SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

300, 304-308, 320 ANDREWS STREET AND 25 EVANS STREET
ROCHESTER, NEW YORK 14604

NYSDEC SITE #E828144

Prepared For: City of Rochester
Division of Environmental Quality
30 Church Street, Room 300B
Rochester, New York, 14614-1278

Prepared By: Day Environmental, Inc.
1563 Lyell Avenue
Rochester, New York 14606

Project No.: 4355S-10

Date: May 2013

SUPPLEMENTAL REMEDIAL INVESTIGATION WORK PLAN

300, 304-308, 320 ANDREWS STREET AND 25 EVANS STREET
ROCHESTER, NEW YORK 14604

NYSDEC SITE #E828144

I, Nathan E. Simon, certify that I am currently a NYS registered professional engineer and that this Supplemental Remedial Investigation Work Plan was prepared in accordance with applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

NATHAN E. SIMON
087172

Nathan Simon

Nathan E. Simon, P.E.
Task Leader (NYS P.E. License #087172)
Day Environmental, Inc.

Jeffrey A. Danzinger
Project Manager
Day Environmental, Inc.

TABLE OF CONTENTS

FIGURES

TABLE

APPENDICES

1.0 INTRODUCTION

The Site consists of four adjacent parcels with a combined area of approximately 1.5 acres located at 300, 304-308, 320 Andrews Street and 25 Evans Street, City of Rochester (City), County of Monroe, New York (Site). A Project Locus Map is provided as Figure 1. This Supplemental Remedial Investigation Work Plan (Supplemental RI Work Plan) was prepared by Day Environmental, Inc. (DAY) to further evaluate environmental conditions for use in refining remedial options to address contaminated media associated with the Site. The Supplemental Remedial Investigation (RI) will be implemented under the New York State Department of Environmental Conservation (NYSDEC) Environmental Restoration Program (ERP) (Site #E828144).

This Supplemental RI Work Plan was prepared based on previous studies conducted at the Site including work completed under a NYSDEC-approved Remedial Investigation/Remedial Alternatives Analysis Work Plan (RI/RAA Work Plan) dated August 2011, as well as Site conditions subsequent to completion of an initial phase of six Interim Remedial Measures (IRMs) that were completed under a NYSDEC-approved Interim Remedial Measures Work Plan dated October 4, 2012. Provisions set forth in NYSDEC guidance documents including, but not limited to, “DER-10, Technical Guidance for Site Investigation and Remediation” dated May 2010 and the NYSDEC “Municipal Assistance Environmental Restoration Projects ‘Brownfield Program’ Procedures Handbook” dated July 2004 were also used in the preparation of this Supplemental RI Work Plan.

The scope of work outlined in this Supplemental RI Work Plan will include implementation of provisions and requirements set forth in the site-specific Health and Safety Plan (HASP), Community Air Monitoring Plan (CAMP), and Quality Assurance Project Plan (QAPP) that were provided as appendices in the August 2011 RI/RAA Work Plan. Implementation of the work described in this Supplemental RI Work Plan will result in further understanding of the remaining environmental impacts to the subsurface soil, soil vapor, and groundwater associated with the historic use of the Site. A seven day notice will be provided to the NYSDEC prior to commencement of each phase of field activities presented herein.

This Supplemental RI Work Plan includes testing to assist in evaluating remedial options. Based on the findings of the cumulative studies completed for this project (including the Supplemental RI work) and the previously completed IRM work, pilot scale and/or bench scale remediation studies and Supplemental IRMs will be developed. Subsequent Work Plans that include details on the scope of work to be performed for the pilot scale and/or bench scale studies and the Supplemental IRM work will be prepared as separate documents and submitted for regulatory agency approval prior to conducting that work.

1.1 Proposed Future Use of Site

The Site is located in the Rochester Center City District (CCD). According to the City’s Neighborhood and Business Development Department, future redevelopment of the Site is anticipated to consist of residential or mixed residential/commercial use.

1.2 Applicable Project Standards, Criteria and Guidance

Based on the CCD zoning, the proposed mixed-use development scenario, the urban setting of the Site, and NYSDEC requirements, applicable standards, criteria and guidance (SCG) values that will be used for this project are outlined below:

- Unrestricted Use, Restricted-Residential Use, Restricted Commercial Use, Protection of Groundwater Soil Cleanup Objectives (SCOs) and other guidance as set forth in 6 New York Codes, Rules, and Regulations (NYCRR) Part 375-4 Environmental Restoration Program dated December 14, 2006.
- Guidelines referenced in the NYSDEC document titled "DER-10 Technical Guidance for Site Investigation and Remediation", May 2010.
- Appropriate water quality standards and guidance values as set forth in NYSDEC Division of Water Technical and Operational Guidance Series (TOGS 1.1.1) document titled "Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations", June 1998 and amended by a January 1999 Errata Sheet, an April 2000 Addendum and a June 2004 Addendum.
- Guidelines referenced in the New York State Department of Health (NYSDOH) document titled "Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York", October 2006
- Monroe County Pure Waters (MCPW) Sewer Use Permit Effluent Standards.

2.0 BACKGROUND AND PREVIOUS ENVIRONMENTAL WORK

This section presents a brief discussion of the settings/uses of the Site and the surrounding area. In addition, an overview of previous environmental work that has been completed to date at the Site is presented in this section.

2.1 Background

The Site is in a commercial area and consists of four parcels, each owned by the City with a combined area of approximately 1.5 acres, that are addressed as 300, 304-308, and 320 Andrews Street, and 25 Evans Street.

Prior to the fall of 2010, the Site was improved with four buildings with associated paved parking lots. The former buildings had a total floor area of approximately 38,349 square feet and consisted of single and two-story brick or concrete block buildings with partial basements and/or slab-on-grade construction, constructed between 1925 and 1965 (refer to Figure 2). Demolition of the on-site structures was completed between the fall of 2010 and the spring of 2011, and Site conditions after the demolition work are depicted on Figure 3.

A narrow former City street known as Evans Street separated the 320 Andrews Street from the other three parcels that are contiguous with each other. The Evans Street right-of-way was formally abandoned by an official map amendment where its land was added onto the adjoining 304-308 Andrews Street, 320 Andrews Street and 25 Evans Street parcels (refer to Figure 3). As part of the abandonment, buried utilities in the former Evans Street right-of-way were removed and/or decommissioned. The Site is bound to the north by the Inner Loop with commercial properties beyond, to the south by Andrews Street with commercial properties beyond, to the east by Franklin Square followed by a City-owned park, and to the west by Bristol Street with commercial properties beyond.

2.2 Previous Environmental Work

Environmental studies that have been completed between 2006 and the present include: Phase I Environmental Site Assessments (2006); a Phase II Environmental Site Assessment (2006); an At-Grade and Sub-Grade Demolition Phase Environmental Study (2010/2011); and the majority of components of a Remedial Investigation (2011 to the present). The 2006 Phase I and Phase II Environmental Site Assessments were not completed under the ERP, but the At-Grade and Sub-Grade Demolition Phase Environmental Study and Remedial Investigation work were completed under NYSDEC and NYSDOH approved work plans. The previous environmental studies and RI identified a number of areas, constituents of concern, and resulting matrices (e.g., soil, groundwater) that have been impacted. The primary contaminant of concern at the Site is Tetrachloroethene (Perchloroethene or PCE). Based on soil sample data from the 2006 Phase II Environmental Site Assessment, the 2010/2011 At-Grade and Sub-Grade Demolition Phase Environmental Study, and RI completed to date, detected PCE concentrations in soil at the primary source/plume area prior to any remediation (see IRM-01 and IRM-02 below) was interpolated and is presented on Figure 4.

Six IRMs (designated as IRM-01 through IRM-06) were completed at the Site in 2012. The locations of the six IRM areas are shown on Figure 5, and these IRMs are summarized below.

IRM-01: A total of 1,673.06 tons of non-hazardous PCE-impacted soil, and 138.83 tons of characteristic hazardous PCE-impacted soil, were removed from this source area down to depths ranging between approximately 4.0 and 15.5 feet below the ground surface (bgs), and disposed off-site at regulated landfills. Only two of thirty-one post-excavation in-situ soil sample locations contained PCE exceeding its Part 375 Protection of Groundwater SCO of 1.3 ppm. No other volatile organic compounds (VOCs) were above applicable SCOs.

IRM-02: Approximately 115 linear feet of combined sanitary/storm main sewer trunk line was decommissioned by removal and/or filling in accordance with Monroe County protocols, associated sewer laterals were capped or removed, and approximately 101 tons of PCE-impacted soil was removed down to depths ranging between approximately 10 and 12.5 feet bgs, in the area of the former Evans Street right-of-way that was in proximity to the IRM-01 PCE contamination source area. These materials were disposed as non-hazardous waste at a regulated landfill. Each of the six post-excavation in-situ soil sample locations from this area were below Part 375 Restricted Residential SCOs and Protection of Groundwater SCOs for VOCs.

IRM-03: Two 5,000-gallon petroleum underground storage tanks (USTs), their K-Crete contents previously used to close the USTs in-place, and 48.82 tons of petroleum-contaminated soil were removed down to depths of approximately 12 feet bgs, and taken off-site. The steel USTs were recycled, and the K-Crete and contaminated soil were disposed as non-hazardous wastes at a regulated landfill. Each of the eight post-excavation in-situ soil sample locations from this area were below Part 375 Restricted Residential SCOs and Protection of Groundwater SCOs for VOCs, SVOCs and Metals.

IRM-04: A total of 15.64 tons of non-hazardous polychlorinated biphenyl (PCB)-impacted soil was removed down to a depth of approximately 3 feet bgs from an anomalous location on the Site and disposed at a regulated landfill. Each of the five post-excavation in-situ soil sample locations from this area were below Part 375 Restricted Residential SCOs and Protection of Groundwater SCOs for PCBs.

IRM-05: A total of 223.21 tons of non-hazardous petroleum and VOC-impacted soil was removed down to depths of approximately 5.5 feet bgs from a former trench floor drain area, and disposed at a regulated landfill. Each of the five post-excavation in-situ soil sample locations from this area were below Part 375 Restricted Residential SCOs and Protection of Groundwater SCOs for VOCs, SVOCs and Metals.

IRM-06: Approximately 205 linear feet of piping, and a limited amount of soil, were removed down to depths of approximately 3 feet bgs from the east side of the Site. Some sediment inside the piping was previously found to contain relatively low concentrations of PCE. The piping, sediments, and limited surrounding soil were disposed off-site at a regulated landfill as a non-hazardous waste. Each of the seven post-excavation in-situ soil sample locations from this area were below Part 375 Restricted Residential SCOs and Protection of Groundwater SCOs for VOCs.

> Only one of the seven post-excavation in-situ soil sample locations from this area was above Part 375 Restricted Residential SCOs and Protection of Groundwater SCOs for the metal lead, and the remaining metals tested for in the seven samples were below their Part 375 Restricted Residential SCOs and Protection of Groundwater SCOs.

The post-excavation samples from IRM-02 and IRM-03 show that the geographic information system (GIS) PCE interpolation model accurately defined the area of PCE-contaminated soil in the source area to be removed. The post-excavation soil samples from IRM-03 through IRM-04 show that these IRMs were generally successful in remediating contaminants in the unsaturated zone at those locations. [Note: It is anticipated that the lead detected at a concentration above SCOs at one of the IRM-06 sample locations will be addressed in the future by institutional controls and engineering controls.]

Staged site soils acceptable for re-use, and imported crushed stone approved by the NYSDEC, were used to backfill the associated excavations. As part of the IRM work, a total of 351.04 tons of hard demolition materials (concrete floor slabs, foundations, etc.) and a tree were also removed from the Site and disposed at a regulated landfill as non-hazardous wastes. The concrete and tree were located within portions of the IRM-01, IRM-02, IRM-03 and IRM-05 areas. An IRM Construction Completion Report is being prepared per the approved IRM Work Plan.

As indicated above, IRM-01 and IRM-02 involved the removal of grossly PCE-contaminated soil located on the central northern portion of the Site (refer to Figure 5). Based on previous investigations and test results, PCE contamination exceeding regulatory criteria is still present at the Site in the vicinity of IRM-01 and IRM-02. This remaining PCE contamination is primarily present in the saturated overburden zone, which is generally below the groundwater table (refer to Figure 6 for PCE in soil, and refer to Figure 7 and Figure 8 showing the most recent PCE results available at each overburden well). Very little PCE contamination is present in the bedrock groundwater. As shown on Figure 9, the most recent June 2012 groundwater sample results show PCE was not detected in 8 of the 9 bedrock well locations.

DAY's work plans, reports, etc. that are associated with the Site that have been completed, or in progress of being completed, include:

- An At-Grade and Sub-Grade Demolition Phase Environmental Work Plan dated October 2010;
- An At-Grade and Sub-Grade Demolition Phase Environmental Report dated August 2011;
- A Remedial Investigation/Remedial Alternatives Analysis Work Plan dated August 2011;
- An Analysis of Brownfields Cleanup Alternatives Report dated August 7, 2012;
- An Interim Remedial Measures Work Plan dated October 4, 2012;
- A Construction Completion Report for the initial IRMs (currently being prepared);
- A Remedial Investigation Report (currently being prepared); and
- NYSDEC EQUIS files for laboratory data (files for RI data have been completed and approved by NYSDEC, files for initial IRMs are currently being prepared).

3.0 SCOPE OF SUPPLEMENTAL RI WORK

In order to design a remedial system to address remaining PCE in deeper aquifer matrix (i.e., saturated soil) and groundwater at the Site to meet Part 375 SCOs and TOGS 1.1.1 groundwater standards and guidance values, additional investigation is required to profile the vertical and aerial extent of PCE in saturated soil and groundwater in the vicinity of IRM-01 and IRM-02. It is proposed that the following components be completed at the Site, as further described in the subsections below.

