walters, EDV Inc.
IIa / IIb	Water	BOD, COD, TOC	Low-Med		Dr. Maxine Wright-Walters, EDV Inc.

[1]Step IIa – Compliance with Methods, Procedures, and Contracts
Step IIb – Comparison with Performance Criteria in QAPP

See Table 1 for additional examples of data elements.

Brownfields QAPP Template #13d
Usability Assessment (Step III) [1]

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

Determine if any detectable amounts of contaminant(s) are present. If no detectable amounts are indicated and all data are acceptable for the verification and validation, then the data is usable. If verification and validation are not acceptable then take corrective action (determine cause, data impact, evaluate the impact and document the rationale for resampling).

Describe the evaluative procedures used to assess overall measurement error associated with the project:
Determine if the quality control data is within the performance criteria (precision, accuracy, etc) through validation process IIb (Validation Activities).

Identify the personnel responsible for performing the usability assessment:
Project Management Team:
Greg Andrus, Lu Engineers
Jane Forbes, City of Rochester
Dr. Maxine Wright-Walters, EDV Inc.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:
The Data Usability Summary Report (DUSR) will describe the rationale for the data and the presentation of any data limitations. For example, if the performance criteria are not usable to address the regulatory requirements or support the project-decision for the City of Rochester, then the DUSR should address how this problem will be resolved and discuss the alternative approach.

[1] Step III – Usability Assessment

Table 1

Data Elements for Data Review Process				
Item	Step I - Data Verification	Step IIa - Data Validation Compliance	Step IIb - Data Validation Comparison	Step III - Data Usability
Planning Documents				
Evidence of approval of QAPP	X			Use outputs from previous steps
Identification of personnel	X			
Laboratory name	X			
Methods (sampling & analytical)	X	X	X	
Performance requirements (including QC criteria)	X	X		
Project quality objectives	X		X	
Reporting forms	X	X		
Sampling plans – locations, maps grids, sample ID numbers	X	X		
Site identification	X			
SOPs (sampling & analytical)	X	X		
Staff training & certification	X			
List of project-specific analytes	X	X		
Analytical Data Package				
Case narrative	X	X	X	Use outputs from previous steps
Internal lab chain of custody	X	X		
Sample condition upon receipt, & storage records	X	X		
Sample chronology (time of receipt, extraction/digestion, analysis)	X	X		
Identification of QC samples (sampling /lab)	X	X		
Associated PE sample results	X	X	X	
Communication Logs	X	X		
Copies of lab notebook, records, prep sheets	X	X		
Corrective action reports	X	X		
Definition of laboratory qualifiers	X	X	X	
Documentation of corrective action results	X	X	X	
Documentation of individual QC results (e.g., spike, duplicate, LCS)	X	X	X	
Documentation of laboratory method deviations	X	X	X	
Electronic data deliverables	X	X		
Instrument calibration reports	X	X	X	
Laboratory name	X	X		
Laboratory sample identification no.	X	X		

QC sample raw data	X	X	X	
QC summary report	X	X	X	
Data Elements for Data Review Process				
Raw data	X	X	X	Use outputs from previous steps
Reporting forms, completed with actual results	X	X	X	
Signatures for laboratory sign-off (e.g., laboratory QA manager)	X	X		
Standards traceability records (to trace standard source form NIST, for example)	X	X	X	
Sampling Documents				
Chain of custody	X	X		Use outputs from previous steps
Communication logs	X	X		
Corrective action reports	X	X	X	
Documentation of corrective action results	X	X	X	
Documentation of deviation from methods	X	X	X	
Documentation of internal QA review	X	X	X	
Electronic data deliverables	X	X		
Identification of QC samples	X	X	X	
Meteorological data from field (e.g., wind, temperature)	X	X	X	
Sampling instrument decontamination records	X	X		
Sampling instrument calibration logs	X	X		
Sampling location and plan	X	X	X	
Sampling notes & drilling logs	X	X	X	
Sampling report (from field team leader to project manager describing sampling activities)	X	X	X	
External Reports				
External audit report	X	X	X	Use outputs from previous steps
External PT sample results	X	X		
Laboratory assessment	X	X		
Laboratory QA plan	X	X		
MDL study information	X	X	X	
NELAP accreditation	X	X		

Appendix D-1

Brownfields Site-Specific QAPP

62-64 Scio Street
Rochester, New York 14604

USEPA Assistance ID No. BF97219700

Example Chain-of-Custody

179 Lake Avenue, Rochester, NY 14608 Office (585) 647-2530 Fax (585) 647-3311

PARADIGM ENVIRONMENTAL SERVICES, INC.

CHAIN OF CUSTODY

REPORT TO:		INVOICE TO:			
COMPANY:		COMPANY: Same		LAB PROJECT #:	CLIENT PROJECT #:
ADDRESS:		ADDRESS:			
CITY: STATE: ZIP:		CITY: STATE: ZIP:		TURNAROUND TIME: (WORKING DAYS)	
PHONE: FAX:		PHONE: FAX:		STD	OTHER
PROJECT NAME/SITE NAME:	ATTN:	ATTN:		☐ 1 ☐ 2 ☐ 3 ☐ 5	☐
	COMMENTS:			Quotation #	

REQUESTED ANALYSIS

DATE	TIME	COMPOSITE	GRAB	SAMPLE LOCATION/FIELD ID	MATRIX	NUMBER CONTAINERS											REMARKS	PARADIGM LAB SAMPLE NUMBER
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
10																		

LAB USE ONLY BELOW THIS LINE

Sample Condition: Per NELAC/ELAP 210/241/242/243/244

Receipt Parameter	NELAC Compliance	
Container Type:	Y ☐	N ☐
Comments:		
Preservation:	Y ☐	N ☐
Comments:		
Holding Time:	Y ☐	N ☐
Comments:		
Temperature:	Y ☐	N ☐
Comments:		

Sampled By **Date/Time**

Total Cost: ☐

Relinquished By **Date/Time**

Received By **Date/Time**

P.I.F. ☐

Received @ Lab By **Date/Time**

Appendix D-2

Brownfields Site-Specific QAPP

62-64 Scio Street
Rochester, New York 14604

USEPA Assistance ID No. BF97219700

SOPs

WASTE PILE SAMPLING

SOP#: 2017
DATE: 11/17/94
REV. #: 0.0

1.0 SCOPE AND APPLICATION

The objective of this standard operating procedure (SOP) is to outline the equipment and methods used in collecting representative samples from waste piles, sludges or other solid or liquid waste mixed with soil.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or other procedure limitations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Stainless steel shovels, trowels, or scoops should be used to clear away surface material before samples are collected. For depth samples, a decontaminated auger may be required to advance the hole, then another decontaminated auger used for sample collection. For a sample core, thin-wall tube samplers or grain samplers may be used. Near surfaces, samples can be collected with a clean stainless steel spoon or trowel.

All samples collected, except those for volatile organic analysis, should be placed into a Teflon lined or stainless steel pail and mixed thoroughly before transfer to appropriate sample container.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

Chemical preservation of solids is generally not recommended. Refrigeration to 4°C is usually the best approach, supplemented by a minimal holding time, depending on contaminants of concern.

Wide mouth glass containers with Teflon lined caps are typically used for waste pile samples. Sample volume required is a function of the analytical requirements and should be specified in the work plan.

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

There are several variables involved in waste sampling, including shape and size of piles, compactness, and structure of the waste material. Shape and size of waste material or waste piles vary greatly in areal extent and height. Since state and federal regulations often require a specified number of samples per volume of waste, the size and shape must be used to calculate volume and to plan for the correct number of samples. Shape must also be accounted for when planning physical access to the sampling point and the equipment necessary to successfully collect the sample at that location.

Material to be sampled may be homogeneous or heterogeneous. Homogeneous material resulting from known situations may not require an extensive sampling protocol. Heterogeneous and unknown wastes require more extensive sampling and analysis to ensure the different components (i.e. layers, strata) are being represented.

The term "representative sample" is commonly used to denote a sample that has the properties and composition of the population from which it was collected and in the same proportions as found in the population. This can be misleading unless one is dealing with a homogenous waste from which one sample can represent the whole population.

The usual options for obtaining the most "representative sample" from waste piles are simple random sampling or stratified random sampling. Simple random sampling is the method of choice unless: (1) there are known distinct strata; (2) one wants to prove or disprove that there are distinct strata; or (3) one is limited in the number of samples and desires to statistically minimize the size of a "hot spot" that could go unsampled. If any of these conditions exist, stratified random sampling would be the better strategy.

Stratified random sampling can be employed only if all points within the pile can be accessed. In such cases, the pile should be divided into a three-dimensional grid system with, the grid cubes should be numbered, and the grid cubes to be sampled should be chosen by random number tables or generators. The only exceptions to this are situations in which representative samples cannot be collected safely or where the investigative team is trying to determine worst case conditions.

If sampling is limited to certain portions of the pile, a statistically based sample will be representative only of that portion, unless the waste is homogenous.

5.0 EQUIPMENT/APPARATUS

Waste pile solids include powdered, granular, or block materials of various sizes, shapes, structure, and compactness. The type of sampler chosen should be compatible with the waste. Samplers commonly used for waste piles include: stainless steel scoops, shovels, trowels, spoons, and stainless steel hand augers, sampling triers, and grain samplers.

Waste pile sampling equipment check list:

- Sampling plan
- Maps/plot plan
- Safety equipment, as specified in the Health and Safety Plan
- Compass
- Tape measure
- Survey stakes or flags
- Camera and film
- Stainless steel, plastic, or other appropriate homogenization bucket or bowl
- Appropriate size sample jars
- Ziplock plastic bags
- Logbook
- Labels
- Chain of Custody records and seals
- Field data sheets
- Cooler(s)
- Ice
- Decontamination supplies/equipment
- Canvas or plastic sheet
- Spade or shovel
- Spatula
- Scoop
- Plastic or stainless steel spoons
- Trowel
- Continuous flight (screw) augers
- Bucket auger
- Post hole auger
- Extension rods
- T-Handle
- Thin-wall tube sampler with cutting tips
- Sampling trier
- Grain sampler

6.0 REAGENTS

No chemical reagents are used for the preservation of waste pile samples; however, decontamination solutions may be required. If decontamination of equipment is required, refer to the Sampling Equipment Decontamination SOP, and the site specific work plan.

7.0 PROCEDURES

7.1 Preparation

1. Review all information available on the waste pile and expected or unknown contaminants.

2. Determine the extent of the sampling effort, the sampling methods to be employed, and the types and amounts of equipment and supplies required.