DAY's proposed analytical program for field samples and quality assurance/quality control (QA/QC) samples, including the analytical parameters and methods, are summarized on Table 1 (Sampling and Analysis Plan). Sampling and analysis, including QA/QC requirements, will be consistent with the guidance in the NYSDEC ERP Handbook and NYSDEC DER-10 technical guidance to ensure verifiable data results are obtained. As a continuation of service, Chemtech Consulting Group, Inc. (Chemtech) will be the primary analytical laboratory used for the scope of analytical laboratory testing outlined herein, and Environmental Data Validation, Inc. (EDV) will continue to complete require Data Usability Summary Reports (DUSR). Analytical laboratory test results will continue to be reported in Analytical Services Protocol (ASP) Category B deliverables data packages, and DUSRs will be completed on final delineation samples. Sample methods, preservation requirements, handling times, chain-of custody, decontamination procedures for field equipment, field blanks, and trip blanks will conform to NYSDEC ASP.

EQUIS files that meet NYSDEC requirements will continue to be submitted for each laboratory package generated during the Supplemental RI work.

Specific Supplemental RI tasks are outlined in the subsections below.

3.1 Site Preparation and Maintenance

The following preparation activities will be implemented at the Site prior to the start, or during a later phase, of the supplemental RI fieldwork. These activities include the following:

- Create and mount a new NYSDEC project sign, if the existing sign is damaged.
- DAY will control Site access during Site work and will be in possession of keys to locks on gates associated with perimeter fencing. DAY will maintain the existing fencing during the Supplemental RI site work.
- A dumpster will be mobilized to the Site and used for general refuse/solid waste disposal for the duration of the work.
- A portable toilet will be mobilized to the Site.
- If necessary, vegetation or snow will be cleared for the duration of the Supplemental RI work.

3.2 Soil Vapor Survey

As described in the August 2011 RI/RAA Work Plan, the presence of VOCs, specifically PCE, in the soil and groundwater at the Site poses a potential route of exposure on-site and off-site via soil vapor intrusion into existing or future buildings. As such, a soil vapor survey is planned to be conducted as specified below in this section of the Supplemental RI Work Plan.

The soil vapor survey will be performed along the perimeter of the Site to assist in evaluating: 1) whether VOCs are present in the soil vapor that could pose a route of exposure; and 2) whether contaminants are migrating off-site via soil vapor. The soil vapor survey is a NYSDOH requirement for this Site.

The soil vapor survey will consist of the following work in accordance with the applicable guidance provided in the NYSDOH document "Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York: dated October 2006, including Section 2.7 (Sampling Protocols) and Section 2.8 (Quality Assurance/Quality Control), refer to Appendix A (Soil Vapor Sampling Guidance):

- The tentative locations of four soil vapor points (designated as SV-1 through SV-4) will be marked out in the field using a global positioning system (GPS) or measurements from existing site structures (refer to Figure 10). Soil vapor locations SV-1 and SV-2 were selected based on proximity to nearby adjoining buildings (e.g., potential off-site receptors), and soil vapor locations SV-3 and SV-4 were selected due to documented VOCs in soil and/or groundwater in those areas, including VOCs previously detected in 2006 Phase II ESA soil samples in the public right-of-way of Franklin Square.
- A subcontractor will install a boring at each soil vapor point location to an approximate depth of six feet bgs. The subcontractor will then convert the four borings into temporary soil vapor points by installing new laboratory or food grade plastic tubing (e.g., Teflon) that will be perforated on the bottom four inches and then be inserted to near the bottom of each soil vapor point. Clean sand will then be used to backfill the annulus around, and at least 0.5 foot above, the perforated tubing in each soil vapor point. A bentonite grout will then be used to backfill the annulus above the sand to the ground surface at each soil vapor point.
- Prior to collecting soil vapor samples, a Helium tracer gas study will be performed at each soil vapor point to verify the bentonite seal integrity. Helium gas, a helium meter, appropriate tubing and container, and bentonite ground seal will be used for the tracer gas test.
- The four soil vapor survey samples will be collected over a two-hour period in batch-certified Summa canisters equipped with laboratory-calibrated regulators, by connecting the respective canister regulator to the above-ground end of the tubing at each soil vapor point.
- One background outdoor air sample (to be designated as location BG-1) will be collected approximately three feet off the ground in a batch-certified Summa canister from an upwind portion of the Site during the same general two hour period.
- Vacuum gauge readings on the respective Summa canisters will be recorded during the sampling at each soil vapor point and also the outdoor air background sample location.

- The four soil vapor samples and the background outdoor air sample will be delivered under chain-of-custody control to Chemtech, which will analyze the samples for TO-15 VOCs using low detection limits acceptable to the NYSDOH. Chemtech's VOC list with method detection limits is included in Appendix B (TO-15 VOCs and Detection Limits for Air Samples).
- The results will be reported in a NYSDEC ASP Category B report, and EDV will complete a DUSR on the results.

3.3 Supplemental Overburden Investigation

As part of the original scope of RI work conducted at this Site, a membrane interface probe (MIP) study accurately delineated PCE-impacted soil to be removed under the IRM-01 and IRM-02 in the unsaturated zone to depths of approximately 12 feet bgs. As such, additional MIP study, supplemented with a hydraulic profiling tool (HPT) study, will be completed at approximately 20 test points to evaluate PCE and VOCs in the deeper saturated zone. Tentative locations for 18 of these test points are shown on Figure 11. The MIP/HPT study will involve measuring continuous electrical conductivity or EC (mS/m), HPT pressure (pounds per square inch or psi), HPT Flow (ml/min), hydrostatic pressure from HPT dissipation tests (psi), estimated hydraulic conductivity or K (ft/day), MIP photoionization detector (PID) response (uV), and MIP halogen specific detector (XSD) Response (uV). DAY will continue to use S2C2, Inc. to provide these specialized services; however, if S2C2 is not available within the schedule for this project, a different specialized entity may be retained to provide the MIP/HPT services. To the extent feasible, the XSD will be calibrated to 1.3 parts per million (ppm) of PCE. If a PCE standard is not a feasible option, then the XSD will be calibrated using the typical TCE standard. In addition to the standard operating procedures (SOPs) included in the August 2011 RI/RAA Work Plan, this work will also be conducted in accordance with the SOP for HPT that is included in Appendix C (Standard Operating Procedure - Hydraulic Profiling Tool).

It is anticipated that the test points will be advanced through high permeability (transmissive) and low permeability overburden zones at locations that are in the vicinity, and hydraulically downgradient, of the IRM-01 and IRM-02 areas. This work is intended to further define the nature and extent of PCE contamination on-site within the overburden to the top of bedrock located approximately 30 feet bgs. It is presumed that the direct sensing equipment may need to be advanced through pre-drilled continuous or intermittent pilot holes, and that test locations within footprints of crusher run backfilled areas may require temporary casing of the backfilled intervals. However, if it is determined that the HPT data being produced are not useable due to interferences caused by the pilot holes, then only MIP may be performed at locations to be advanced through pilot holes. The MIP would include EC, PID and XSD measurements.

As shown on Table 1, it is anticipated that up to four soil and/or groundwater samples will be collected and tested for target compound list (TCL) VOCs using United States Environmental Protection Agency (USEPA) Method 8260, and that the results would be compared to the PID and XSD data. In addition, it is anticipated that up to two samples may be collected and tested for permanganate natural oxidant demand (PNOD) using American Society for Testing Materials (ASTM) Method D7262-07.

The results of the above-described work will be presented using GIS and/or other visualization software to develop a high-resolution 2D and/or 3D model of the remaining PCE contamination in relation to previous test locations, previous remedial areas, and other pertinent Site features.

3.4 Supplemental Groundwater Investigation

To further delineate groundwater contamination at the Site, and to evaluate off-site migration of contamination that is emanating from the Site, four new overburden groundwater monitoring wells (designated as MW-18 through MW-21) will be installed, developed and surveyed in accordance with the well installation procedures provided in the August 2011 RI/RAA Work Plan. Tentative locations of the four new wells are shown on Figure 12. DAY will continue to use Quality Inspection Services, Inc. (QISI) to provide the drilling services; however, if QISI is not available within the schedule for this project, a different drilling subcontractor may be retained to provide the drilling services. The new well locations will supplement the existing groundwater monitoring well network. As shown on Figure 12, three of these new wells are located on the northern central portion of the Site, and the fourth new well is located off-site in the public right-of-way of Cumberland Street. Three of these new wells are hydraulically downgradient, and one new well is located cross-gradient, from the former PCE source area. [Note: the presence of the heavily used Inner Loop highway precludes the installation of a closer well location that would be hydraulically downgradient from off-site existing well position MW-11.] At each of the four new well locations, a rotary drill-rig and crew will collect continuous soil samples from the ground surface to top of bedrock and will subsequently install a 2" inner diameter polyvinyl chloride (PVC) monitoring well. The wells will consist of up to twenty foot PVC screens attached to solid PVC riser with similar sand pack, bentonite seal, grout and protective casings as existing wells.

Each boring will be continuously sampled from the ground surface to sampler refusal using split spoons. These field samples will be screened with a PID, visually observed, and logged in accordance with protocol set forth in the August 2011 RI/RAA Work Plan.

As shown on Table 1, one soil sample from each of the four well locations (total of 4 soil samples) may be collected for possible analytical laboratory testing. Depending upon location and field conditions encountered, analytical laboratory testing will include TCL VOCs and tentatively identified compounds (TICs) using USEPA Method 8260, and potentially PNOD using ASTM Method D7262-07; however, the samples may be tested for other parameters that would be determined with input and approval from the City and NYSDEC.

As part of the supplemental groundwater investigation, a groundwater sampling and analysis event will be completed using passive diffusion bag (PDB) sampler techniques from the complete well field at the Site that will consist of 17 existing overburden wells, the 4 new overburden wells, and the 9 existing bedrock wells. (i.e., total of 30 wells). This event is intended to monitor groundwater quality conditions on and off the Site subsequent to the completion of the previous IRM work (i.e., IRM-01 through IRM-06), and establish baseline groundwater conditions prior to pilot testing or any subsequent remedial work (e.g., supplemental IRM work). The PDB groundwater sampling will be conducted in accordance with the protocols previously established in the August 2011 RI/RAA Work Plan, including modifications that were subsequently approved by the NYSDEC. Prior to deployment of the PDBs, the depth intervals where the PDBs are to be set in each specific well will be determined with input and approval from the City and the NYSDEC Project Manager.

Initially, a heron oil/water interface probe (or similar equipment) will be used to evaluate the presence of dense non-aqueous phase liquid (DNAPL) and light non-aqueous phase liquid (LNAPL) at each well, and also measure static water levels. The PDBs will then be filled with deionized water from the laboratory, and one PDB will be deployed at each well. At least two weeks later, the PDBs will be retrieved, and water in the PDBs will be transferred to corresponding sample containers. The samples will be delivered under chain-of-custody control to Chemtech, which will analyze the samples for TCL VOCs and TICs using USEPA Method 8260. This tentative scope of groundwater analysis for field samples and QA/QC samples is included in Table 1.

With input and approval from the City and NYSDEC Project Manager, select samples may also be collected using low-flow or conventional purge and sample methods, and be tested for other parameters depending upon the actual Supplemental IRM remedial technology being considered by DAY, the City and the NYSDEC.

Potentiometric groundwater contour maps (overburden and bedrock) showing groundwater flow directions will be prepared using the calculated groundwater elevations developed from static water levels collected during the sampling event. To supplement existing data, hydraulic conductivity testing (slug-in, slug-out, and modeling) may be conducted on two of the four new overburden groundwater monitoring wells in accordance with protocols outlined in the August 2011 RI/RAA Work Plan. Hydraulic gradients and seepage velocities will subsequently be calculated. Depending upon the actual Supplemental IRM technologies being considered, other hydrogeology and lithology testing may be completed as deemed necessary with input and approval from the City and NYSDEC.

3.5 Investigation-Derived Wastes Management and Disposal

It is anticipated that solid and liquid investigation-derived wastes (IDW) will be generated during the Supplemental RI work. IDW will be characterized and managed (e.g., handled, transported and disposed) in general accordance with the applicable provisions set forth in the August 2011 RI/RAA Work Plan, including DER-10 Section 3.3(e). As shown on Table 1, it is anticipated that up to two solid (i.e., soil) IDW samples will be analyzed by Chemtech for Toxicity Characteristic Leaching Procedure (TCLP) VOCs using USEPA Methods 1311 and 8260, TCLP metals using USEPA Methods 1311 and 6010/7470, and ignitability using Method 1010; and that one liquid (i.e., groundwater, decontamination water) IDW sample will be analyzed for purgeable organics using USEPA Method 624.

3.6 Quality Assurance/Quality Control

Provisions set forth in the QAPP included in the August 2011 RI/RAA Work Plan will be implemented during the Supplemental RI Work. Chemtech will continue to provide analytical laboratory testing services, and EDV will continue to provide DUSR services. The DUSR-validated data will be incorporated in analytical laboratory tables that will be included in the RI. [Note, PNOD and/or other remediation viability testing may be completed by other laboratories (e.g., Carus Remediation Technologies), which will not require evaluation in a DUSR.]

3.7 Health and Safety

Provisions set forth in the HASP, CAMP and Emergency Contingency Plan (ECP) that are outlined in the August 2011 RI/RAA Work Plan will be implemented during the Supplemental RI Work.

3.8 Reporting

The findings of the Supplemental RI work will be incorporated into the RI Report (RIR) for the project, which is presented in the August 2011 RI/RAA Work Plan. Consistent with NYSDEC DER-10, the Conceptual Site Model (CSM) will be revised to account for existing information and data, as well as new information and data obtained during the course of the Supplemental RI work.

4.0 SCHEDULE

The Supplemental RI work will proceed immediately following NYSDEC approval of this Supplemental RI Work Plan. A tentative schedule for each phase of the Supplemental RI work is provided below. As shown, it is anticipated that the duration of the Supplemental RI work will be approximately 3 months.

3.1	**Site Preparation and Maintenance**	Month 1
3.2	**Soil Vapor Survey**	Month 1
3.3	**Supplemental Overburden Investigation**	Month 1
3.4	**Supplemental Groundwater Investigation**	Months 2 through 3

DAY will coordinate and communicate with City and NYSDEC project managers and their staff regarding implementation of the various aspects of this project. This includes, but is not limited to, participation in regularly-scheduled progress meetings, presentation of field findings and analytical laboratory test results, and during development of the RIR.

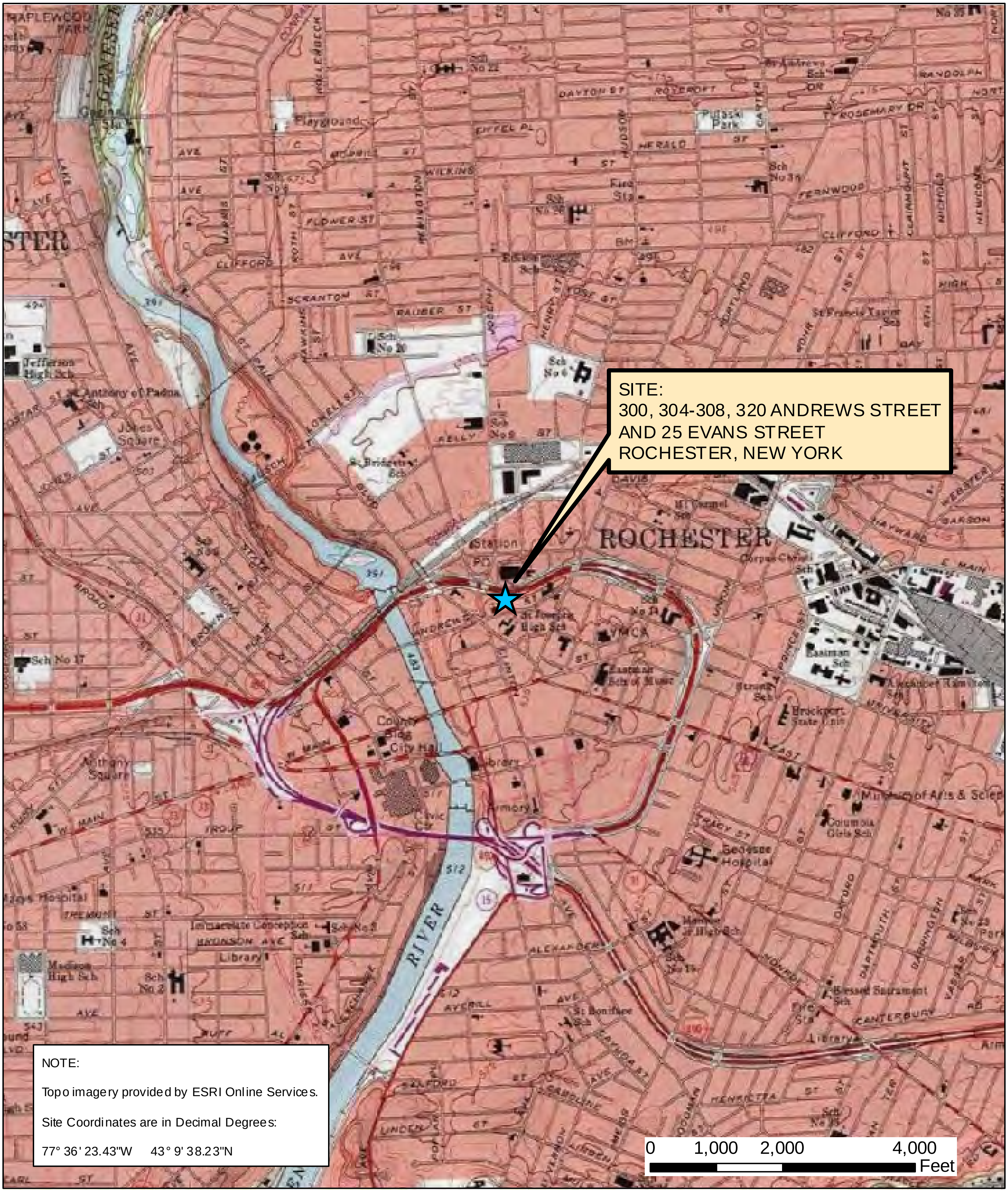
Note, the anticipated schedule provided above is dependent on a number of factors and could change. For example, the schedule is dependent on timely input on various aspects of the Work by the City and regulatory agencies, weather conditions, data results that could change or alter the scope of work, etc.

5.0 ACRONYMS

ASP	Analytical Services Protocol
ASTM	American Society for Testing Materials
BGS	Below the Ground Surface
CAMP	Community Air Monitoring Plan
CCD	Center City District
Chemtech	Chemtech Consulting Group, Inc.
City	City of Rochester
CSM	Conceptual Site Model
DAY	Day Environmental, Inc.
DNAPL	Dense Non-Aqueous Phase Liquid
DUSR	Data Usability Summary Report
EC	Electrical Conductivity
ECP	Emergency Contingency Plan
EDV	Environmental Data Validation, Inc.
ELAP	Environmental Laboratory Approval Program
ERP	Environmental Restoration Program
GIS	Geographic Information System
GPS	Global Positioning System
HASP	Health And Safety Plan
HDPE	High Density Polyethylene
HPT	Hydraulic Profiling Tool
IDW	Investigation Derived Waste
IRM	Interim Remedial Measure
K	Hydraulic Conductivity
MCPW	Monroe County Pure Waters
MIP	Membrane Interface Probe
LNAPL	Light Non-Aqueous Phase Liquid
NYCRR	New York Codes, Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
PCBs	Polychlorinated Biphenyl
PCE	Tetrachloroethene (a/k/a perchloroethene)
PDB	Passive Diffusion bag
P.E.	Professional Engineer
PID	Photoionization Detector
PNOD	Permanganate Natural Oxidant Demand
PPM	Parts Per Million
PSI	Pounds per Square Inch
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QISI	Quality Inspection Services, Inc.
RI	Remedial Investigation
RIR	Remedial Investigation Report
RI/RAA	Remedial Investigation/remedial Alternatives Analysis
SCG	Standard, Criteria and Guidance
SCO	Soil Cleanup Objective
SOP	Standard Operating Procedure
TCL	Target Compound List
TCLP	Toxicity Characteristic L:eaching Procedure
TIC	Tentatively Identified Compound
TOGs	Technical and Operational Guidance Series
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound
XSD	Halogen Specific Detector

FIGURES

\GIS\GIS Mapping\Andrews Street\4355S-1A.mxd



SITE:
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

NOTE:

Topo imagery provided by ESRI Online Services.

Site Coordinates are in Decimal Degrees:

77° 36' 23.43"W 43° 9' 38.23"N

Date
10-01-2012

Drawn By
CPS

Scale
AS NOTED

day
DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10016-0701

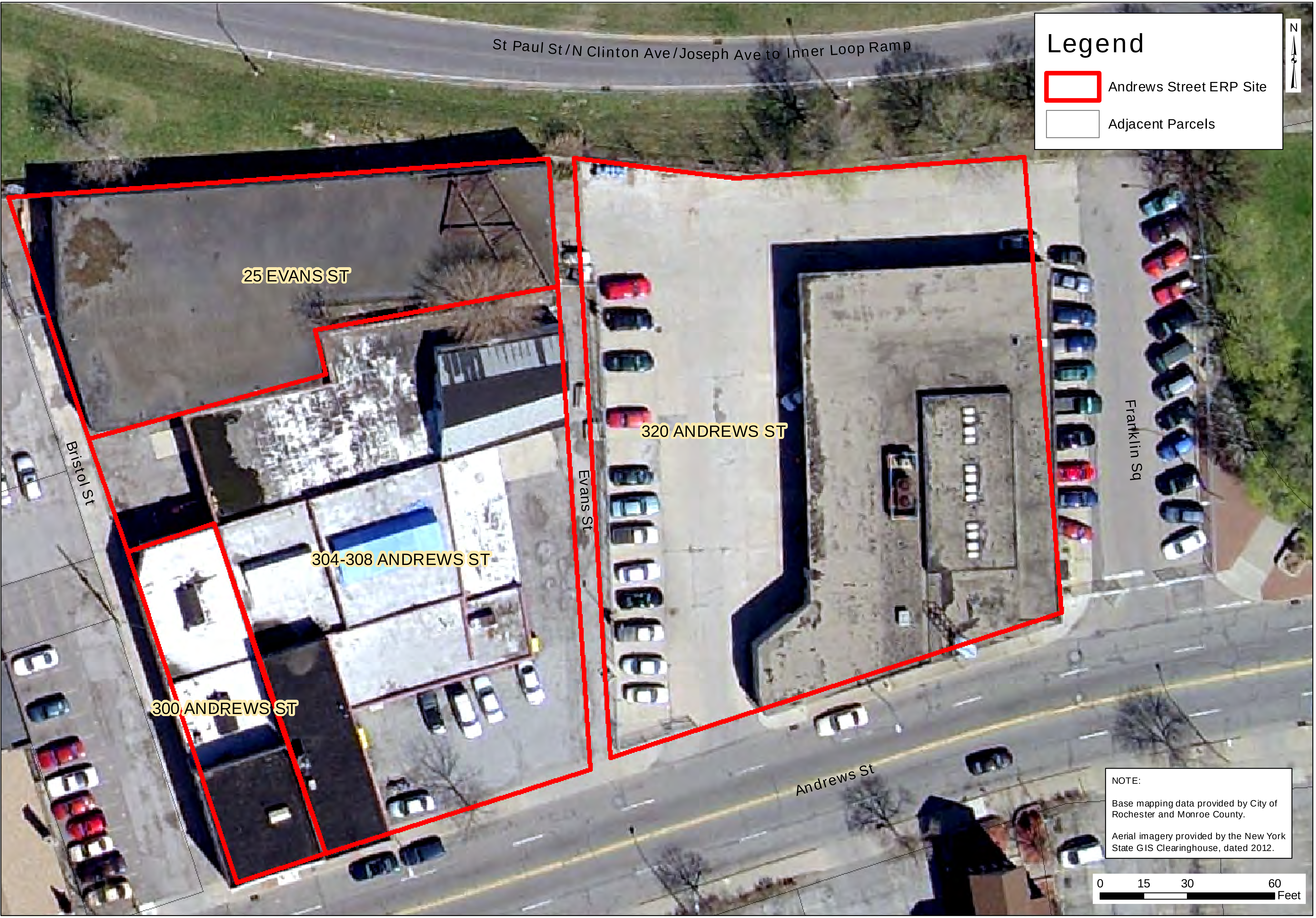
Project Title
300, 304-308, 320 ANDREWS STREET AND
25 EVANS STREET
ROCHESTER, NEW YORK
(NYSDEC SITE NO.: E828144)

ENVIRONMENTAL RESTORATION PROJECT

Drawing Title
Project Locus Map

Project No.
4355S-10

FIGURE 1



NOTE:

Base mapping data provided by City of Rochester and Monroe County.

Aerial imagery provided by the New York State GIS Clearinghouse, dated 2012.

Document Path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI - 2 -Pre-demo Site Plan.mxd

DESIGNED BY	DATE
JAD	05-2013
DRAWN BY	DATE DRAWN
CPS	05-2013
SCALE	DATE ISSUED
AS NOTED	05-16-2013

DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO.: E828144

Drawing Title
Pre-Demolition Site Conditions

Project No.
4355S-10

FIGURE 2

NOTE:

Base mapping data provided by City of Rochester and Monroe County.

Aerial imagery provided by the New York State GIS Clearinghouse, dated 2012.

Document Path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI - Site Plan.mxd

DESIGNED BY	DATE
JAD	05-2013
DRAWN BY	DATE DRAWN
CPS	05-2013
SCALE	DATE ISSUED
AS NOTED	05-16-2013

day
DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

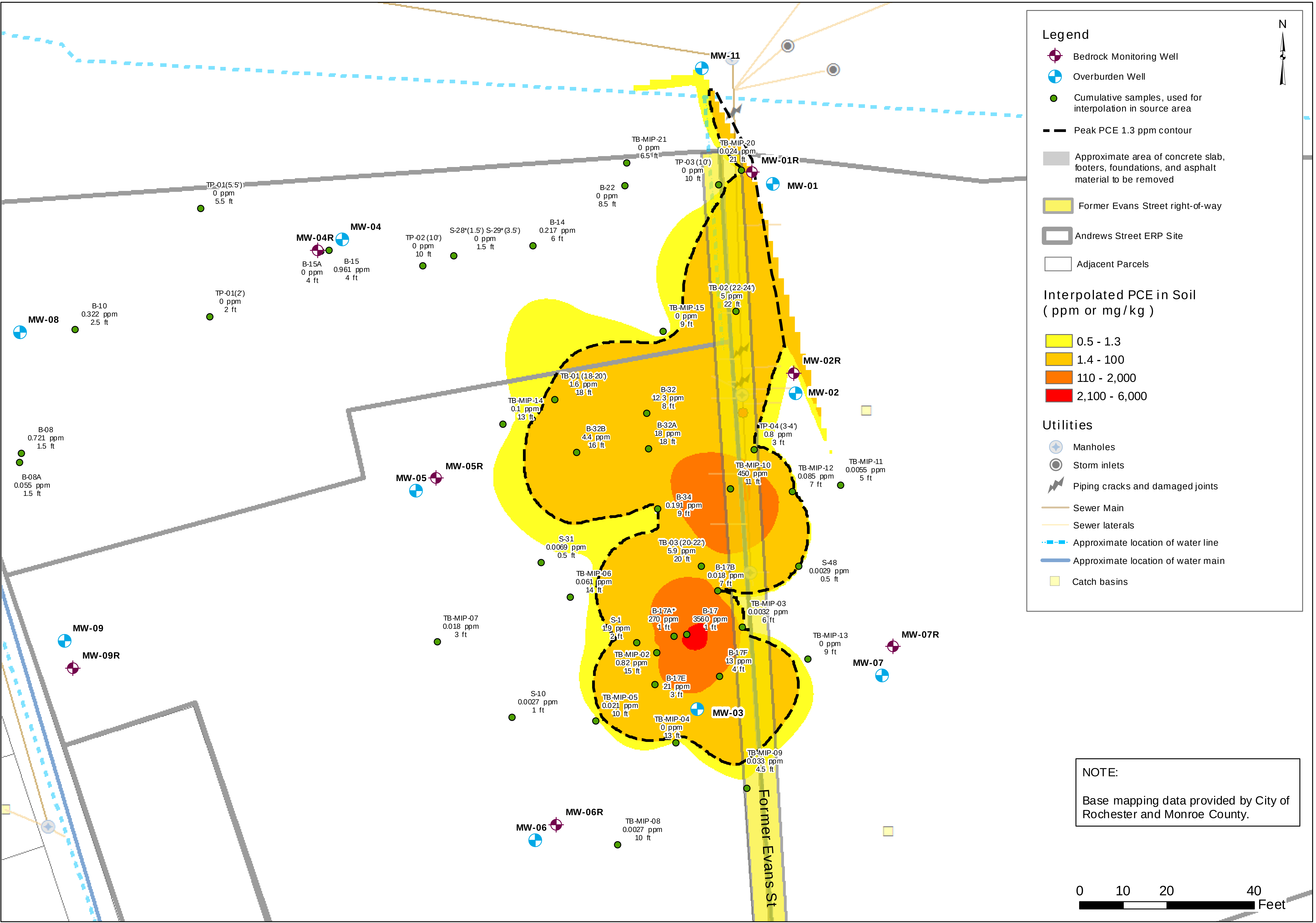
Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO.: E828144

Drawing Title
Post-Demolition Site Conditions

Project No.
4355S-10

FIGURE 3



Legend

- Bedrock Monitoring Well
- Overburden Well
- ● Cumulative samples, used for interpolation in source area
- Peak PCE 1.3 ppm contour
- Approximate area of concrete slab, footers, foundations, and asphalt material to be removed
- Former Evans Street right-of-way
- Andrews Street ERP Site
- Adjacent Parcels

Interpolated PCE in Soil (ppm or mg/kg)

- 🟨 0.5 - 1.3
- 🟧 1.4 - 100
- 🟧 110 - 2,000
- 🟥 2,100 - 6,000

Utilities

- Manholes
- Storm inlets
- Piping cracks and damaged joints
- Sewer Main
- Sewer laterals
- Approximate location of water line
- Approximate location of water main
- Catch basins

NOTE:

Base mapping data provided by City of Rochester and Monroe County.