3. Obtain necessary sampling and monitoring equipment.

4. Decontaminate or pre-clean equipment, and ensure that it is in working order.

5. Prepare schedules, and coordinate with staff, client, and regulatory agencies, if appropriate.

6. Perform a general site survey prior to site entry in accordance with the site specific Health and Safety Plan.

7. Use stakes or flagging to identify and mark

all sampling locations. Specific site factors, including extent and nature of contaminant should be considered when selecting sample locations. If required, the proposed locations may be adjusted based on site access, property boundaries, and surface obstructions.

7.2 Sample Collection

7.2.1 Sampling with Shovels and Scoops

Collection of samples from surface portions of the pile can be accomplished with tools such as spades, shovels, and scoops. Surface material can be removed to the required depth with this equipment, then a stainless steel or plastic scoop, or equivalent can be used to collect the sample.

Accurate, representative samples can be collected with this procedure depending on the care and precision demonstrated by sample team members. Use of a flat, pointed mason trowel to cut a block of the desired material can be helpful when undisturbed profiles are required. A stainless steel scoop, lab spoon, plastic spoon, or equivalent will suffice in most other applications. Care should be exercised to avoid the use of devices plated with chrome or other materials. Plating is particularly common with implements such as garden trowels.

The following procedure is used to collect the surface samples:

1. Carefully remove the top layer of material to the desired sample depth with a pre-cleaned spade.

2. Using a pre-cleaned stainless steel scoop, plastic spoon, trowel, or equivalent remove and discard a thin layer of material from the area which came in contact with the spade.

3. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent, and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

7.2.2 Sampling with Bucket Augers and Thin-Wall Tube Samplers

These samplers consist of a series of extensions, a "T" handle, and a bucket auger or thin-wall tube sampler (Appendix A, Figure 1). The auger is used to bore a hole to a desired sampling depth, and is then withdrawn. The sample may be collected directly from the bucket auger. If a core sample is to be collected, the auger tip is then replaced with a thin-wall tube sampler. The sampler is then lowered down the borehole, and driven into the pile to the completion depth. The sampler is withdrawn and the core collected from the thin-wall tube sampler.

Several augers are available. These include: bucket, continuous flight (screw), and post hole augers. Bucket augers are better for direct sample recovery since they provide a large volume of sample in a short time. When continuous flight augers are used, the sample can be collected directly from the flights, which are usually at five (5) foot intervals. The continuous flight augers are satisfactory for use when a composite of the complete waste pile column is desired. Post hole augers have limited utility for sample collection as they are designed to cut through fibrous, rooted, swampy areas.

The following procedure will be used for collecting waste pile samples with the bucket augers and thin-wall tube samplers:

1. Attach the auger bit to a drill rod extension, and attach the "T" handle to the drill rod.

2. Clear the area to be sampled of any surface debris. It may be advisable to remove the first three to six inches of surface material for an area approximately six inches in radius around the drilling location.

3. Begin augering, periodically removing and depositing accumulated materials onto a plastic sheet spread near the hole. This prevents accidental brushing of loose

material back down the borehole when removing the auger or adding drill rod extensions. It also facilitates refilling the hole, and avoids possible contamination of the surrounding area.

4. After reaching the desired depth, slowly and carefully remove the auger from the borehole. When sampling directly from the auger, collect the sample after the auger is removed from the borehole and proceed to Step 10.

5. Remove auger tip from drill rods and replace with a pre-cleaned thin-wall tube sampler. Install proper cutting tip.

6. Carefully lower the tube sampler down the borehole. Gradually force the tube sampler into the pile. Care should be taken to avoid scraping the borehole sides. Avoid hammering the drill rod extensions to facilitate coring as the vibrations may cause the borehole walls to collapse.

7. Remove the tube sampler, and unscrew the drill rod extensions.

8. Remove the cutting tip and the thin-wall tube sampler.

9. Discard the top of the core (approximately one-inch), as this represents material collected before penetration of the layer of concern. Place the remaining core into the appropriate labeled sample container. Sample homogenization is not required.

10. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

11. If another sample is to be collected in the same hole, but at a greater depth, reattach the bucket auger to the drill and assembly, and follow steps 3 through 11, making sure to decontaminate the bucket auger and thin-wall tube sampler between samples.

7.2.3 Sampling with a Trier

This sampling device consists of a trier, and a "T" handle. The trier is driven into the waste pile and used to extract a core sample from the appropriate depth.

The following procedure will be used to collect waste pile samples with a sampling trier:

1. Insert the trier (Appendix A, Figure 2) into the material to be sampled at a 0E to 45E angle from horizontal. This orientation minimizes spillage of the sample. Extraction of the samples might require tilting of the sample containers.

2. Rotate the trier once or twice to cut a core of material.

3. Slowly withdraw the trier, making sure that the slot is facing upward.

4. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are being collected, place samples from the other sampling intervals into the homogenization container and mix thoroughly. When compositing is complete, place the sample

into appropriate, labeled containers and secure the caps tightly.

7.2.4 Sampling with a Grain Sampler

The grain sampler (Appendix A, Figure 3) is used for sampling powdered or granular wastes or materials in bags, fiber drums, sacks, similar containers or piles. This sampler is most useful when the solids are no greater than 0.6 cm (1/4") in diameter.

This sampler consists of two slotted telescoping brass or stainless steel tubes. The outer tube has a conical, pointed tip at one end that permits the sampler to penetrate the material being sampled. The sampler is opened and closed by rotating the inner tube. Grain samplers are generally 61 to 100 cm (24 to 40 in.) long by 1.27 to 2.54 cm (1/2 to 1 in.) in diameter and are commercially available at laboratory supply houses.

The following procedures will be used to collect waste pile samples with a grain sampler:

1. With the sampler in the closed position, insert it into the granular or powdered material or waste being sampled from a point near a top edge or corner, through the center, and to a point diagonally opposite the point of entry.

2. Rotate the sampler inner tube into the open position.

3. Wiggle the sampler a few times to allow material to enter the open slots.

4. Place the sampler in the closed position and withdraw from the material being sampled.

5. Place the sampler in a horizontal position with the slots facing upward.

6. Rotate the outer tube and slide it away from the inner tube.

7. If volatile organic analysis is to be performed, transfer the sample into an appropriate, labeled sample container with a stainless steel lab spoon, plastic lab spoon, or equivalent and secure the cap tightly. Place the remainder of the sample into a stainless steel, plastic, or other appropriate homogenization container, and mix thoroughly to obtain a homogenous sample representative of the entire sampling interval. Then, either place the sample into appropriate, labeled containers and secure the caps tightly; or, if composite samples are to be collected, place a sample from another sampling interval into the homogenization container and mix thoroughly. When compositing is complete, place the sample into appropriate, labeled containers and secure the caps tightly.

8.0 CALCULATIONS

This section is not applicable to this SOP.

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following QA procedures apply:

1. All data must be documented on field data sheets or within site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation, and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA/OSHA and corporate health and safety procedures.

12.0 REFERENCES

Test Methods for Evaluating Solids Waste (SW-846), Third Edition, Vol. II Field Manual U.S. EPA Office of Solid Waste and Emergency Response, Washington, D.C. November, 1986.

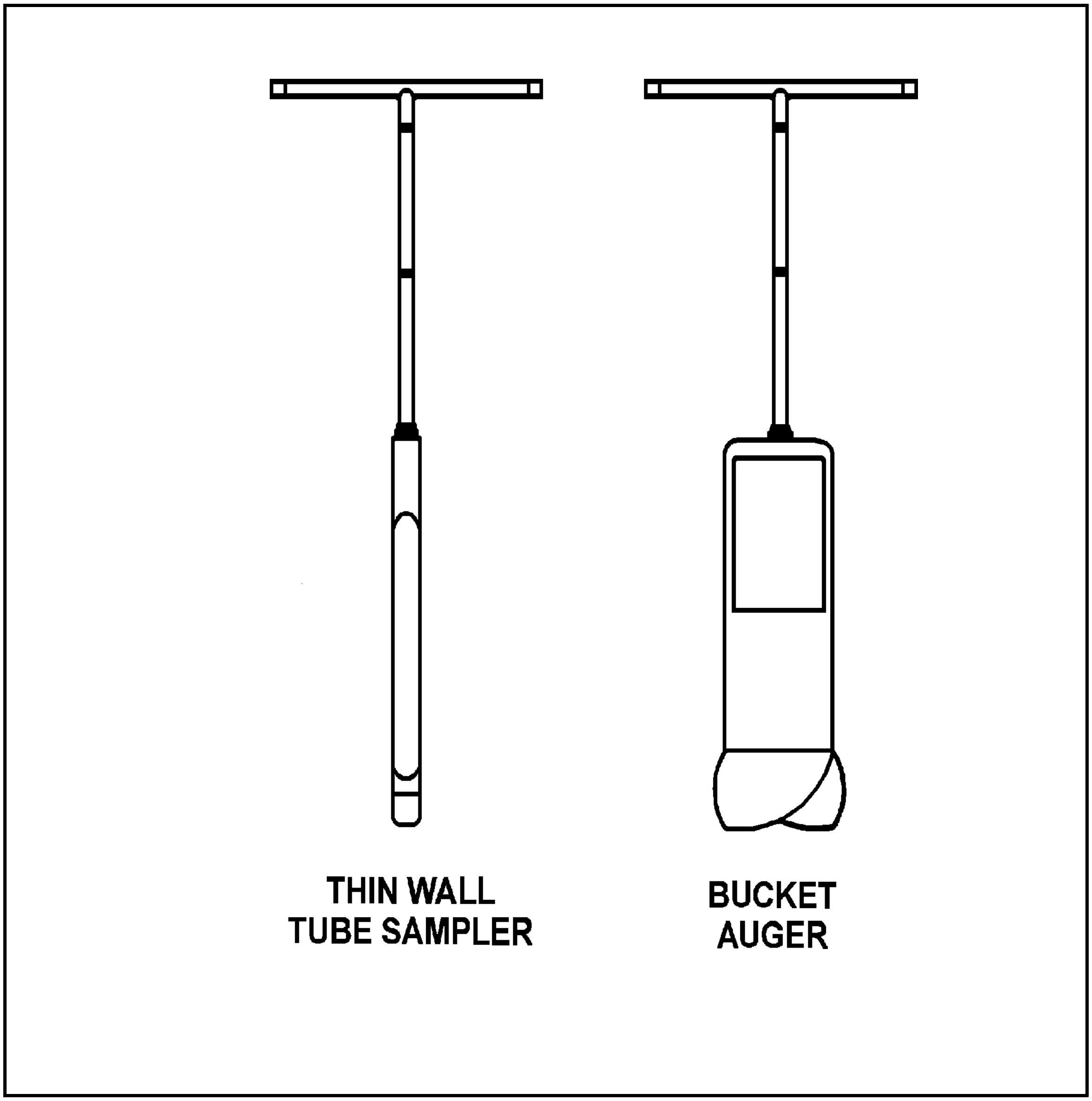
Engineering Support Branch Standard Operating Procedures and Quality Assurance Manual, U.S. Environmental Protection Agency, Region IV, April 1, 1986.

Field Sampling Procedures Manual, New Jersey Department of Environmental Protection, February, 1988.

APPENDIX A

Figures

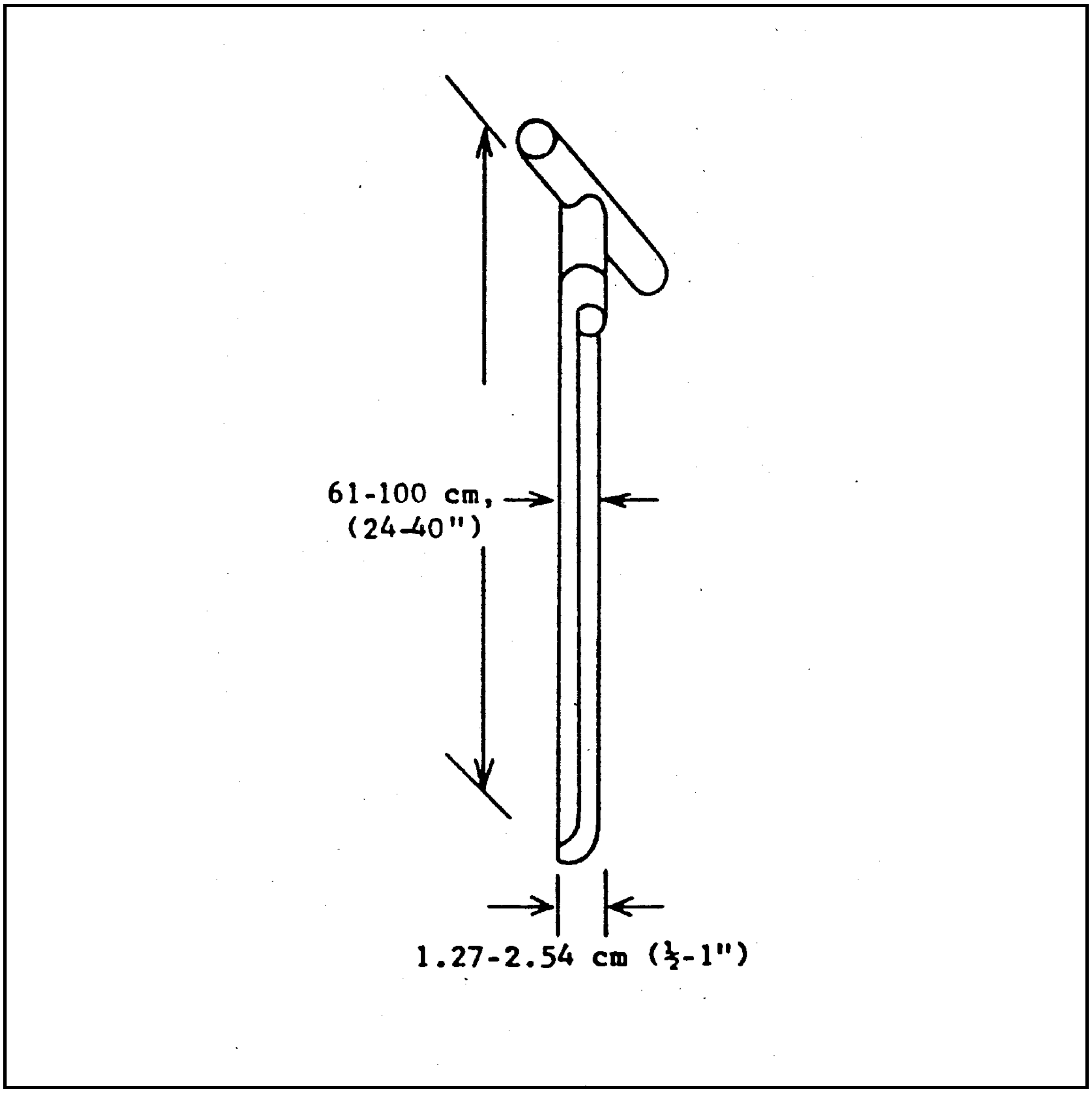
FIGURE 1. Sampling Augers



APPENDIX A (Cont'd)

Figures

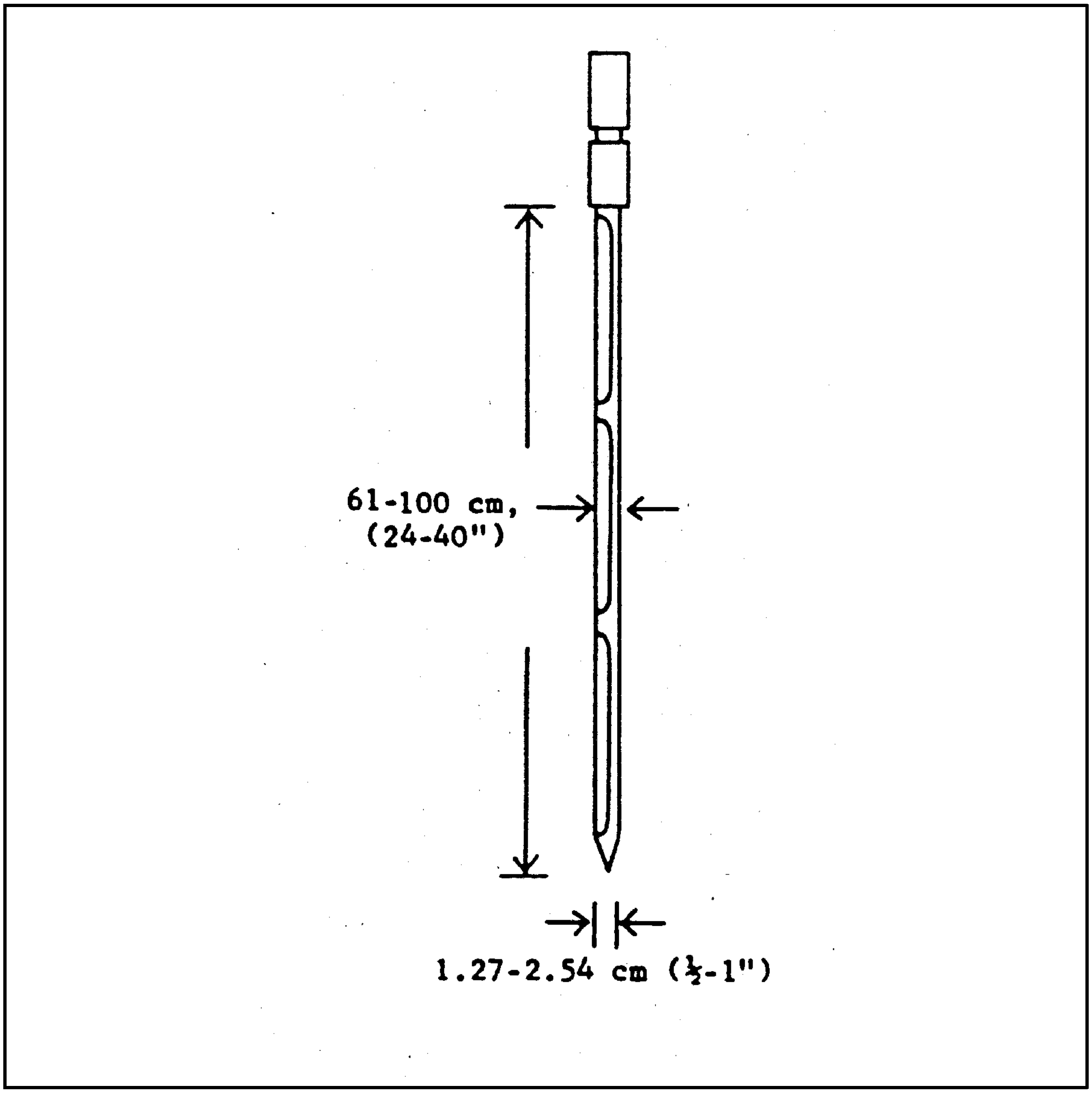
FIGURE 2. Sampling Trier



APPENDIX A (Cont'd)

Figures

FIGURE 3. Grain Sampler



Field Equipment Decontamination Procedures

1.0 OBJECTIVE

This guideline is to provide general reference information on field decontamination.

2.0 LIMITATIONS

These limitations apply to all field decontamination activities excepting requirements of project-specific plans for field decontamination.

3.0 DEFINITIONS

The following terminology is applicable to field decontamination.

Decontamination. The process of neutralization, washing, rinsing, and removing contamination from exposed surfaces of equipment to minimize the potential for contaminant migration.

Cross-Contamination. The transfer of contaminants from their known or suspected location into a noncontaminated location.

4.0 GUIDELINES

Effective decontamination procedures are implemented to minimize the potential for cross-contamination and to minimize the potential for off-site contaminant migration.

The generalized sequence of routine decontamination procedures for sampling equipment consists of a detergent wash (i.e., low-phosphate Alconox detergent), followed by two rinses with tap water. If muddy conditions prevail, it is recommended that the equipment be rinsed with tap water into a separate tub prior to the detergent wash. Heavy equipment, such as drill rigs and drilling equipment, are normally steam-cleaned or pressure-washed to remove all adhered materials.

4.1 Routine Decontamination Procedures for Sampling Equipment

The following decontamination procedure is applicable for all equipment used to collect routine samples for Substances of Concern (SOC).

1. Wash and scrub equipment with detergent.
   Alconox and water are generally used.*
2. Rinse with tap water.
3. Final rinse with tap water.
4. Air-dry.
5. Wrap in aluminum foil, shiny side out, for transport.

* If equipment is muddy, it should first be rinsed with water in a separate tub prior to the detergent and water scrub.

If the equipment is visibly oily and not disposable, then it is rinsed with methanol, hexane, and methanol again, prior to the detergent and water scrub. Otherwise discard.

4.1 Decontamination Procedure of Tubing and a Pump if Used to Evacuate a Well

The pump and tubing must be decontaminated according to the following procedure prior to each use. If tubing is dedicated to the well and stored in the well, then it will not require decontamination.

1. Alconox soap and water wash.
2. Tap (or potable) water rinse.
3. Pump a minimum of 4 liters of tap water through the pump.
4. Distilled/deionized water rinse.