Map document path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-3-PCE in soil.mxd

Last date document was saved: 21 May 2013

DESIGNED BY JAD	DATE 06-2012
DRAWN BY CPS	DATE DRAWN 06-2012
SCALE AS NOTED	DATE ISSUED 05-16-2013

day
DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK
ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO: E828144

Drawing Title
Interpolated Area of Peak PCE Soil Concentrations in Source Area (Prior to IRMs)

Project No.
4355S-10

FIGURE 4

NOTE:

Base mapping data provided by City of Rochester and Monroe County.

Map document path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-4-IRM-01 to IRM06.mxd

Last date document was saved: 21 May 2013

DATE	06-2012
DESIGNED BY	JAD
DATE DRAWN	06-2012
DRAWN BY	CPS
DATE ISSUED	05-16-2013
SCALE	AS NOTED

day

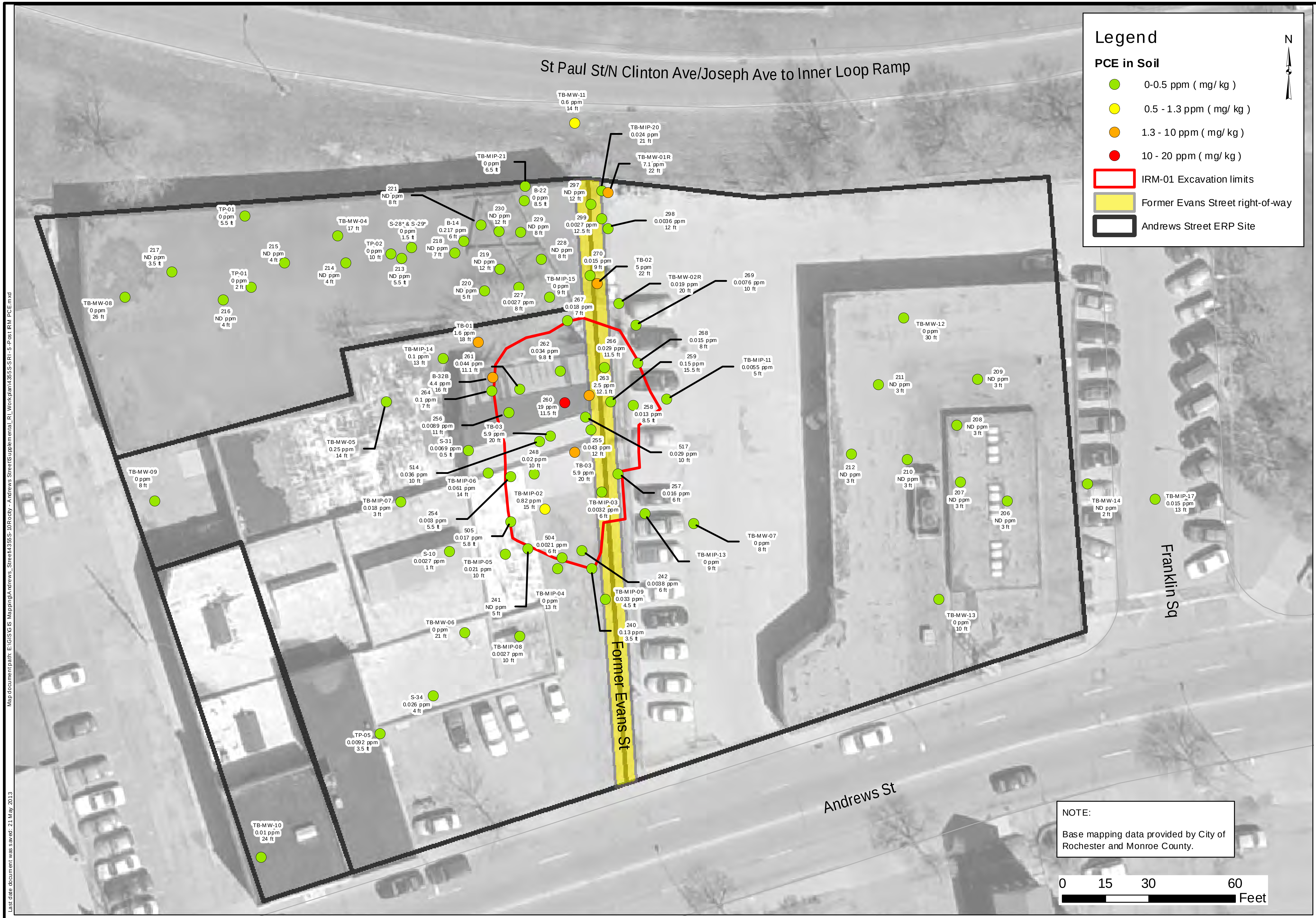
DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK
ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO: E828144

Drawing Title
2012 IRM Removal Areas

Project No.
4355S-10

FIGURE 5



NOTE:

Base mapping data provided by City of Rochester and Monroe County.

DESIGNED BY	DATE
JAD	06-2012
DRAWN BY	DATE DRAWN
CPS	06-2012
SCALE	DATE ISSUED
AS NOTED	05-16-2013

day
DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO: E828144

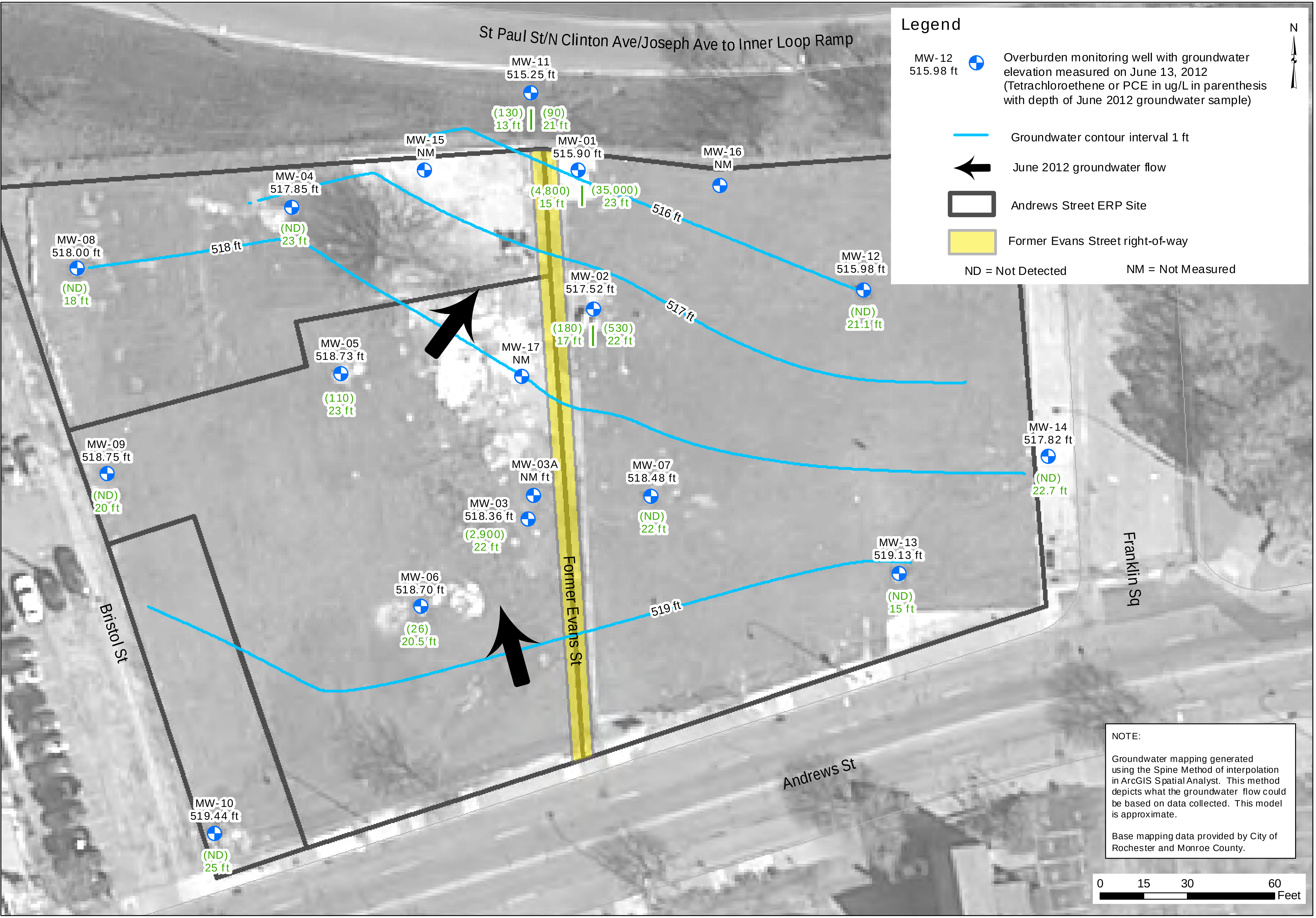
Drawing Title
Post - IRM PCE Concentrations in Demolition Phase and RI Soil Samples

Project No.
4355S-10

FIGURE 6

Map document path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-5-Post IRM PCE.mxd

Last date document was saved: 21 May 2013



NOTE:

Groundwater mapping generated using the Spine Method of interpolation in ArcGIS Spatial Analyst. This method depicts what the groundwater flow could be based on data collected. This model is approximate.

Base mapping data provided by City of Rochester and Monroe County.

Document Path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-6-Overburden GW 6-13-2012 PCE 06-2012.mxd

DESIGNED BY	DATE
NES	04-2013
DRAWN BY	DATE DRAWN
CPS	04-2013
SCALE	DATE ISSUED
AS NOTED	05-10-2013

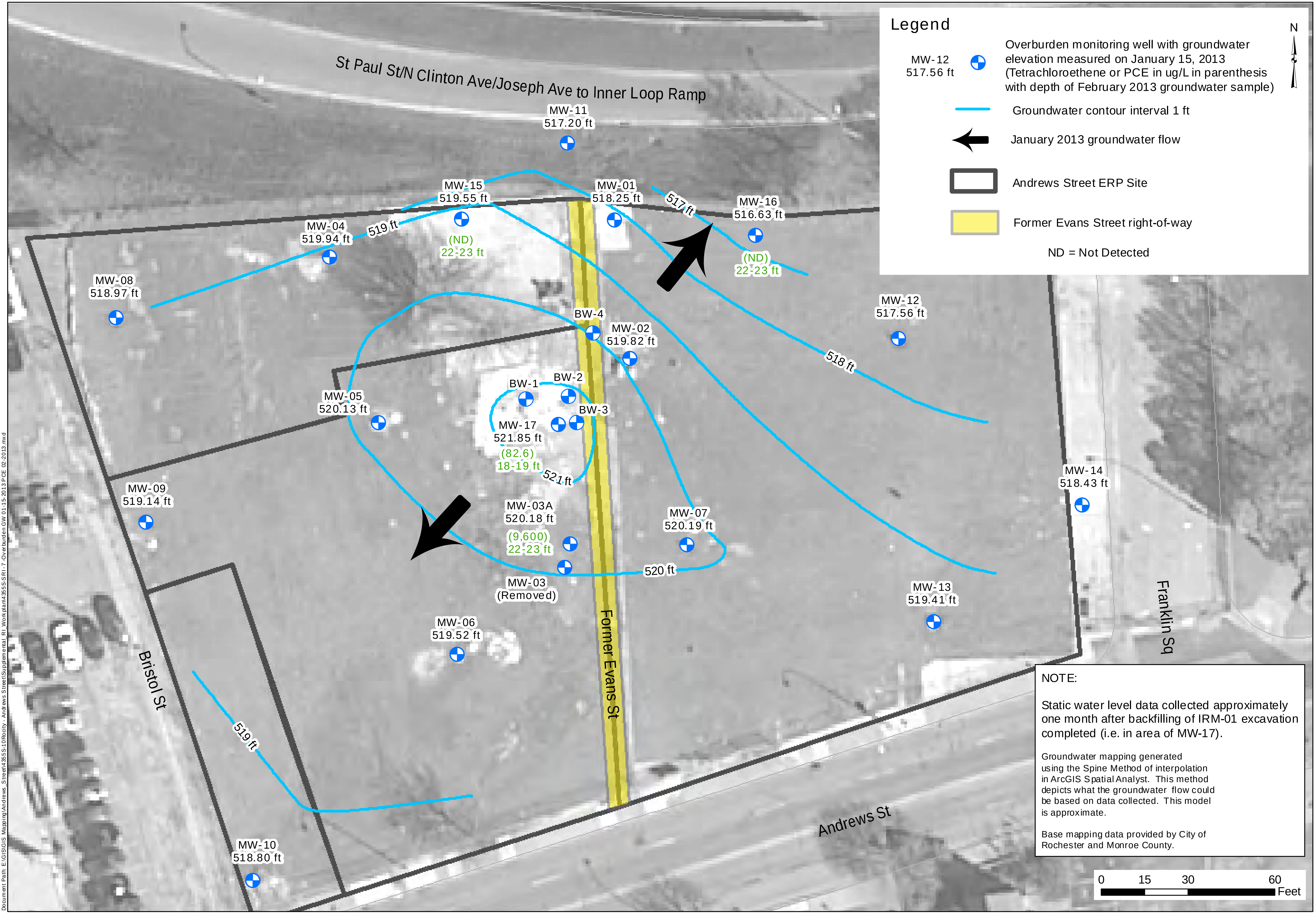
DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK
ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO.: E828144

Drawing Title
Site Plan with Overburden Groundwater Potentiometric Map for June 13, 2012 and PCE Concentrations Detected in June 2012 Overburden Groundwater Samples

Project No.
4355S-10

FIGURE 7



Legend

MW-12 517.56 ft	●	Overburden monitoring well with groundwater elevation measured on January 15, 2013 (Tetrachloroethene or PCE in ug/L in parenthesis with depth of February 2013 groundwater sample)
	—	Groundwater contour interval 1 ft
	←	January 2013 groundwater flow
	☐	Andrews Street ERP Site
	🟨	Former Evans Street right-of-way

ND = Not Detected

NOTE:

Static water level data collected approximately one month after backfilling of IRM-01 excavation completed (i.e. in area of MW-17).

Groundwater mapping generated using the Spine Method of interpolation in ArcGIS Spatial Analyst. This method depicts what the groundwater flow could be based on data collected. This model is approximate.

Base mapping data provided by City of Rochester and Monroe County.

Document Path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-7-Overburden GW 01-15-2013 PCE 02-2013.mxd

DATE	04-2013
DATE DRAWN	04-2013
DATE ISSUED	05-10-2013
DESIGNED BY	NES
DRAWN BY	CPS
SCALE	AS NOTED

day
DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

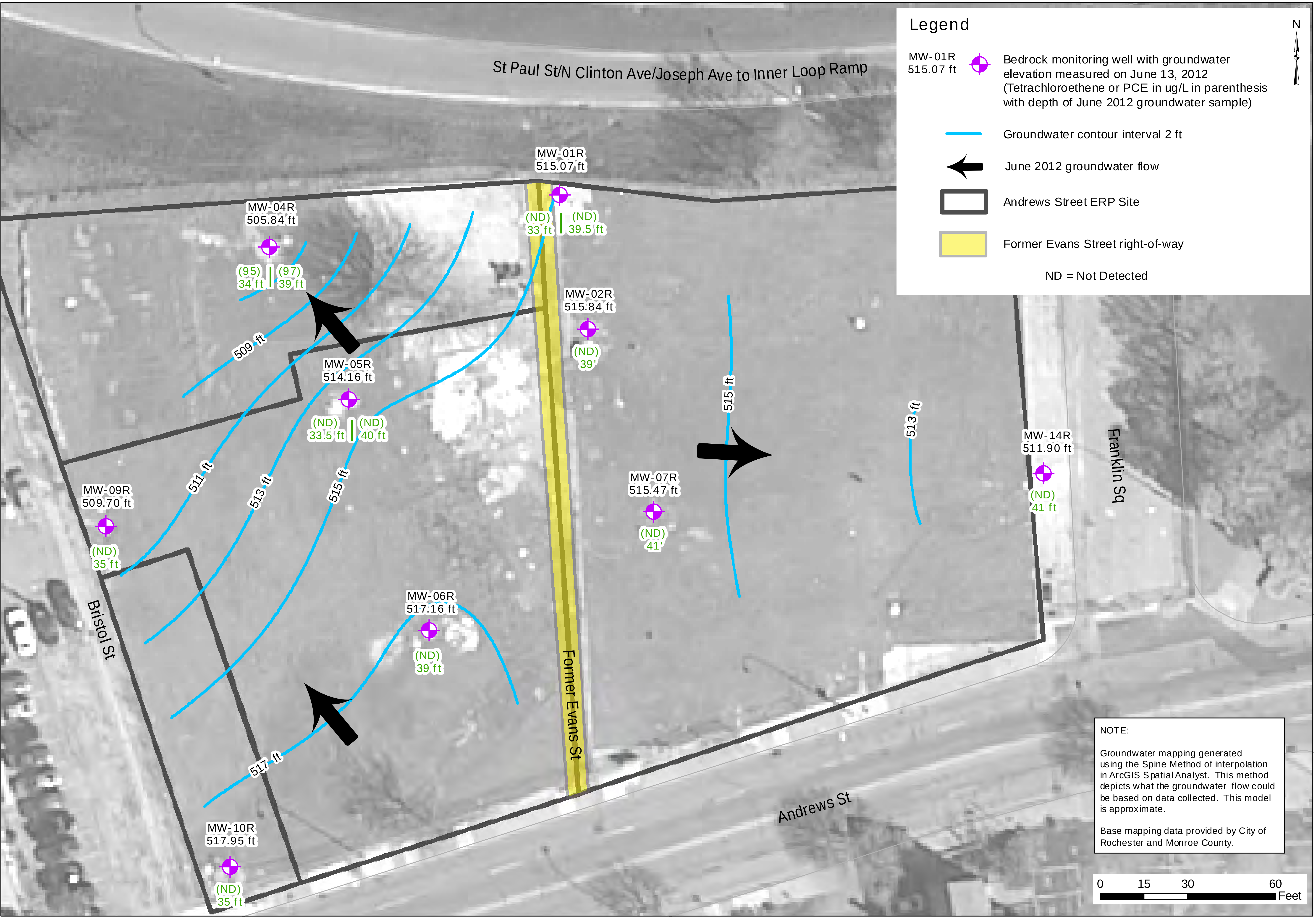
Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO.: E828144

Drawing Title
Site Plan with Overburden Groundwater Potentiometric Map for January 15, 2013 and PCE Concentrations Detected in February 2013 Overburden Groundwater Samples

Project No.
4355S-10

FIGURE 8



Legend

MW-01R 515.07 ft ⌖ Bedrock monitoring well with groundwater elevation measured on June 13, 2012 (Tetrachloroethene or PCE in ug/L in parenthesis with depth of June 2012 groundwater sample)

— Groundwater contour interval 2 ft

← June 2012 groundwater flow

▭ Andrews Street ERP Site

🟨 Former Evans Street right-of-way

ND = Not Detected

NOTE:

Groundwater mapping generated using the Spine Method of interpolation in ArcGIS Spatial Analyst. This method depicts what the groundwater flow could be based on data collected. This model is approximate.

Base mapping data provided by City of Rochester and Monroe County.

Document Path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI -8 -Bedrock GW 06-13-2012 PCE 06-2012.mxd

DESIGNED BY	DATE
NES	04-2013
DRAWN BY	DATE DRAWN
CPS	04-2013
SCALE	DATE ISSUED
AS NOTED	05-10-2013

day

DAY ENVIRONMENTAL, INC.

Environmental Consultants
Rochester, New York 14606
New York, New York 10170

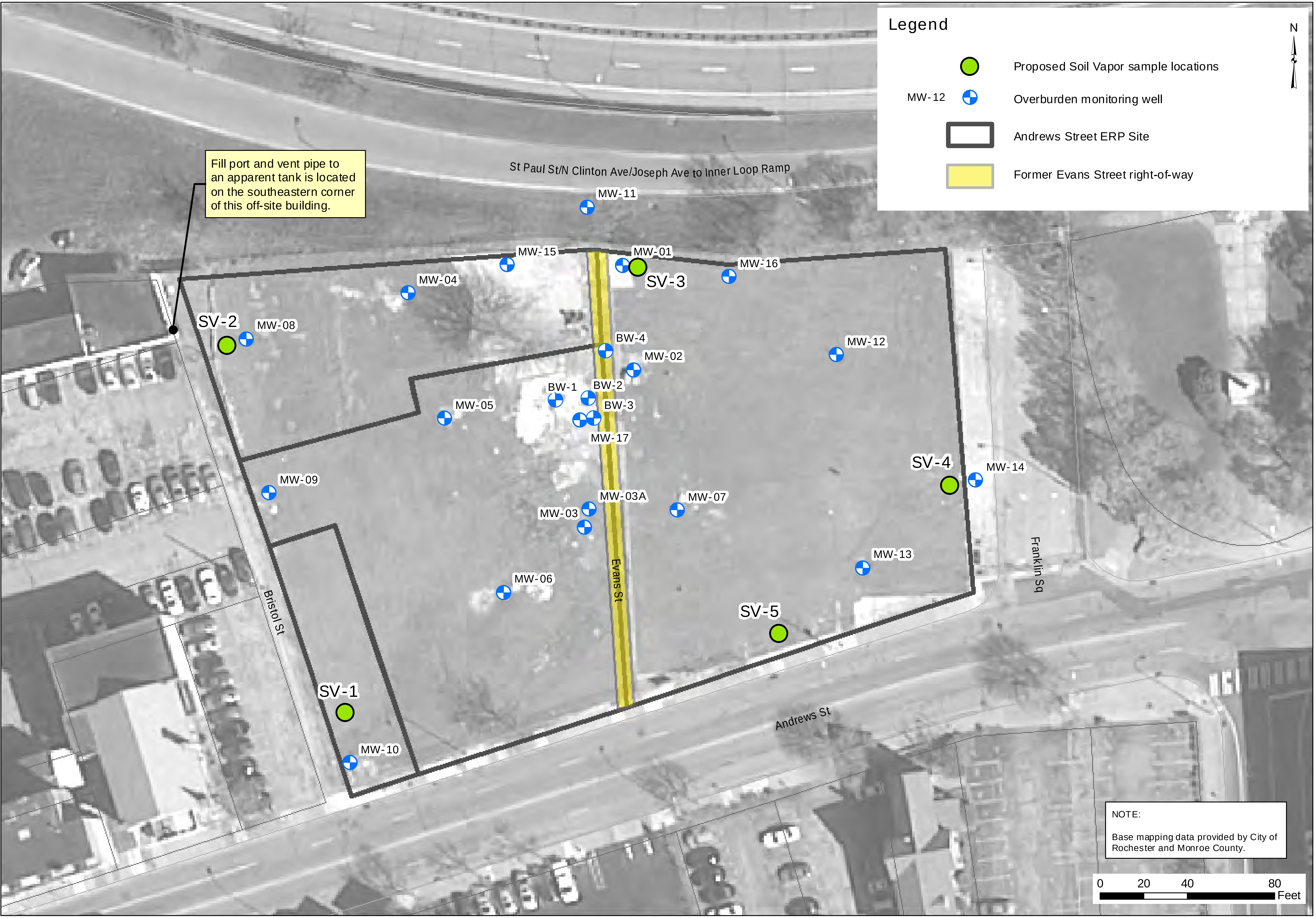
Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO.: E828144

Drawing Title
Site Plan with Bedrock Groundwater Potentiometric Map for June 13, 2012 and PCE Concentrations Detected in June 2012 Bedrock Groundwater Samples

Project No.
4355S-10

FIGURE 9



Document Path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-9 - Proposed SVI.mxd

DESIGNED BY	DATE	DRAWN BY	DATE DRAWN	SCALE	DATE ISSUED
NES	05-2013	CPS	05-2013	AS NOTED	05-15-2013

day

DAY ENVIRONMENTAL, INC.

Environmental Consultants
Rochester, New York 14606
New York, New York 10170

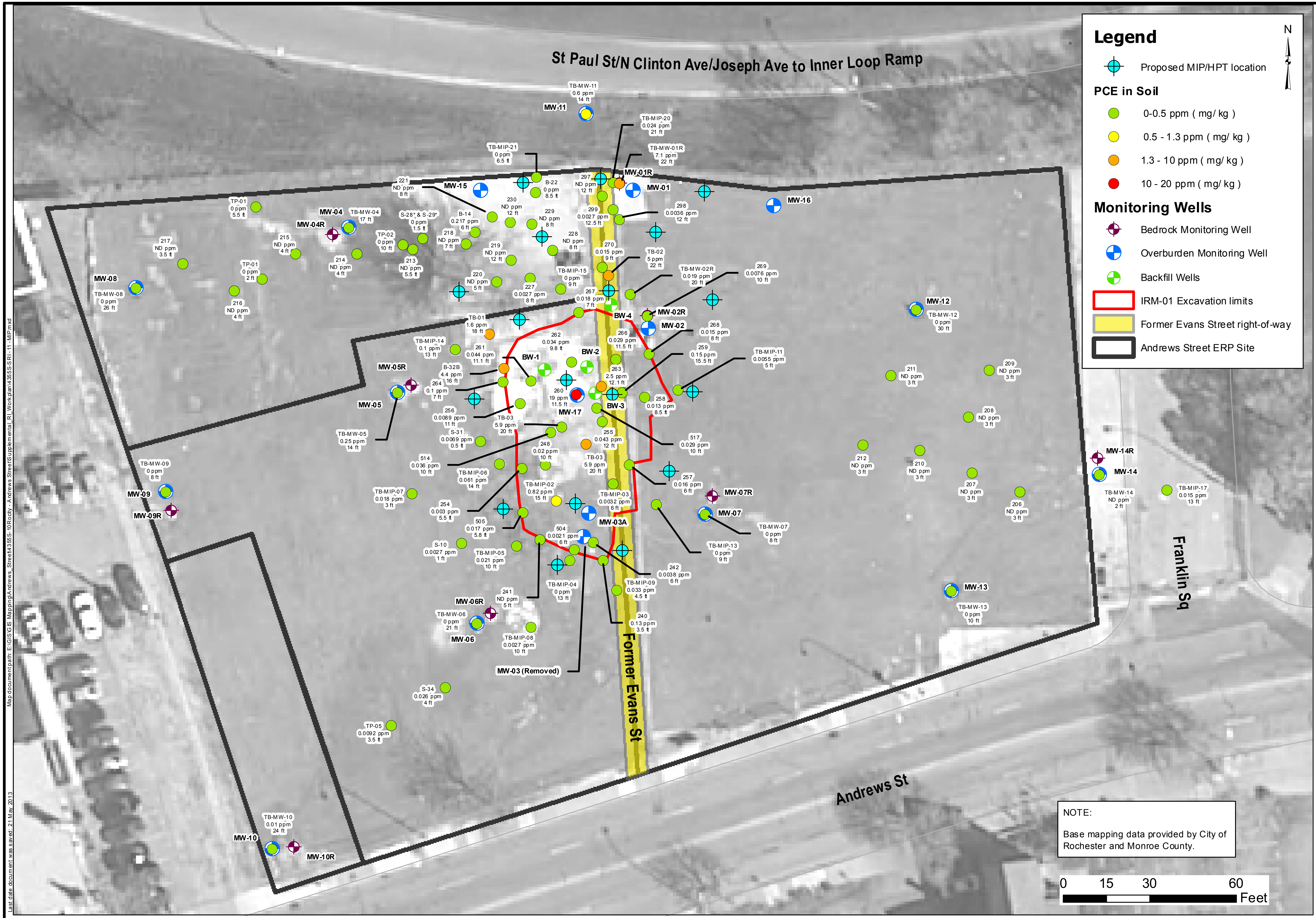
Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO.: E828144

Drawing Title
Proposed Soil Vapor Sample Location Plan

Project No.
4355S-10

FIGURE 10



NOTE:

Base mapping data provided by City of Rochester and Monroe County.