4.2 Decontamination Procedure for Field Instruments

1. All field instruments will be cleaned as per the manufacturer's instructions.
2. All probes will be rinsed with DI water between sample locations.

Groundwater Monitoring Well Installation Procedure
62-64 Scio Street

Prior to initiating drilling activities, the drilling rig, augers, rods, split spoons, pertinent equipment, well pipe and screens will be steam cleaned. These activities will be performed prior to arrival at the Site. Throughout and after the cleaning processes, direct contact between the equipment and the ground surface will be avoided. The drilling rig and all equipment will be steam cleaned upon completion of the investigation and prior to leaving the Site.

Two-inch diameter groundwater monitoring wells will be installed through the bedrock/ overburden interface using hollow stem auger techniques, and HQ coring approximately 5 feet into bedrock. All permanent groundwater monitoring wells will be constructed according to the following specifications: 10 feet of 2-inch Schedule 40 polyvinyl chloride (PVC) machine-slotted screen (0.010-inch slot) installed five feet into groundwater followed by 2-inch ID schedule 40 PVC riser casing.

A sand filter pack composed of chemically inert, coarse-grained sand will be placed from the bottom of the boring to 1 to 2 feet above the top of the screen. A 2-foot thick bentonite seal will be placed above the sand, followed by Portland cement/5% bentonite grout to surface. The wells will be completed with bolted flush-to-grade manway well covers set in concrete drainage pads. Vented PVC well caps will be placed on each well upon completion. No glue will be used for completion of wells.

During the drilling process, a portable VOC monitor (i.e., PID), and an O2/explosimeter will be used to monitor the gases exiting the hole.

Well Casing (Riser)
The well riser shall consist of 2-inch diameter, threaded flush-joint polyvinyl chloride (PVC) pipe. All well risers will conform to the requirements of ASTM-D 1785 Schedule 40 pipe, and shall bear markings that will identify the material as that which is specified. All materials used to construct the wells will be NSF International (a division of American National Standards Institute (ANSI)/American Society of Testing and Materials (ASTM)) approved.

Well Screen
Generally, wells will be constructed with 10-foot machine-slotted screens, unless otherwise specified in the RI Work Plan or dictated by field conditions (e.g., screens of less than 10 feet in length may be used, depending on the characteristics of the well).

Screen and riser sections shall be joined by flush-threaded coupling to form watertight unions that retain 100% of the strength of the casing. Solvent PVC glues shall not be used at any time in the construction of the wells. The bottom of the screen shall be sealed with a treated cap or plug. No lead shot or lead wool is to be employed in sealing the bottom of the well or for sealant at any point in the well.

All risers and screens shall be set round, plumb, and true to line.

Artificial Sand Pack

Granular backfill will be chemically and texturally clean inert, siliceous, and of appropriate grain size for the screen slot size and the host environment. The well screen and riser casing will be installed, and the sand pack placed around the screen and casing to a depth approximately 2 feet above the top of the well screen.

Bentonite Seal

A minimum 2-foot thick seal of bentonite pellets/chips and water slurry will be placed directly on top of the sand pack, and care will be taken to avoid bridging. The seal will be measured immediately after placement, without allowance for swelling.

Grout Mixture

Upon completion of the bentonite seal, the well will be grouted with a non-shrinking cement grout mix to be placed from the top of the bentonite seal to the ground surface. The cement grout shall consist of a mixture of Portland cement (ASTM C 150) and water, in the proportion of not more than 7 gallons of clean water per bag of cement (1 cubic foot or 94 pounds). Additionally, 3% by weight of bentonite powder shall be added, if permitted.

Surface Protection

At all times during the progress of the work, precautions shall be used to prevent tampering with or the entrance of foreign material into the well. Upon completion of the well, a suitable vented cap shall be installed to prevent material from entering the well. For on-Site wells, the PVC well riser shall be surrounded by a steel casing rising 24 to 36 inches above ground level and set into a concrete pad. A concrete pad, sloped away from the well, shall be constructed around the well casing. The ground immediately around the top of the well shall be sloped away from the well. There shall be an opening in the protective casing wall at the top of the cement pad to allow for internal drainage. On-Site wells, located on the southern portion of the Site and any off-Site wells will be installed flush mounted.

Any well that is to be temporarily removed from service or left incomplete due to delay in construction, shall be capped with a watertight cap and equipped with a “vandal-proof” cover, satisfying applicable NYSDEC regulations or recommendations.

Surveying

Coordinates and elevations will be established by a New York State licensed land surveyor for each monitoring well location. A map of each Site will be prepared for inclusion into the final report for the Site.

Elevations (0.010 foot) will be established for the ground surface at each monitoring well, the top of each monitoring well inner casing (TOC), and at least one other permanent object (i.e., property corner markers, corners of buildings, bridges, etc.) in the vicinity of the wells. Elevations will be provided using the NAD 83 UTM Zone 18 (NYTM) coordinate system.

Geologic Logging and Sampling

At each well location, the boring will be advanced through overburden using a drill rig and hollow-stem auger, and soils will be visually inspected for stains and monitored with a PID. Depending on the amount of existing subsurface data at the selected well locations (to be determined), soil samples may be collected continuously over the entire depth of the well. The sampling device will be decontaminated according to procedures outlined in Section above.

As necessary to completely assess the nature and extent of residual contamination follwong completion of the source area excavation, the split-spoon sampler will be driven into the soil using a 140-pound safety hammer and allowed to free-fall 30 inches, in accordance with ASTM-D 1586-84 specifications. The number of blows required to drive the sampler each 6 inches of penetration will be recorded. Soil samples will be screened in the field for volatile organic vapors using a PID, and will be classified in accordance with Unified or Burmeister Soil Classification System specifications, and logged. Samples will be stored in glass jars until they are needed for testing or the project is complete. Logging during the coring process will be completed by a qualified geologist who will fully document lithology and hydrogeologic characteristics.

Monitoring well borings will be installed to a depth determined through the examination of boring logs and water levels encountered as well as on-Site discussions and agreement between the NYSDEC representative and Lu Engineers' Field Team Leader. All significant discrepancies between the prepared Work Plan and actual Site conditions will be noted and countersigned by both parties in the project's on-Site logbook.

If hydrogeologic conditions are favorable for well installation at a depth less than design, the well will be installed at the boring or coring termination depth. In the event that maximum design depth is reached and hydrogeologic conditions are not suitable for well installation, the maximum drilling depth will be revised. Hydrogeologic suitability for well emplacement will be determined by the supervising geologist in consultation with NYSDEC, based on thickness and estimated hydraulic conductivity to the saturated zone encountered. If necessary, the borehole will be advanced to water or abandoned.

Drilling logs will be prepared by an experienced geologist who will be present during all drilling operations. One copy of each field boring log, well construction log, and groundwater data will be submitted as part of the report. Information provided in the logs shall include, but not be limited to, the following:

- Date, test hole identification, and project identification;
- Name of individual developing the log;
- Name of driller and assistant(s);
- Drill, make and model, auger size;
- Identification of alternative drilling methods used and justification thereof (i.e., rotary drilling with a specific bit type to remove material from within the hollow stem augers);
- Standard penetration test (ASTM D-1586) blow counts;
- Field diagram of each monitoring well installed with the depth to bottom of screen, top of screen, and pack, bentonite seal, etc.;

- Reference elevation for all depth measurements;
- Depth of each change of stratum;
- Thickness of each stratum;
- Identification of the material of which each stratum is composed, according to the USCS system or standard rock nomenclature, as appropriate;
- Depth interval from which each sample was taken;
- Depth at which hole diameters (bit sizes) change;
- Depth at which groundwater is encountered;
- Depth to static water level;
- Total depth of completed well;
- Depth or location of any loss of tools or equipment;
- Location of any fractures, joints, faults, cavities, or weathered zones;
- Depth of any grouting or sealing;
- Nominal hole diameters;
- Amount of cement used for grouting or sealing;
- Depth and type of well casing;
- Description of well screen (to include depth, length, location, diameter, slot sizes, material, and manufacturer);
- Any sealing-off of water-bearing strata;
- Static water level upon completion of the well and after development;
- Drilling date or dates;
- Construction details of well; and
- An explanation of any variations from the CAP.

WELL DEVELOPMENT

SOP#: 2044
DATE: 10/03/94
REV. #: 0.0

1.0 SCOPE AND APPLICATION

The purpose of this standard operating procedure (SOP) is to provide an overview of monitor well development practices. The purpose of monitor well development is to ensure removal of fines from the vicinity of the well screen. This allows free flow of water from the formation into the well and also reduces the turbidity of the water during sampling events. The most common well development methods are: surging, jetting, overpumping and bailing.

Surging involves raising and lowering a surge block or surge plunger inside the well. The resulting surging motion forces water into the formation and loosens sediment to be pulled from the formation into the well. Occasionally, sediments must be removed from the well with a sand bailer to prevent sand locking of the surge block. This method may cause the sand pack around the screen to be displaced to a degree that damages its value as a filtering medium. For example, channels or voids may form near the screen if the filter pack sloughs away during surging (Keely and Boateng, 1987).

Jetting involves lowering a small diameter pipe into the well a few feet above the well screen, and injecting water or air through the pipe under pressure so that sediments at the bottom are geysered out of the top of the well. It is important not to jet air or water directly across the screen. This may cause fines in the well to be driven into the entrance of the screen openings, thereby causing blockages.

Overpumping involves pumping at a rate rapid enough to draw the water level in the well as low as possible, and allowing it to recharge. This process is repeated until sediment-free water is produced.

Bailing includes using a simple check-valve bailer to remove water from the well. The bailing method, like other methods, should be repeated until sediment free water is produced. Bailing may be the method of choice in a shallow well or well that recharges slowly.

These are standard (i.e., typically applicable) operating procedures which may be varied or changed as required, dependent on site conditions, equipment limitations or limitations imposed by the procedure or other procedure limitations. In all instances, the ultimate procedures employed should be documented and associated with the final report.

Mention of trade names or commercial products does not constitute U.S. EPA endorsement or recommendation for use.

2.0 METHOD SUMMARY

Development of a well should occur as soon as it is practical after installation, but not sooner than 48 hours after grouting is completed, if a rigorous well development method is being used. If a less rigorous method, such as bailing, is used for development, it may be initiated shortly after installation. The main concern is that the method being used for development does not interfere with allowing the grout to set.

Open the monitoring well, take initial measurements (i.e., head space air monitor readings, water level, well depth, pH, temperature, and specific conductivity) and record results in the site logbook. Develop the well by the appropriate method (i.e., overpumping, jetting, or surging) to accommodate site conditions and project requirements. Continue until the developed water is clear and free of sediments. Containerize all discharge water from known or suspected contaminated areas. Record final measurements in logbook. Decontaminate equipment as appropriate prior to use in the next well.

3.0 SAMPLE PRESERVATION, CONTAINERS, HANDLING, AND STORAGE

This section is not applicable to this (SOP).

4.0 INTERFERENCES AND POTENTIAL PROBLEMS

The following interferences or problems may occur during well development:

1. Overpumping is not as vigorous as surging and jetting, and is probably the most desirable method for monitor well development.

2. The possibility of disturbing the filter pack increases with surging and jetting well development methods.

3. The introduction of external water or air by jetting may alter the hydrochemistry of the aquifer.

5.0 EQUIPMENT/APPARATUS

The type of equipment used for well development is dependent on the diameter of the well and the development method. For example, the diameter of most submersible pumps is too large to fit in a two-inch inner diameter (I.D.) well and an inertia pump or other development method should be used.

In general, the well should be developed with the drilling equipment shortly after it is drilled. Most drilling rigs have air compressors or pumps that may be used for the development process.

6.0 REAGENTS

No chemical reagents are used in this procedure; however, decontamination solutions may be necessary. If decontamination of equipment is required at a well, refer to the SOP for Sampling Equipment Decontamination and the site specific work plan.

7.0 PROCEDURES

7.1 Preparation

1. Coordinate site access and obtain keys to the locks.

2. Obtain information on each well to be developed (i.e., drilling, method, well

diameter, depth, screened interval, anticipated contaminations, etc.).

3. Obtain a water level meter, a depth sounder, air monitoring equipment, materials for decontamination, pH and specific conductivity meters, a thermometer, stopwatch, and development equipment/apparatus.

4. Assemble containers for temporary storage of water produced during well development. Containers must be structurally sound, compatible with anticipated contaminants, and easy to manage in the field. The use of truck-mounted tanks may be necessary in some cases; alternately, a portable water treatment unit (i.e., activated carbon) may be used to decontaminate the purge water.

7.2 Operation

Development should be performed as soon as it is practical after the well is installed, but no sooner than 48 hours after grouting is completed. Dispersing agents, acids, or disinfectants should not be used to enhance development of the well.

1. Assemble necessary equipment on a plastic sheet around the well.

2. Record pertinent information in field logbook (personnel, time, location ID, etc.).

3. Open monitor well, take air monitoring reading at the top of casing and breathing zone as appropriate.

4. Measure depth to water and the total depth of the monitoring well.

5. Develop the well until the water is clear and free of sediments. Note the initial color, clarity, and odor of the water.

6. Measure the initial pH, temperature, and specific conductivity of the water and record in logbook.

7. All water produced by development in contaminated or suspected contaminated areas must be containerized or treated. Each container must be clearly labeled with the location ID. Determination of the appropriate disposal method will be based on the first round of analytical results from each well.

8. No water shall be added to the well to assist development without prior approval by appropriate personnel. If a well cannot be cleaned of mud to produce formation water because the aquifer yields insufficient water, small amounts of potable water may be injected to clean up this poorly yielding well. This may be done by dumping in buckets of water. When most of the mud is out, continue development with formation water only. It is essential that at least five times the amount of water injected must be produced back from the well in order to assure that all injected water is removed from the formation.

9. Note the final color, clarity and odor of the water.

10. Measure the final pH, temperature and specific conductance of the water and record in the site logbook.

11. Record the following data in the site logbook:

    - Well designation (location ID)
    - Date(s) of well installation
    - Date(s) and time of well development
    - Static water level before and after development
    - Quantity of water removed and time of removal
    - Type and size/capacity of pump and/or bailer used
    - Description of well development techniques used

7.3 Post-Operation

1. Decontaminate all equipment.

2. Store containers of water produced during development in a safe and secure area.

3. After the first round of analytical results have been received, determine and implement the appropriate water disposal method.

8.0 CALCULATIONS

There are no calculations necessary to implement this procedure. However, if it is necessary to calculate the volume of water in the well, utilize the following equation:

$$\textit{Well volume} \;\; ' \;\; \mathrm{B} r^2 h \; (cf) \quad [\textit{Equation } 1]$$

where:

B	=	pi
r	=	radius of monitoring well (feet)
h	=	height of the water column (feet) [This may be determined by subtracting the depth to water from the total depth of the well as measured from the same reference point.]
cf	=	conversion factor (gal/ft^3) = 7.48 gal/ft^3 [In this equation, 7.48 gal/ft^3 is the necessary conversion factor.]

Monitor well diameters are typically 2", 3", 4", or 6". Knowing the diameter of the monitor well, there are a number of standard conversion factors which can be used to simplify the equation above.

The volume, in gallons per linear foot, for various standard monitor well diameters can be calculated as follows:

$$V \; (gal/ft) \;\; ' \;\; \mathrm{B} r^2 \; (cf) \quad [\textit{Equation } 2]$$

where:

B	=	pi
r	=	radius of monitoring well (feet)
cf	=	conversion factor (7.48 gal/ft^3)

For example, a two inch diameter well, the volume per linear foot can be calculated as follows:

vol/linear ft	=	nr^2 (cf) [Equation 2]
	=	3.14 (1/12 ft)^2 7.48 gal/ft^3
	=	0.1632 gal/ft

Remember that if you have a two inch diameter, well you must convert this to the radius in feet to be able to use the equation.

The conversion factors for the common size monitor wells are as follows:

Well diameter	2"	3"	4"	6"
Volume (gal/ft)	0.1632	0.3672	0.6528	1.4688

If you utilize the conversation factors above, Equation 1 should be modified as follows:

$$\textit{Well volume} \;\; ' \;\; (h)(cf) \quad [\textit{Equation } 3]$$

where:

h	=	height of water column (feet)
cf	=	the conversion factor calculated from Equation 2

9.0 QUALITY ASSURANCE/ QUALITY CONTROL

There are no specific quality assurance activities which apply to the implementation of these procedures. However, the following general QA procedures apply:

1. All data must be documented in personal/site logbooks.

2. All instrumentation must be operated in accordance with operating instructions as supplied by the manufacturer, unless otherwise specified in the work plan. Equipment checkout and calibration activities must occur prior to sampling/operation and they must be documented.

10.0 DATA VALIDATION

This section is not applicable to this SOP.

11.0 HEALTH AND SAFETY

When working with potentially hazardous materials, follow U.S. EPA, OSHA, and corporate health and safety practices.

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Ground Water Issue

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

Background

The Regional Superfund Ground Water Forum is a group of ground-water scientists, representing EPA's Regional Superfund Offices, organized to exchange information related to ground-water remediation at Superfund sites. One of the major concerns of the Forum is the sampling of ground water to support site assessment and remedial performance monitoring objectives. This paper is intended to provide background information on the development of low-flow sampling procedures and its application under a variety of hydrogeologic settings. It is hoped that the paper will support the production of standard operating procedures for use by EPA Regional personnel and other environmental professionals engaged in ground-water sampling.

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I. Introduction

The methods and objectives of ground-water sampling to assess water quality have evolved over time. Initially the emphasis was on the assessment of water quality of aquifers as sources of drinking water. Large water-bearing units were identified and sampled in keeping with that objective. These were highly productive aquifers that supplied drinking water via private wells or through public water supply systems. Gradually, with the increasing awareness of subsurface pollution of these water resources, the understanding of complex hydrogeochemical processes which govern the fate and transport of contaminants in the subsurface increased. This increase in understanding was also due to advances in a number of scientific disciplines and improvements in tools used for site characterization and ground-water sampling. Ground-water quality investigations where pollution was detected initially borrowed ideas, methods, and materials for site characterization from the water supply field and water analysis from public health practices. This included the materials and manner in which monitoring wells were installed and the way in which water was brought to the surface, treated, preserved and analyzed. The prevailing conceptual ideas included convenient generalizations of ground-water resources in terms of large and relatively homogeneous hydrologic *units*. With time it became apparent that conventional water supply generalizations of *homogeneity* did not adequately represent field data regarding pollution of these subsurface resources. The important role of *heterogeneity* became increasingly clear not only in geologic terms, but also in terms of complex physical,

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chemical and biological subsurface processes. With greater appreciation of the role of heterogeneity, it became evident that subsurface pollution was ubiquitous and encompassed the unsaturated zone to the deep subsurface and included unconsolidated sediments, fractured rock, and *aquitards* or low-yielding or impermeable formations. Small-scale processes and heterogeneities were shown to be important in identifying contaminant distributions and in controlling water and contaminant flow paths.

It is beyond the scope of this paper to summarize all the advances in the field of ground-water quality investigations and remediation, but two particular issues have bearing on ground-water sampling today: aquifer heterogeneity and colloidal transport. Aquifer heterogeneities affect contaminant flow paths and include variations in geology, geochemistry, hydrology and microbiology. As methods and the tools available for subsurface investigations have become increasingly sophisticated and understanding of the subsurface environment has advanced, there is an awareness that in most cases a primary concern for site investigations is characterization of contaminant flow paths rather than entire aquifers. In fact, in many cases, plume thickness can be less than well screen lengths (e.g., 3-6 m) typically installed at hazardous waste sites to detect and monitor plume movement over time. Small-scale differences have increasingly been shown to be important and there is a general trend toward smaller diameter wells and shorter screens.

The hydrogeochemical significance of colloidal-size particles in subsurface systems has been realized during the past several years (Gschwend and Reynolds, 1987; McCarthy and Zachara, 1989; Puls, 1990; Ryan and Gschwend, 1990). This realization resulted from both field and laboratory studies that showed faster contaminant migration over greater distances and at higher concentrations than flow and transport model predictions would suggest (Buddemeier and Hunt, 1988; Enfield and Bengtsson, 1988; Penrose et al., 1990). Such models typically account for interaction between the mobile aqueous and immobile solid phases, but do not allow for a mobile, reactive solid phase. It is recognition of this third *phase* as a possible means of contaminant transport that has brought increasing attention to the manner in which samples are collected and processed for analysis (Puls et al., 1990; McCarthy and Degueldre, 1993; Backhus et al., 1993; U. S. EPA, 1995). If such a phase is present in sufficient mass, possesses high sorption reactivity, large surface area, and remains stable in suspension, it can serve as an important mechanism to facilitate contaminant transport in many types of subsurface systems.

Colloids are particles that are sufficiently small so that the surface free energy of the particle dominates the bulk free energy. Typically, in ground water, this includes particles with diameters between 1 and 1000 nm. The most commonly observed mobile particles include: secondary clay minerals; hydrous iron, aluminum, and manganese oxides; dissolved and particulate organic materials, and viruses and bacteria. These reactive particles have been shown to be mobile under a variety of conditions in both field studies and laboratory column experiments, and as such need to be included in monitoring programs where identification of the *total* mobile contaminant loading (dissolved + naturally suspended particles) at a site is an objective. To that end, sampling methodologies must be used which do not artificially bias *naturally* suspended particle concentrations.