Map document path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-11-MIP.mxd

Last date document was saved: 21 May 2013

DESIGNED BY JAD	DATE 06-2012
DRAWN BY CPS	DATE DRAWN 06-2012
SCALE AS NOTED	DATE ISSUED 05-16-2013

DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

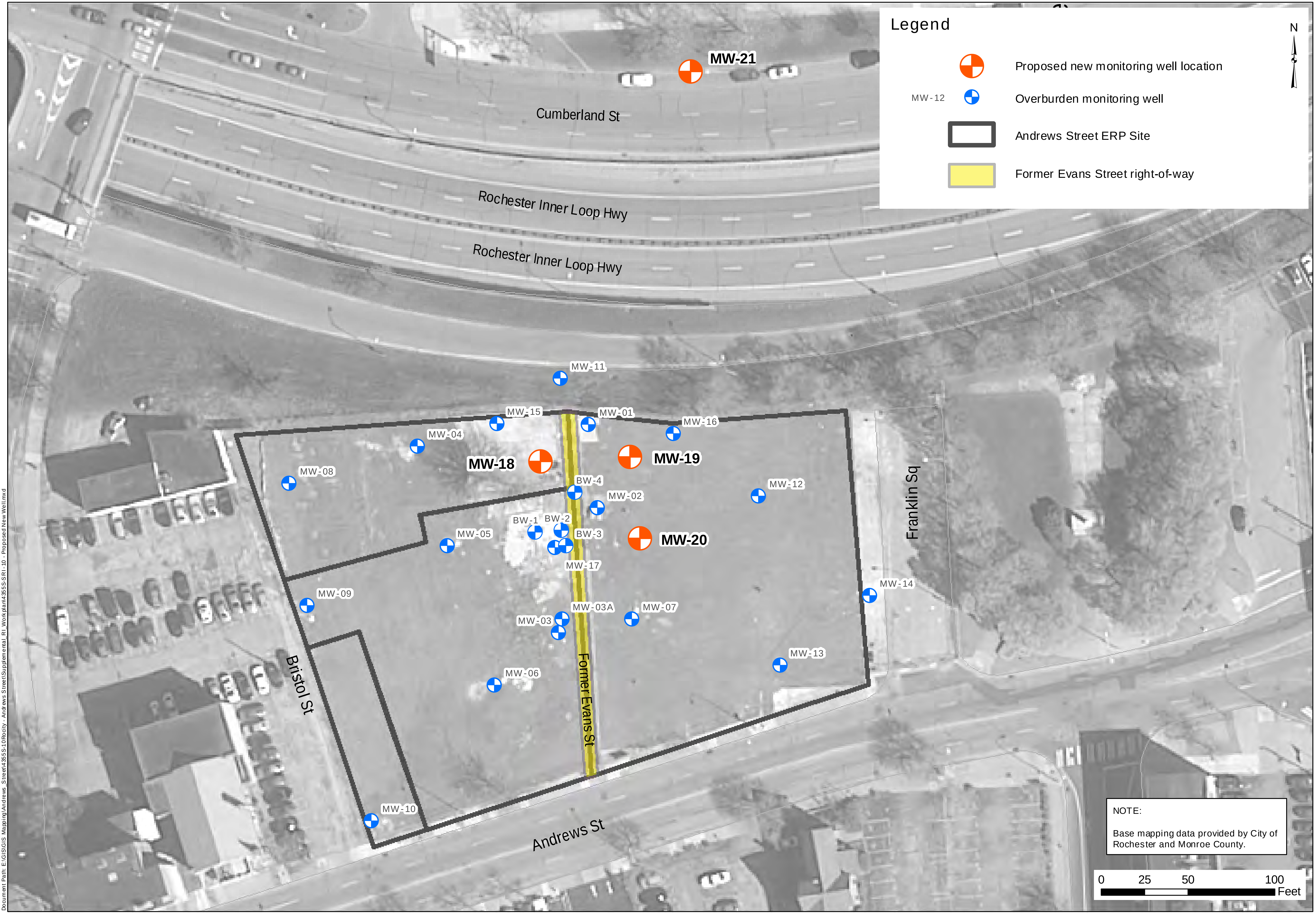
Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO: E828144

Drawing Title
Proposed MIP/HPT Location Plan in Relation to Post - IRM PCE Concentrations
in Demolition Phase and RI Soil Samples

Project No.
4355S-10

FIGURE 11



NOTE:

Base mapping data provided by City of Rochester and Monroe County.

Document Path: E:\GIS\GIS Mapping\Andrews_Street\4355S-10Rocity - Andrews Street\Supplemental_RI_Workplan\4355S-SRI-10 - Proposed New Well.mxd

DESIGNED BY	DATE
NES	05-2013

DRAWN BY	DATE DRAWN
CPS	05-2013

SCALE	DATE ISSUED
AS NOTED	05-15-2013

DAY ENVIRONMENTAL, INC.
Environmental Consultants
Rochester, New York 14606
New York, New York 10170

Project Title
300, 304-308, 320 ANDREWS STREET
AND 25 EVANS STREET
ROCHESTER, NEW YORK

ENVIRONMENTAL RESTORATION PROJECT NYSDEC SITE NO.: E828144

Drawing Title
Proposed New Monitoring Well Location Plan

Project No.
4355S-10

FIGURE 12

TABLE

Table 1 - Sampling and Analysis Plan

Table 1

Sampling and Analysis Plan

Andrews Street Site
300, 304-308 and 320 Andrews Street and
25 Evans Street, Rochester, New York

NYSDEC Site ERP #E828144

TASK	ANALYTICAL LABORATORY	PARAMETERS	METHOD	SAMPLE MATRIX	MAXIMUM ANTICIPATED # OF FIELD SAMPLES	TRIP BLANKS	MS/MSD OR MS/MD	DUPLICATE SAMPLES	FIELD BLANKS
Soil Vapor Survey	Chemtech	VOCs	TO-15	Soil vapor	4	0	0	0	0
		VOCs	TO-15	Outdoor Background Air	1	0	0	0	0
Supplemental Overburden Investigation	Chemtech	TCL VOCs+TICs	8260	Soil or Groundwater	4	0	1	0	1
	Chemtech, Carus, or Other	PNOD	ASTM D7262-07	Soil	2	0	0	0	0
Supplemental Groundwater Investigation	Chemtech, Carus, or Other	PNOD	ASTM D7262-07	Soil	4	0	0	0	0
	Chemtech	TCL VOCs+TICs	8260	Soil	4	0	1	0	1
		TCL VOCs+TICs	8260	Groundwater	30	2	2	0	2
Waste Characterization (Investigation-Derived Waste)	Chemtech	TCLP VOCs	1311, 8260	Soil	2	0	0	0	0
		TCLP Metals	1311, 6010/7470	Soil	2	0	0	0	0
		Ignitability (Flashpoint)	1010	Soil	2	0	0	0	0
		Purgeable Organics	624	Water	1	0	0	0	0

Note: Refer to Attachments 3, 5, 6, 7 of QAPP in August 2011 RI/RAA Work Plan for additional information requested by DER-10 Section 2.4(a)v

VOCs = Volatile Organic Compounds

TCL = Target Compound List

PNOD - Permanganate Natural Oxidant Demand

TCLP = Toxicity Characteristic Leaching Procedure

APPENDIX A

Soil Vapor Sampling Guidance

(Section 2.7 and Section 2.8 of the NYSDOH document "Final Guidance for Evaluating Soil Vapor Intrusion in the State of New York" dated October 2006)

FINAL

Guidance for Evaluating Soil Vapor Intrusion in the State of New York

October 2006

Prepared by:

NEW YORK STATE DEPARTMENT OF HEALTH
Center for Environmental Health
Bureau of Environmental Exposure Investigation

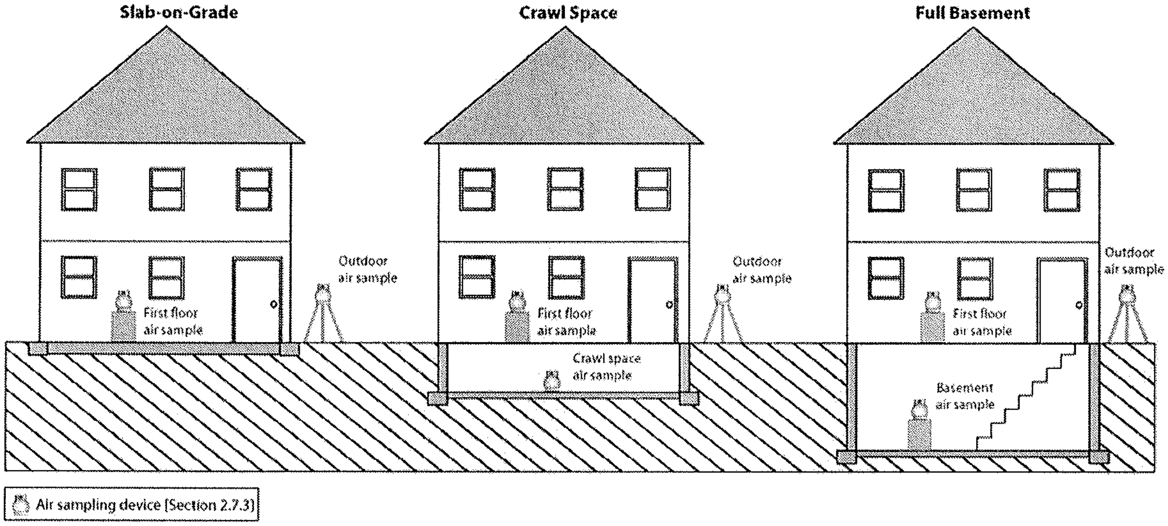


Figure 2.1
Schematic of indoor and outdoor air sampling locations

2.6.4 Outdoor air

Typically, an outdoor air sample is collected outside of each building where an indoor air sample is collected. However, if several buildings are being sampled within a localized area, representative outdoor air samples may be appropriate. For example, one outdoor air sample may be sufficient for three houses being sampled in a cul-de-sac. Outdoor air samples should be collected from a representative upwind location, away from wind obstructions (e.g., trees or bushes), and at a height above the ground to represent breathing zones (3 to 5 feet) [Figure 2.1]. A representative sample is one that is not biased toward obvious sources of volatile chemicals (e.g., automobiles, lawn mowers, oil storage tanks, gasoline stations, industrial facilities, etc.). For buildings with HVAC systems that draw outdoor air into the building, an outdoor air sample collected near the outdoor air intake may be appropriate.

2.7 Sampling protocols

The procedures recommended here may be modified depending on site-specific conditions, the sampling objectives, or emerging technologies and methodologies. Alternative sampling procedures should be described thoroughly and proposed in a work plan submitted for review by the State. The State will review and comment on the proposed procedure and consider the efficacy of the alternative sampling procedure based on the objectives of investigation. In all cases, work plans should thoroughly describe the proposed sampling procedure. Similarly, the procedures that were implemented in the field should be documented and included in the final report of the sampling results.

2.7.1 Soil vapor

Soil vapor probe installations [Figure 2.2] may be permanent, semi-permanent or temporary. In general, permanent or semi-permanent installations are preferred for data consistency reasons and to ensure outdoor air infiltration does not occur. Temporary probes should only be used if measures are taken to ensure that an adequate surface seal is created to prevent outdoor air infiltration and if tracer gas is used at every sampling location. [See Section 2.7.5 for additional information about the use of tracer gas when collecting soil vapor samples.] Soil vapor implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any permanent construction protocol:

a. implants should be installed using an appropriate method based on site conditions (e.g., direct push, manually driven, auger — if necessary to attain the desired depth or if sidewall smearing is a concern, etc.);

b. porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) should be used to create a sampling zone 1 to 2 feet in length;

c. implants should be fitted with inert tubing (e.g., polyethylene, stainless steel, nylon, Teflon®, etc.) of the appropriate size (typically 1/8 inch to 1/4 inch diameter) and of laboratory or food grade quality to the surface;

d. soil vapor probes should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet to prevent outdoor air infiltration and the remainder of the borehole backfilled with clean material;

e. for multiple probe depths, the borehole should be grouted with bentonite between probes to create discrete sampling zones or separate nested probes should be installed [Figure 2.2]; and

f. steps should be taken to minimize infiltration of water or outdoor air and to prevent accidental damage (e.g., setting a protective casing around the top of the probe tubing and grouting in place to the top of bentonite, sloping the ground surface to direct water away from the borehole like a groundwater monitoring well, etc.).