Currently the most common ground-water purging and sampling methodology is to purge a well using bailers or high speed pumps to remove 3 to 5 casing volumes followed by sample collection. This method can cause adverse impacts on sample quality through collection of samples with high levels of turbidity. This results in the inclusion of otherwise immobile artifactual particles which produce an overestimation of certain analytes of interest (e.g., metals or hydrophobic organic compounds). Numerous documented problems associated with filtration (Danielsson, 1982; Laxen and Chandler, 1982; Horowitz et al., 1992) make this an undesirable method of rectifying the turbidity problem, and include the removal of potentially mobile (contaminant-associated) particles during filtration, thus artificially biasing contaminant concentrations low. Sampling-induced turbidity problems can often be mitigated by using low-flow purging and sampling techniques.

Current subsurface conceptual models have undergone considerable refinement due to the recent development and increased use of field screening tools. So-called hydraulic *push* technologies (e.g., cone penetrometer, Geoprobe®, QED HydroPunch®) enable relatively fast screening site characterization which can then be used to design and install a monitoring well network. Indeed, alternatives to conventional monitoring wells are now being considered for some hydrogeologic settings. The ultimate design of any monitoring system should however be based upon adequate site characterization and be consistent with established monitoring objectives.

If the sampling program objectives include accurate assessment of the magnitude and extent of subsurface contamination over time and/or accurate assessment of subsequent remedial performance, then some information regarding plume delineation in three-dimensional space is necessary prior to monitoring well network design and installation. This can be accomplished with a variety of different tools and equipment ranging from hand-operated augers to screening tools mentioned above and large drilling rigs. Detailed information on ground-water flow velocity, direction, and horizontal and vertical variability are essential baseline data requirements. Detailed soil and geologic data are required prior to and during the installation of sampling points. This includes historical as well as detailed soil and geologic logs which accumulate during the site investigation. The use of borehole geophysical techniques is also recommended. With this information (together with other site characterization data) and a clear understanding of sampling objectives, then appropriate location, screen length, well diameter, slot size, etc. for the monitoring well network can be decided. This is especially critical for new in situ remedial approaches or natural attenuation assessments at hazardous waste sites.

In general, the overall goal of any ground-water sampling program is to collect water samples with no alteration in water chemistry; analytical data thus obtained may be used for a variety of specific monitoring programs depending on the regulatory requirements. The sampling methodology described in this paper assumes that the monitoring goal is to sample monitoring wells for the presence of contaminants and it is applicable whether mobile colloids are a concern or not and whether the analytes of concern are metals (and metalloids) or organic compounds.

II. Monitoring Objectives and Design Considerations

The following issues are important to consider prior to the design and implementation of any ground-water monitoring program, including those which anticipate using low-flow purging and sampling procedures.

A. Data Quality Objectives (DQOs)

Monitoring objectives include four main types: detection, assessment, corrective-action evaluation and resource evaluation, along with *hybrid* variations such as site-assessments for property transfers and water availability investigations. Monitoring objectives may change as contamination or water quality problems are discovered. However, there are a number of common components of monitoring programs which should be recognized as important regardless of initial objectives. These components include:

1) Development of a conceptual model that incorporates elements of the regional geology to the local geologic framework. The conceptual model development also includes initial site characterization efforts to identify hydrostratigraphic units and likely flow-paths using a minimum number of borings and well completions;

2) Cost-effective and well documented collection of high quality data utilizing simple, accurate, and reproducible techniques; and

3) Refinement of the conceptual model based on supplementary data collection and analysis.

These fundamental components serve many types of monitoring programs and provide a basis for future efforts that evolve in complexity and level of spatial detail as purposes and objectives expand. High quality, reproducible data collection is a common goal regardless of program objectives.

High quality data collection implies data of sufficient accuracy, precision, and completeness (i.e., ratio of valid analytical results to the minimum sample number called for by the program design) to meet the program objectives. Accuracy depends on the correct choice of monitoring tools and procedures to minimize sample and subsurface disturbance from collection to analysis. Precision depends on the repeatability of sampling and analytical protocols. It can be assured or improved by replication of sample analyses including blanks, field/lab standards and reference standards.

B. Sample Representativeness

An important goal of any monitoring program is collection of data that is truly representative of conditions at the site. The term *representativeness* applies to chemical and hydrogeologic data collected via wells, borings, piezometers, geophysical and soil gas measurements, lysimeters, and temporary sampling points. It involves a recognition of the statistical variability of individual subsurface physical properties, and contaminant or major ion concentration levels, while explaining extreme values. Subsurface temporal and spatial variability are facts. Good professional practice seeks to maximize representativeness by using proven accurate and reproducible techniques to define limits on the distribution of measurements collected at a site. However, measures of representativeness are dynamic and are controlled by evolving site characterization and monitoring objectives. An evolutionary site characterization model, as shown in Figure 1, provides a systematic approach to the goal of consistent data collection.

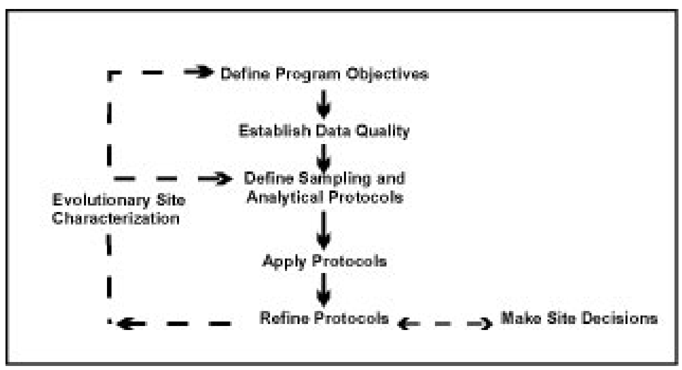

Figure 1. Evolutionary Site Characterization Model

The model emphasizes a recognition of the causes of the variability (e.g., use of inappropriate technology such as using bailers to purge wells; imprecise or operator-dependent methods) and the need to control avoidable errors.

1) Questions of Scale

A sampling plan designed to collect representative samples must take into account the potential scale of changes in site conditions through space and time as well as the chemical associations and behavior of the parameters that are targeted for investigation. In subsurface systems, physical (i.e., aquifer) and chemical properties over time or space are not statistically independent. In fact, samples taken in close proximity (i.e., within distances of a few meters) or within short time periods (i.e., more frequently than monthly) are highly auto-correlated. This means that designs employing high-sampling frequency (e.g., monthly) or dense spatial monitoring designs run the risk of redundant data collection and misleading inferences regarding trends in values that aren't statistically valid. In practice, contaminant detection and assessment monitoring programs rarely suffer these *over-sampling* concerns. In corrective-action evaluation programs, it is also possible that too little data may be collected over space or time. In these cases, false interpretation of the spatial extent of contamination or underestimation of temporal concentration variability may result.

2) Target Parameters

Parameter selection in monitoring program design is most often dictated by the regulatory status of the site. However, background water quality constituents, purging indicator parameters, and contaminants, all represent targets for data collection programs. The tools and procedures used in these programs should be equally rigorous and applicable to all categories of data, since all may be needed to determine or support regulatory action.

C. Sampling Point Design and Construction

Detailed site characterization is central to all decision-making purposes and the basis for this characterization resides in identification of the geologic framework and major hydro-stratigraphic units. Fundamental data for sample point location include: subsurface lithology, head-differences and background geochemical conditions. Each sampling point has a proper use or uses which should be documented at a level which is appropriate for the program's data quality objectives. Individual sampling points may not always be able to fulfill multiple monitoring objectives (e.g., detection, assessment, corrective action).

1) Compatibility with Monitoring Program and Data Quality Objectives

Specifics of sampling point location and design will be dictated by the complexity of subsurface lithology and variability in contaminant and/or geochemical conditions. It should be noted that, regardless of the ground-water sampling approach, few sampling points (e.g., wells, drive-points, screened augers) have zones of influence in excess of a few feet. Therefore, the spatial frequency of sampling points should be carefully selected and designed.

2) Flexibility of Sampling Point Design

In most cases *well-point* diameters in excess of 1 7/8 inches will permit the use of most types of submersible pumping devices for low-flow (minimal drawdown) sampling. It is suggested that *short* (e.g., less than 1.6 m) screens be incorporated into the monitoring design where possible so that comparable results from one device to another might be expected. *Short*, of course, is relative to the degree of vertical water quality variability expected at a site.

3) Equilibration of Sampling Point

Time should be allowed for equilibration of the well or sampling point with the formation after installation. Placement of well or sampling points in the subsurface produces some disturbance of ambient conditions. Drilling techniques (e.g., auger, rotary, etc.) are generally considered to cause more disturbance than *direct-push* technologies. In either case, there may be a period (i.e., days to months) during which water quality near the point may be distinctly different from that in the formation. Proper development of the sampling point and adjacent formation to remove fines created during emplacement will shorten this water quality *recovery* period.

III. Definition of Low-Flow Purging and Sampling

It is generally accepted that water in the well casing is non-representative of the formation water and needs to be purged prior to collection of ground-water samples. However, the water in the screened interval may indeed be representative of the formation, depending upon well construction and site hydrogeology. Wells are purged to some extent for the following reasons: the presence of the air interface at the top of the water column resulting in an oxygen concentration gradient with depth, loss of volatiles up the water column, leaching from or sorption to the casing or filter pack, chemical changes due to clay seals or backfill, and surface infiltration.

Low-flow purging, whether using portable or dedicated systems, should be done using pump-intake located in the middle or slightly above the middle of the screened interval. Placement of the pump too close to the bottom of the well will cause increased entrainment of solids which have collected in the well over time. These particles are present as a result of well development, prior purging and sampling events, and natural colloidal transport and deposition. Therefore, placement of the pump in the middle or toward the top of the screened interval is suggested. Placement of the pump at the top of the water column for sampling is only recommended in unconfined aquifers, screened across the water table, where this is the desired sampling point. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval.

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min. The effectiveness of using low-flow purging is intimately linked with proper screen location, screen length, and well construction and development techniques. The reestablishment of natural flow paths in both the vertical and horizontal directions is important for correct interpretation of the data. For high resolution sampling needs, screens less than 1 m should be used. Most of the need for purging has been found to be due to passing the sampling device through the overlying casing water which causes mixing of these stagnant waters and the dynamic waters within the screened interval. Additionally, there is disturbance to suspended sediment collected in the bottom of the casing and the displacement of water out into the formation immediately adjacent to the well screen. These disturbances and impacts can be avoided using dedicated sampling equipment, which precludes the need to insert the sampling device prior to purging and sampling.