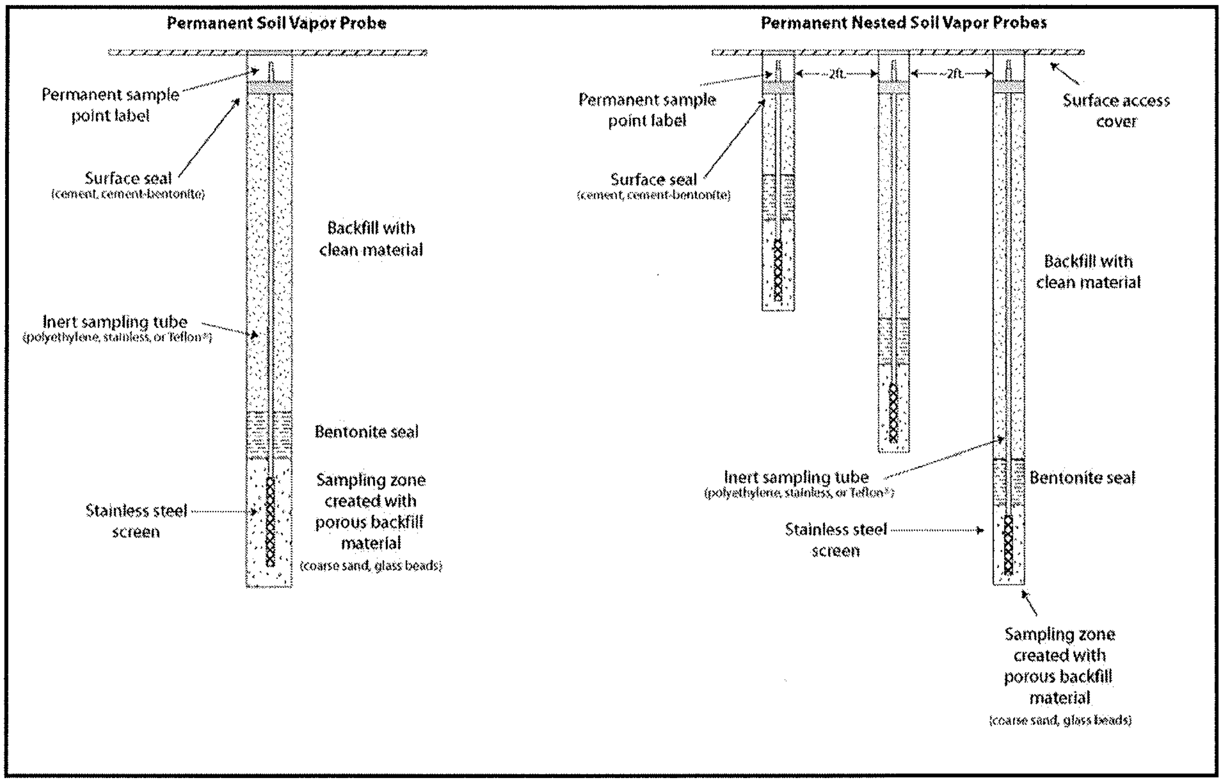


Figure 2.2

Schematics of a generic permanent soil vapor probe and permanent nested soil vapor probes

[Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]

To obtain representative samples and to minimize possible discrepancies, soil vapor samples should be collected in the following manner at all locations:

a. at least 24 hours after the installation of permanent probes and shortly after the installation of temporary probes, one to three implant volumes (i.e., the volume of the sample probe and tube) should be purged prior to collecting the samples;

b. flow rates for both purging and collecting should not exceed 0.2 liters per minute to minimize outdoor air infiltration during sampling;

c. samples should be collected, using conventional sampling methods, in an appropriate container — one which

    i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),

    ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and

    iii. is certified clean by the laboratory;

d. sample size depends upon the volume of that will achieve minimum reporting limits [Section 2.9]; and
e. a tracer gas (e.g., helium, butane, sulfur hexafluoride, etc.) should be used when collecting soil vapor samples to verify that adequate sampling techniques are being implemented (i.e., to verify infiltration of outdoor air is not occurring) [Section 2.7.5].

In some cases, weather conditions may present certain limitations on soil vapor sampling. For example, condensation in the sample tubing may be encountered during winter sampling due to low outdoor air temperatures. Devices, such as tube warmers, may be used to address these conditions. Anticipated limitations to the sampling should be discussed prior to the sampling event so appropriate measures can be taken to address these difficulties and produce representative and reliable data.

When soil vapor samples are collected, the following actions should be taken to document local conditions during sampling that may influence interpretation of the results:

a. if sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified;
b. outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (north);
c. weather conditions (e.g., precipitation and outdoor temperature) should be noted for the past 24 to 48 hours; and
d. any pertinent observations should be recorded, such as odors and readings from field instrumentation.

Additional information that could be gathered to assist in the interpretation of the results includes barometric pressure, wind speed and wind direction.

The field sampling team should maintain a sample log sheet summarizing the following:

a. sample identification,
b. date and time of sample collection,
c. sampling depth,
d. identity of samplers,
e. sampling methods and devices,
f. purge volumes,
g. volume of soil vapor extracted,
h. if canisters used, the vacuum before and after samples were collected,
i. apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and
j. chain of custody protocols and records used to track samples from sampling point to analysis.

2.7.2 Sub-slab vapor

During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 - 75 °F) for at least 24 hours prior to and during the scheduled sampling time. Prior to installation of the sub-slab vapor probe, the building floor should be inspected and any penetrations (cracks, floor drains, utility perforations, sumps, etc.) should be noted and recorded. Probes should be installed at locations where the potential for ambient air infiltration via floor penetrations is minimal.

Sub-slab vapor probe installations [Figure 2.3] may be permanent, semi-permanent or temporary. A vacuum should not be used to remove drilling debris from the sampling port. Sub-slab implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any construction protocol:

a. permanent recessed probes should be constructed with brass or stainless steel tubing and fittings;
b. temporary probes should be constructed with inert tubing (e.g., polyethylene, stainless steel, nylon, Teflon®, etc.) of the appropriate size (typically 1/8 inch to 1/4 inch diameter), and of laboratory or food grade quality;
c. tubing should not extend further than 2 inches into the sub-slab material;
d. porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) should be added to cover about 1 inch of the probe tip for permanent installations; and
e. the implant should be sealed to the surface with non-VOC-containing and non-shrinking products for temporary installations (e.g., permagum grout, melted beeswax, putty, etc.) or cement for permanent installations.

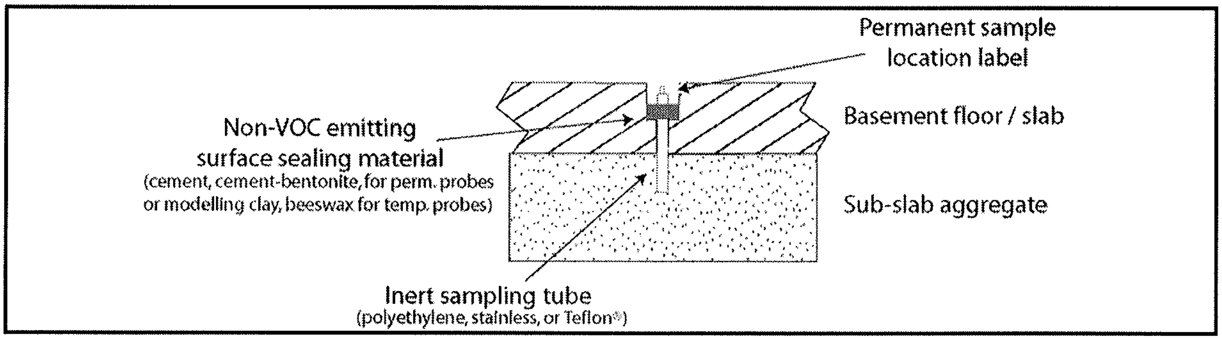


Figure 2.3

Schematic of a generic sub-slab vapor probe

[Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]

To obtain representative samples that meet the data quality objectives, sub-slab vapor samples should be collected in the following manner:

a. after installation of the probes, one to three volumes (i.e., the volume of the sample probe and tube) must be purged prior to collecting the samples to ensure samples collected are representative;

b. flow rates for both purging and collecting must not exceed 0.2 liters per minute to minimize ambient air infiltration during sampling; and

c. samples should be collected, using conventional sampling methods, in an appropriate container — one which

    i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),

    ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and

    iii. is certified clean by the laboratory;

d. sample size depends upon the volume of that will achieve minimum reporting limits [Section 2.9], the flow rate, and the sampling duration; and

e. ideally, samples should be collected over the same period of time as concurrent indoor and outdoor air samples.

When sub-slab vapor samples are collected, the following actions should be taken to document conditions during sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

a. historic and current storage and uses of volatile chemicals should be identified, especially if sampling within a commercial or industrial building (e.g., use of volatile chemicals in commercial or industrial processes and/or during building maintenance);

b. the use of heating or air conditioning systems during sampling should be noted;

c. floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system air supply and return registers, compass orientation (north), footings that create separate foundation sections, and any other pertinent information should be completed;

d. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas;

e. weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported; and

f. any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.), should be recorded.

Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas), the barometric pressure and photographs to accompany floor plan sketches.

The field sampling team should maintain a sample log sheet summarizing the following:

a. sample identification,
b. date and time of sample collection,
c. sampling depth,
d. identity of samplers,
e. sampling methods and devices,
f. soil vapor purge volumes,
g. volume of soil vapor extracted,
h. if canisters used, vacuum of canisters before and after samples collected,
i. apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and
j. chain of custody protocols and records used to track samples from sampling point to analysis.

2.7.3 Indoor air

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 - 75 °F) for at least 24 hours prior to and during the scheduled sampling time. If possible, prior to collecting indoor samples, a pre-sampling inspection [Section 2.11.1] should be performed to evaluate the physical layout and conditions of the building being investigated, to identify conditions that may affect or interfere with the proposed sampling, and to prepare the building for sampling. This process is described in Section 2.11.1.

In general, indoor air samples should be collected in the following manner:

a. sampling duration should reflect the exposure scenario being evaluated without compromising the detection limit or sample collection flow rate (e.g., an 8 hour sample from a workplace with a single shift versus a 24 hour sample from a workplace with multiple shifts). To ensure that air is representative of the locations sampled and to avoid undue influence from sampling personnel, samples should be collected for at least 1 hour. If the goal of the sampling is to represent average concentrations over longer periods, then longer duration sampling periods may be appropriate. Typically, 24 hour samples are collected from residential settings;
b. personnel should avoid lingering in the immediate area of the sampling device while samples are being collected;
c. sample flow rates must conform to the specifications in the sample collection method and, if possible, should be consistent with the flow rates for concurrent outdoor air and sub-slab samples; and
d. samples must be collected, using conventional sampling methods, in an appropriate container — one which

i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),

ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and

iii. is certified clean by the laboratory.

At sites with tetrachloroethene contamination, passive air monitors that are specifically analyzed for tetrachloroethene (i.e., "perc badges") are commonly used to collect indoor and outdoor air samples. If site characterization activities indicate that degradation products of tetrachloroethene also represent a vapor intrusion concern, perc badges may be used to indicate the likelihood of vapor intrusion (i.e., by using tetrachloroethene as a surrogate) followed, as appropriate, by more comprehensive sampling and laboratory analyses to quantify both tetrachloroethene and its degradation products. Perc badge samples ideally should be collected over a twenty-four hour period, but for no less than eight hours.

The following actions should be taken to document conditions during indoor air sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

a. historic and current uses and storage of volatile chemicals should be identified, especially if sampling within a commercial or industrial building (e.g., use of volatile chemicals in commercial or industrial processes and/or during building maintenance);

b. a product inventory survey documenting sources of volatile chemicals present in the building during the indoor air sampling that could potentially influence the sample results should be completed [Section 2.11.2];

c. the use of heating or air conditioning systems during sampling should be noted;

d. floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system supply and return registers, compass orientation (north), footings that create separate foundation sections, and any other pertinent information should be completed;

e. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas;

f. weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported; and

g. any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.), should be recorded.

Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas), the barometric pressure and photographs to accompany floor plan sketches.

The field sampling team should maintain a sample log sheet summarizing the following:

a. sample identification,
b. date and time of sample collection,
c. sampling height,
d. identity of samplers,
e. sampling methods and devices,
f. depending upon the method, volume of air sampled,
g. if canisters are used, vacuum of canisters before and after samples collected, and
h. chain of custody protocols and records used to track samples from sampling point to analysis.

2.7.4 Outdoor air

Outdoor air samples should be collected simultaneously with indoor air samples to evaluate the potential influence, if any, of outdoor air on indoor air quality. They may also be collected simultaneously with soil vapor samples to identify potential outdoor air interferences associated with infiltration of outdoor air into the sampling apparatus while the soil vapor was collected. To obtain representative samples that meet the data quality objectives, outdoor air samples should be collected in a manner consistent with that for indoor air samples (described in Section 2.7.3).

The following actions should be taken to document conditions during outdoor air sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

a. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations, the location of potential interferences (e.g., gasoline stations, factories, lawn movers, etc.), compass orientation (north), and paved areas;
b. weather conditions (e.g., precipitation and outdoor temperature) should be reported; and
c. any pertinent observations, such as odors, readings from field instrumentation, and significant activities in the vicinity (e.g., operation of heavy equipment or dry cleaners) should be recorded.

2.7.5 Tracer gas

When collecting soil vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control measure to verify the integrity of the soil vapor probe seal. Without the use of a tracer, there is no way to verify that a soil vapor sample has not been diluted by outdoor air.

Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer. Typically, sulfur hexafluoride (SF_6) or helium are used as tracers because they are readily available, have low toxicity, and can be monitored with portable measurement devices. Butane and propane (or other gases) could also be used as a tracer in some situations. Compounds other than those mentioned here may be appropriate, provided they meet project-specific data quality objectives. Where applicable, steps should be taken to ensure that the gas used by the laboratory to clean the air sampling container is different from the gas used as a tracer during sampling (e.g., helium).