Isolation of the screened interval water from the overlying stagnant casing water may be accomplished using low-flow minimal drawdown techniques. If the pump intake is located within the screened interval, most of the water pumped will be drawn in directly from the formation with little mixing of casing water or disturbance to the sampling zone. However, if the wells are not constructed and developed properly, zones other than those intended may be sampled. At some sites where geologic heterogeneities are sufficiently different within the screened interval, higher conductivity zones may be preferentially sampled. This is another reason to use shorter screened intervals, especially where high spatial resolution is a sampling objective.

B. Water Quality Indicator Parameters

It is recommended that water quality indicator parameters be used to determine purging needs prior to sample collection in each well. Stabilization of parameters such as pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature and turbidity should be used to determine when formation water is accessed during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by oxidation-reduction potential, dissolved oxygen and turbidity. Temperature and pH, while commonly used as purging indicators, are actually quite insensitive in distinguishing between formation water and stagnant casing water; nevertheless, these are important parameters for data interpretation purposes and should also be measured. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. Instruments are available which utilize in-line flow cells to continuously measure the above parameters.

It is important to establish specific well stabilization criteria and then consistently follow the same methods thereafter, particularly with respect to drawdown, flow rate and sampling device. Generally, the time or purge volume required for parameter stabilization is independent of well depth or well volumes. Dependent variables are well diameter, sampling device, hydrogeochemistry, pump flow rate, and whether the devices are used in a portable or dedicated manner. If the sampling device is already in place (i.e., dedicated sampling systems), then the time and purge volume needed for stabilization is much shorter. Other advantages of dedicated equipment include less purge water for waste disposal, much less decontamination of equipment, less time spent in preparation of sampling as well as time in the field, and more consistency in the sampling approach which probably will translate into less variability in sampling results. The use of dedicated equipment is strongly recommended at wells which will undergo routine sampling over time.

If parameter stabilization criteria are too stringent, then minor oscillations in indicator parameters may cause purging operations to become unnecessarily protracted. It should also be noted that turbidity is a very conservative parameter in terms of stabilization. Turbidity is always the last parameter to stabilize. Excessive purge times are invariably related to the establishment of too stringent turbidity stabilization criteria. It should be noted that natural turbidity levels in ground water may exceed 10 nephelometric turbidity units (NTU).

C. Advantages and Disadvantages of Low-Flow (Minimum Drawdown) Purging

In general, the advantages of low-flow purging include:

- samples which are representative of the *mobile* load of contaminants present (dissolved and colloid-associated);
- minimal disturbance of the sampling point thereby minimizing sampling artifacts;
- less operator variability, greater operator control;

- reduced stress on the formation (minimal drawdown);
- less mixing of stagnant casing water with formation water;
- reduced need for filtration and, therefore, less time required for sampling;
- smaller purging volume which decreases waste disposal costs and sampling time;
- better sample consistency; reduced artificial sample variability.

Some disadvantages of low-flow purging are:

- higher initial capital costs,
- greater set-up time in the field,
- need to transport additional equipment to and from the site,
- increased training needs,
- resistance to change on the part of sampling practitioners,
- concern that new data will indicate a *change in conditions* and trigger an *action*.

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

The following ground-water sampling procedure has evolved over many years of experience in ground-water sampling for organic and inorganic compound determinations and as such summarizes the authors' (and others) experiences to date (Barcelona et al., 1984, 1994; Barcelona and Helfrich, 1986; Puls and Barcelona, 1989; Puls et. al. 1990, 1992; Puls and Powell, 1992; Puls and Paul, 1995). High-quality chemical data collection is essential in ground-water monitoring and site characterization. The primary limitations to the collection of *representative* ground-water samples include: mixing of the stagnant casing and *fresh* screen waters during insertion of the sampling device or ground-water level measurement device; disturbance and resuspension of settled solids at the bottom of the well when using high pumping rates or raising and lowering a pump or bailer; introduction of atmospheric gases or degassing from the water during sample handling and transfer, or inappropriate use of vacuum sampling device, etc.

A. Sampling Recommendations

Water samples should not be taken immediately following well development. Sufficient time should be allowed for the ground-water flow regime in the vicinity of the monitoring well to stabilize and to approach chemical equilibrium with the well construction materials. This lag time will depend on site conditions and methods of installation but often exceeds one week.

Well purging is nearly always necessary to obtain samples of water flowing through the geologic formations in the screened interval. Rather than using a general but arbitrary guideline of purging three casing volumes prior to sampling, it is recommended that an in-line water quality measurement device (e.g., flow-through cell) be used to establish the stabilization time for several parameters (e.g. , pH, specific conductance, redox, dissolved oxygen, turbidity) on a well-specific basis. Data on pumping rate, drawdown, and volume required for parameter stabilization can be used as a guide for conducting subsequent sampling activities.

The following are recommendations to be considered before, during and after sampling:

- use low-flow rates (<0.5 L/min), during both purging and sampling to maintain minimal drawdown in the well;
- maximize tubing wall thickness, minimize tubing length;
- place the sampling device intake at the desired sampling point;
- minimize disturbances of the stagnant water column above the screened interval during water level measurement and sampling device insertion;
- make proper adjustments to stabilize the flow rate as soon as possible;
- monitor water quality indicators during purging;
- collect unfiltered samples to estimate contaminant loading and transport potential in the subsurface system.

B. Equipment Calibration

Prior to sampling, all sampling device and monitoring equipment should be calibrated according to manufacturer’s recommendations and the site Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP). Calibration of pH should be performed with at least two buffers which bracket the expected range. Dissolved oxygen calibration must be corrected for local barometric pressure readings and elevation.

C. Water Level Measurement and Monitoring

It is recommended that a device be used which will least disturb the water surface in the casing. Well depth should be obtained from the well logs. Measuring to the bottom of the well casing will only cause resuspension of settled solids from the formation and require longer purging times for turbidity equilibration. Measure well depth after sampling is completed. The water level measurement should be taken from a permanent reference point which is surveyed relative to ground elevation.

D. Pump Type

The use of low-flow (e.g., 0.1-0.5 L/min) pumps is suggested for purging and sampling all types of analytes. All pumps have some limitation and these should be investigated with respect to application at a particular site. Bailers are inappropriate devices for low-flow sampling.

1) General Considerations

There are no unusual requirements for ground-water sampling devices when using low-flow, minimal drawdown techniques. The major concern is that the device give consistent results and minimal disturbance of the sample across a range of *low* flow rates (i.e., < 0.5 L/min). Clearly, pumping rates that cause minimal to no drawdown in one well could easily cause *significant* drawdown in another well finished in a less transmissive formation. In this sense, the pump should not cause undue pressure or temperature changes or physical disturbance on the water sample over a reasonable sampling range. Consistency in operation is critical to meet accuracy and precision goals.

2) Advantages and Disadvantages of Sampling Devices

A variety of sampling devices are available for low-flow (minimal drawdown) purging and sampling and include peristaltic pumps, bladder pumps, electrical submersible pumps, and gas-driven pumps. Devices which lend themselves to both dedication and consistent operation at definable low-flow rates are preferred. It is desirable that the pump be easily adjustable and operate reliably at these lower flow rates. The peristaltic pump is limited to shallow applications and can cause degassing resulting in alteration of pH, alkalinity, and some volatiles loss. Gas-driven pumps should be of a type that does not allow the gas to be in direct contact with the sampled fluid.

Clearly, bailers and other *grab* type samplers are ill-suited for low-flow sampling since they will cause repeated disturbance and mixing of *stagnant* water in the casing and the *dynamic* water in the screened interval. Similarly, the use of inertial lift foot-valve type samplers may cause too much disturbance at the point of sampling. Use of these devices also tends to introduce uncontrolled and unacceptable operator variability.

Summaries of advantages and disadvantages of various sampling devices are listed in Herzog et al. (1991), U. S. EPA (1992), Parker (1994) and Thurnblad (1994).

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The key is to minimize disturbance of water and solids in the well casing.

F. Filtration

Decisions to filter samples should be dictated by sampling objectives rather than as a *fix* for poor sampling practices, and field-filtering of certain constituents should not be the default. Consideration should be given as to what the application of field-filtration is trying to accomplish. For assessment of truly dissolved (as opposed to operationally *dissolved* [i.e., samples filtered with 0.45 µm filters]) concentrations of major ions and trace metals, 0.1 µm filters are recommended although 0.45 µm filters are normally used for most regulatory programs. Alkalinity samples must also be filtered if significant particulate calcium carbonate is suspected, since this material is likely to impact alkalinity titration results (although filtration itself may alter the CO_2 composition of the sample and, therefore, affect the results).

Although filtration may be appropriate, filtration of a sample may cause a number of unintended changes to occur (e.g. oxidation, aeration) possibly leading to filtration-induced artifacts during sample analysis and uncertainty in the results. Some of these unintended changes may be unavoidable but the factors leading to them must be recognized. Deleterious effects can be minimized by consistent application of certain filtration guidelines. Guidelines should address selection of filter type, media, pore size, etc. in order to identify and minimize potential sources of uncertainty when filtering samples.

In-line filtration is recommended because it provides better consistency through less sample handling, and minimizes sample exposure to the atmosphere. In-line filters are available in both disposable (barrel filters) and non-disposable (in-line filter holder, flat membrane filters) formats and various filter pore sizes (0.1-5.0 µm). Disposable filter cartridges have the advantage of greater sediment handling capacity when compared to traditional membrane filters. Filters must be pre-rinsed following manufacturer's recommendations. If there are no recommendations for rinsing, pass through a minimum of 1 L of ground water following purging and prior to sampling. Once filtration has begun, a filter cake may develop as particles larger than the pore size accumulate on the filter membrane. The result is that the effective pore diameter of the membrane is reduced and particles smaller than the stated pore size are excluded from the filtrate. Possible corrective measures include prefiltering (with larger pore size filters), minimizing particle loads to begin with, and reducing sample volume.

G. Monitoring of Water Level and Water Quality Indicator Parameters

Check water level periodically to monitor drawdown in the well as a guide to flow rate adjustment. The goal is minimal drawdown (<0.1 m) during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities within the screened interval, and may require adjustment based on site-specific conditions and personal experience. In-line water quality indicator parameters should be continuously monitored during purging. The water quality indicator parameters monitored can include pH, redox potential, conductivity, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Pumping rate, drawdown, and the time or volume required to obtain stabilization of parameter readings can be used as a future guide to purge the well. Measurements should be taken every three to five minutes if the above suggested rates are used. Stabilization is achieved after all parameters have stabilized for three successive readings. In lieu of measuring all five parameters, a minimum subset would include pH, conductivity, and turbidity or DO. Three successive readings should be within ± 0.1 for pH, ± 3% for conductivity, ± 10 mv for redox potential, and ± 10% for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an exponential or asymptotic change to stable values during purging. Dissolved oxygen and turbidity usually require the longest time for stabilization. The above stabilization guidelines are provided for rough estimates based on experience.

H. Sampling, Sample Containers, Preservation and Decontamination

Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at established purge rate or may be adjusted slightly to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Sampling should occur in a progression from least to most contaminated well, if this is known. Generally, volatile (e.g., solvents and fuel constituents) and gas sensitive (e.g., Fe^{2+}, CH_4, H_2S/HS^-, alkalinity) parameters should be sampled first. The sequence in which samples for most inorganic parameters are collected is immaterial unless filtered (dissolved) samples are desired. Filtering should be done last and in-line filters should be used as discussed above. During both well purging and sampling, proper protective clothing and equipment must be used based upon the type and level of contaminants present.

The appropriate sample container will be prepared in advance of actual sample collection for the analytes of interest and include sample preservative where necessary. Water samples should be collected directly into this container from the pump tubing.

Immediately after a sample bottle has been filled, it must be preserved as specified in the site (QAPP). Sample preservation requirements are based on the analyses being performed (use site QAPP, FSP, RCRA guidance document [U. S. EPA, 1992] or EPA SW-846 [U. S. EPA, 1982]). It may be advisable to add preservatives to sample bottles in a controlled setting prior to entering the field in order to reduce the chances of improperly preserving sample bottles or introducing field contaminants into a sample bottle while adding the preservatives.

The preservatives should be transferred from the chemical bottle to the sample container using a disposable polyethylene pipet and the disposable pipet should be used only once and then discarded.

After a sample container has been filled with ground water, a Teflon™ (or tin)-lined cap is screwed on tightly to prevent the container from leaking. A sample label is filled out as specified in the FSP. The samples should be stored inverted at 4°C.

Specific decontamination protocols for sampling devices are dependent to some extent on the type of device used and the type of contaminants encountered. Refer to the site QAPP and FSP for specific requirements.

I. Blanks

The following blanks should be collected:

(1) field blank: one field blank should be collected from each source water (distilled/deionized water) used for sampling equipment decontamination or for assisting well development procedures.

(2) equipment blank: one equipment blank should be taken prior to the commencement of field work, from each set of sampling equipment to be used for that day. Refer to site QAPP or FSP for specific requirements.

(3) trip blank: a trip blank is required to accompany each volatile sample shipment. These blanks are prepared in the laboratory by filling a 40-mL volatile organic analysis (VOA) bottle with distilled/deionized water.

V. Low-Permeability Formations and Fractured Rock

The overall sampling program goals or sampling objectives will drive how the sampling points are located, installed, and choice of sampling device. Likewise, site-specific hydrogeologic factors will affect these decisions. Sites with very low permeability formations or fractures causing discrete flow channels may require a unique monitoring approach. Unlike water supply wells, wells installed for ground-water quality assessment and restoration programs are often installed in low water-yielding settings (e.g., clays, silts). Alternative types of sampling points and sampling methods are often needed in these types of environments, because low-permeability settings may require extremely low-flow purging (<0.1 L/min) and may be technology-limited. Where devices are not readily available to pump at such low flow rates, the primary consideration is to avoid dewatering of the well screen. This may require repeated recovery of the water during purging while leaving the pump in place within the well screen.

Use of low-flow techniques may be impractical in these settings, depending upon the water recharge rates. The sampler and the end-user of data collected from such wells need to understand the limitations of the data collected; i.e., a strong potential for underestimation of actual contaminant concentrations for volatile organics, potential false negatives for filtered metals and potential false positives for unfiltered metals. It is suggested that comparisons be made between samples recovered using low-flow purging techniques and samples recovered using passive sampling techniques (i.e., two sets of samples). Passive sample collection would essentially entail acquisition of the sample with no or very little purging using a dedicated sampling system installed within the screened interval or a passive sample collection device.

A. Low-Permeability Formations (<0.1 L/min recharge)

1. Low-Flow Purging and Sampling with Pumps

a. "portable or non-dedicated mode" - Lower the pump (one capable of pumping at <0.1 L/min) to mid-screen or slightly above and set in place for minimum of 48 hours (to lessen purge volume requirements). After 48 hours, use procedures listed in Part IV above regarding monitoring water quality parameters for stabilization, etc., but do not dewater the screen. If excessive drawdown and slow recovery is a problem, then alternate approaches such as those listed below may be better.

b. "dedicated mode" - Set the pump as above at least a week prior to sampling; that is, operate in a dedicated pump mode. With this approach significant reductions in purge volume should be realized. Water quality parameters should stabilize quite rapidly due to less disturbance of the sampling zone.

2. Passive Sample Collection

Passive sampling collection requires insertion of the device into the screened interval for a sufficient time period to allow flow and sample equilibration before extraction for analysis. Conceptually, the extraction of water from low yielding formations seems more akin to the collection of water from the unsaturated zone and passive sampling techniques may be more appropriate in terms of obtaining "representative" samples. Satisfying usual sample volume requirements is typically a problem with this approach and some latitude will be needed on the part of regulatory entities to achieve sampling objectives.

B. Fractured Rock

In fractured rock formations, a low-flow to zero purging approach using pumps in conjunction with packers to isolate the sampling zone in the borehole is suggested. Passive multi-layer sampling devices may also provide the most "representative" samples. It is imperative in these settings to identify flow paths or water-producing fractures prior to sampling using tools such as borehole flowmeters and/or other geophysical tools.

After identification of water-bearing fractures, install packer(s) and pump assembly for sample collection using low-flow sampling in "dedicated mode" or use a passive sampling device which can isolate the identified water-bearing fractures.

VI. Documentation

The usual practices for documenting the sampling event should be used for low-flow purging and sampling techniques. This should include, at a minimum: information on the conduct of purging operations (flow-rate, drawdown, water-quality parameter values, volumes extracted and times for measurements), field instrument calibration data, water sampling forms and chain of custody forms. See Figures 2 and 3 and "Ground Water Sampling Workshop -- A Workshop Summary" (U. S. EPA, 1995) for example forms and other documentation suggestions and information. This information coupled with laboratory analytical data and validation data are needed to judge the "useability" of the sampling data.

VII. Notice

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Figure 2. **Ground Water Sampling Log**

Project _______________ **Site** _______________ **Well No.** _____________ **Date** _________________________

Well Depth ____________ **Screen Length** __________ **Well Diameter** _________ **Casing Type** ____________

Sampling Device _______________ **Tubing type** ____________________ **Water Level** __________________

Measuring Point ___________________ **Other Infor** ____

____

Sampling Personnel ____

Time	pH	Temp	Cond.	Dis.O_2	Turb.	[ ]Conc			Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

Figure 3. **Ground Water Sampling Log** (with automatic data logging for most water quality parameters)

Project _______________ **Site** _______________ **Well No.** _____________ **Date** ________________________

Well Depth ____________ **Screen Length** __________ **Well Diameter** _________ **Casing Type** ___________

Sampling Device _______________ **Tubing type** _____________________ **Water Level** _________________

Measuring Point ___________________ **Other Infor** ____

____

Sampling Personnel ____

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

Information: 2 in = 617 ml/ft, 4 in = 2470 ml/ft: $Vol_{cyl} = \pi r^2 h$, $Vol_{sphere} = 4/3\pi\ r^3$

Sampling Instructions

The following sampling instructions are used for collecting water or groundwater samples for DNA analysis by DGGE and/or CENSUS. The recommended sampling container is a 1L Poly bottle with a screw cap. Amber glass bottles can be used but are not recommended due to the likelihood of breakage during shipment. Microbial Insights, Inc. can provide the proper sampling supplies upon request.

Once the proper sampling bottle is obtained be sure not to contaminate the inside of the sample bottle with skin, dirt or any form of debris (this helps to ensure the accuracy of the data results). Wearing latex gloves (or similar) is recommended when sampling.

The required volume of water to conduct DNA based analyses from groundwater samples is 1L.

* Note: It is important to collect as close to the required amounts as possible to ensure the ability to properly conduct the analysis requested. Hold time is 24-48 hours for this analysis.

To Submit Sample:

1. Once the required amount of groundwater has been collected into the proper sampling container, seal the container tightly with a screw cap lid.
2. Properly affix a label with the sample name, date and analysis.
3. Be sure to fill out the Chain of Custody (COC) form correctly and accurately and ship it along with the samples. A COC form is required for QA/QC purposes.
4. Once the bottles have been correctly labeled, place them in the designated cooler. Be sure to fill the remaining space in the cooler with blue ice or regular ice that has been double bagged in Ziploc bags. Use sufficient ice to keep the entire shipment around 4°C, especially during the summer months.
5. All paperwork to be sent with the samples should be placed within a waterproof pouch or Ziploc bag and placed on top of the samples or affixed to the inside lid of the cooler.
6. Seal the cooler lid with a strong packaging tape.

Shipping Instructions

Packaging Samples:

1. Samples should be shipped in a cooler with ice or blue ice for next day delivery. If regular ice is used, the ice should be double bagged.
2. A chain of custody form must be included with each shipment of samples. Access our chain of custody at www.microbe.com .

Shipment for Weekday Delivery:

Samples for weekday delivery should be shipped to:

Sample Custodian
Microbial Insights, Inc.
2340 Stock Creek Blvd.
Rockford, TN 37853-3044
(865) 573-8188

Shipment for Saturday Delivery:

Coolers to be delivered on Saturday must be sent to our FedEx Drop Location. To ensure proper handling the following steps must be taken:

1. FedEx shipping label should be marked under (6) Special Handling, check Hold Saturday,
2. The cooler must be taped with FedEx SATURDAY tape.
3. The shipping label must be filled out with the Drop Location address below. Our laboratory name must be on the address label.
4. You MUST call Microbial Insights, Inc. with the tracking number of the package on Friday (prior to 4pm Eastern Time) to arrange for Saturday pickup. Without proper labeling and the tracking number, there is no guarantee that the samples will be collected.

Samples for Saturday delivery should be shipped to:

Microbial Insights, Inc.
FedEx Drop Location
10601 Murdock Road
Knoxville, TN 37932
(865) 300-8053 or (865) 384-4005

Note: Groundwater samples received on Saturday cannot be frozen and therefore may exceed recommended hold times.