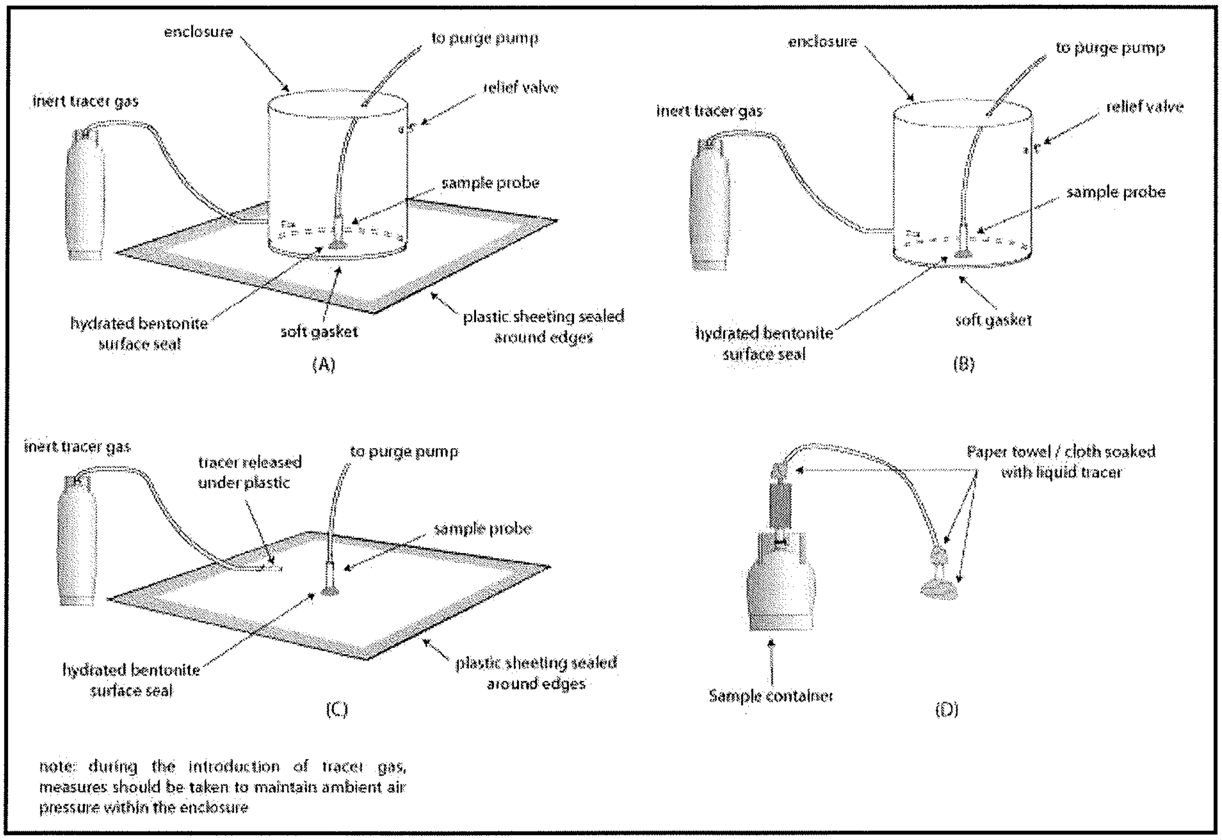
The protocol for using a tracer gas is straightforward: simply enrich the atmosphere in the immediate vicinity of the area where the probe intersects the ground surface with the tracer gas, and measure a vapor sample from the probe for the presence of high concentrations (> 10%) of the tracer. A cardboard box, a plastic pail, or even a garbage bag can serve to keep the tracer gas in contact with the probe during the testing. If there are concerns about infiltration of ambient air through other parts of the sampling train (such as around the fittings, not just at the probe/ground interface), then consideration should be given to ensuring that the tracer gas is in contact with the entire sampling apparatus. In these cases, field personnel may prefer to use a liquid tracer — soaking paper towels with a liquid tracer and placing the towels around the probe/ground interface, around fittings, and/or in the corner of a shroud.

There are two basic approaches to testing for the tracer gas:

1. include the tracer gas in the list of target analytes reported by the laboratory; or
2. use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to and after sampling for the compounds of concern. (Note that the tracer gas samples can be collected via syringe, Tedlar® bag etc. They need not be collected in Summa® canisters or minicans.)

The advantage of the second approach is that the real time tracer sampling results can be used to confirm the integrity of the probe seals prior to formal sample collection.

Figure 2.4 depicts common methods for using tracer gas. In examples a, b and c, the tracer gas is released in the enclosure prior to initially purging the sample point. Care should be taken to avoid excessive purging prior to sample collection. Care should also be taken to prevent pressure build-up in the enclosure during introduction of the tracer gas. Inspection of the installed sample probe, specifically noting the integrity of the surface seal and the porosity of the soil in which the probe is installed, will help to determine the tracer gas setup. Figure 2.4a may be most effective at preventing tracer gas infiltration, however, it may not be appropriate in some situations depending on site-specific conditions. Figures 2.4b and 2.4c may be sufficient for probes installed in tight soils with well-constructed surface seals. Figure 2d provides an example of using a liquid tracer. In all cases, the same tracer gas application should be used for all probes at any given site.



note: during the introduction of tracer gas, measures should be taken to maintain ambient air pressure within the enclosure

Figure 2.4
Schematics of generic tracer gas applications when collecting soil vapor samples

Because minor leakage around the probe seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 10%) of tracer gas are observed in a sample, the probe seal should be enhanced to reduce the infiltration of outdoor air.

Where permanent or semi-permanent sampling probes are used, tracer gas samples should be collected at each of the sampling probes during the initial stages of a soil vapor sampling program. If the results of the initial samples indicate that the probe seals are adequate, reducing the number of locations at which tracer gas samples are employed may be considered. At a minimum, tracer gas samples should be collected with at least 10% of the soil vapor samples collected in subsequent sampling rounds. When using permanent soil vapor probes as part of a long-term monitoring program, annual testing of the probe integrity is recommended. Where temporary probes are used, tracer gas should be used at every sampling location, every time.

2.8 Quality assurance/quality control (QA/QC)

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

In general, appropriate QA/QC procedures should be followed during all aspects of sample collection and analysis to ensure that sampling error is minimized and high quality data are obtained. Sampling team members should avoid actions (e.g., fueling vehicles, using permanent marking pens, wearing freshly dry-cleaned clothing or personal fragrances, etc.) which can cause sample interference in the field. Portable air monitoring equipment or field instrumentation should be properly maintained, calibrated and tested to ensure validity of measurements. Air sampling equipment should be stored, transported and between samples decontaminated in a manner consistent with the best environmental consulting practices to minimize problems such as field contamination and cross-contamination. Samples should be collected using certified clean sample devices. Where applicable, steps should be taken to ensure that the gas used by the laboratory to clean the sample device is different from the gas used as a tracer during sampling (e.g., helium). Samples should meet sample holding times and temperatures, and should be delivered to the analytical laboratory as soon as possible after collection. In addition, laboratory accession procedures should be followed, including field documentation (sample collection information and locations), chain of custody, field blanks, field sample duplicates and laboratory duplicates, as appropriate.

Some methods call for collecting samples in duplicate (e.g., indoor air sampling using passive sampling devices for tetrachloroethene) to assess errors. Duplicate and/or split samples should be collected in accordance with the sampling and analytical methods being implemented.

For certain regulatory programs, a Data Usability Summary Report (DUSR) or equivalent report may be required to determine whether or not the data, as presented, meets the site or project specific criteria for data quality and data use. This requirement may dictate the level of QC and the category of data deliverable to request from the laboratory. Guidance on preparing these reports is available by contacting the NYSDEC's Division of Environmental Remediation.

New York State Public Health Law requires laboratories analyzing environmental samples collected from within New York State to have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. If ELAP certification is not currently required for an analyte (e.g., trichloroethene), the analysis should be performed by a laboratory that has ELAP certification for similar compounds in air and uses analytical methods with minimum reporting limits similar to background (e.g., tetrachloroethene via EPA Method TO-15). Questions about a laboratory's current certification status should be directed to an ELAP representative at 518-485-5570 or by email at elap@health.state.ny.us.

The work plan should state that all samples that will be used to make decisions on appropriate actions to address exposures and environmental contamination will be analyzed by an ELAP-certified laboratory. The name of the laboratory should also be provided. Similarly, the name of the laboratory that was used should be included in the report of the sampling results. For samples collected and tested in the field for screening purposes by using field testing technology, the qualifications of the field technician should be documented in the work plan.

APPENDIX B

TO-15 VOCs and Detection Limits for Air Samples

Chemtech Consulting Group, Inc.

TO-15 VOCs and Detection Limits for Air Samples

Matrix	CAS #	Compound Name	Molecular Wt	ug/m3 MDL	LOD ug/m3	LOQ ug/m3
Air	71-55-6	1,1,1-Trichloroethane	133	0.16	0.16	2.72
Air	79-34-5	1,1,2,2-Tetrachloroethane	168	0.69	0.69	3.44
Air	79-00-5	1,1,2-Trichloroethane	133	0.54	0.54	2.72
Air	76-13-1	1,1,2-Trichlorotrifluoroethane	187	0.32	0.76	3.82
Air	75-34-3	1,1-Dichloroethane	99	0.16	0.40	2.02
Air	75-35-4	1,1-Dichloroethene	97	0.20	0.40	1.98
Air	120-82-1	1,2,4-Trichlorobenzene	181	0.29	0.74	3.70
Air	95-63-6	1,2,4-Trimethylbenzene	120	0.50	0.49	2.45
Air	106-93-4	1,2-Dibromoethane	188	0.77	0.77	3.84
Air	95-50-1	1,2-Dichlorobenzene	147	0.60	0.60	3.01
Air	107-06-2	1,2-Dichloroethane	99	0.40	0.40	2.02
Air	78-87-5	1,2-Dichloropropane	113	0.46	0.46	2.31
Air	108-67-8	1,3,5-Trimethylbenzene	120	0.49	0.49	2.45
Air	106-99-0	1,3-Butadiene	54	0.22	0.22	1.10
Air	541-73-1	1,3-Dichlorobenzene	147	0.60	0.60	3.01
Air	106-46-7	1,4-Dichlorobenzene	147	0.60	0.60	3.01
Air	123-91-1	1,4-Dioxane	88	0.36	0.36	1.80
Air	540-84-1	2,2,4-Trimethylpentane	114	0.21	0.47	2.33
Air	78-93-3	2-Butanone	72	0.29	0.29	1.47
Air	95-49-8	2-Chlorotoluene	126.6	0.52	0.52	2.59
Air	591-78-6	2-Hexanone	100	0.41	0.41	2.04
Air	622-96-8	4-Ethyltoluene	120	0.49	0.49	2.45
Air	108-10-1	4-Methyl-2-Pentanone	100	0.20	0.41	2.04
Air	67-64-1	Acetone	58	0.24	0.24	1.19
Air	107-05-1	Allyl Chloride	77	0.16	0.31	1.57
Air	71-43-2	Benzene	78	0.12	0.32	1.60
Air	100-44-7	Benzyl Chloride	141	0.58	0.58	2.88
Air	75-27-4	Bromodichloromethane	164	0.33	0.67	3.35
Air	593-60-2	Bromoethene	107	0.14	0.44	2.19
Air	75-25-2	Bromoform	253	0.49	1.03	5.17
Air	74-83-9	Bromomethane	95	0.12	0.39	1.94
Air	75-15-0	Carbon Disulfide	76	0.14	0.31	1.55
Air	56-23-5	Carbon Tetrachloride	154	0.19	0.19	3.15
Air	108-90-7	Chlorobenzene	113	0.46	0.46	2.31
Air	75-00-3	Chloroethane	65	0.27	0.27	1.33
Air	67-66-3	Chloroform	119	0.08	0.49	2.43
Air	74-87-3	Chloromethane	50	0.20	0.20	1.02
Air	156-59-2	cis-1,2-Dichloroethene	97	0.20	0.40	1.98
Air	10061-01-5	cis-1,3-Dichloropropene	111	0.45	0.45	2.27
Air	110-82-7	Cyclohexane	82	0.34	0.34	1.68
Air	124-48-1	Dibromochloromethane	208	0.43	0.85	4.25
Air	75-71-8	Dichlorodifluoromethane	121	0.18	0.49	2.47
Air	76-14-2	Dichlorotetrafluoroethane	171	0.27	0.70	3.50
Air	64-17-5	Ethanol	46.1	0.19	0.19	0.94
Air	141-78-6	Ethyl Acetate	88	0.36	0.36	1.80
Air	100-41-4	Ethyl Benzene	106	0.43	0.43	2.17
Air	142-82-5	Heptane	100	0.41	0.41	2.04
Air	87-68-3	Hexachloro-1,3-Butadiene	261	1.07	1.07	5.34
Air	110-54-3	Hexane	86	0.15	0.35	1.76
Air	67-63-0	Isopropyl Alcohol	60	0.25	0.25	1.23
Air	136777-61-2	m/p-Xylene	106	0.43	0.87	4.34
Air	80-62-6	Methyl methacrylate	100.1	0.41	0.41	2.05
Air	1634-04-4	Methyl tert-Butyl Ether	88	0.19	0.36	1.80
Air	75-09-2	Methylene Chloride	85	0.16	0.35	1.74
Air	95-47-6	o-Xylene	106	0.43	0.43	2.17
Air	115-07-1	Propene	42	0.18	0.17	0.86
Air	100-42-5	Styrene	104	0.43	0.43	2.13
Air	10061-02-6	t-1,3-Dichloropropene	111	0.45	0.45	2.27
Air	27975-78-6	tert-butyl alcohol	74.1	0.30	0.30	1.52
Air	127-18-4	Tetrachloroethene	166	0.20	0.20	3.39
Air	109-99-9	Tetrahydrofuran	72	0.29	0.29	1.47
Air	108-88-3	Toluene	92	0.20	0.38	1.88
Air	156-60-5	trans-1,2-Dichloroethene	97	0.20	0.40	1.98
Air	79-01-6	Trichloroethene	131	0.08	0.16	2.68
Air	75-69-4	Trichlorofluoromethane	137	0.22	0.56	2.80
Air	108-05-4	Vinyl Acetate	86	0.35	0.35	1.76
Air	75-01-4	Vinyl Chloride	62.5	0.08	0.08	1.28

MDL - Method detection Limit LOD - Limits of Detection LOQ - Limits of Quantitation

APPENDIX C

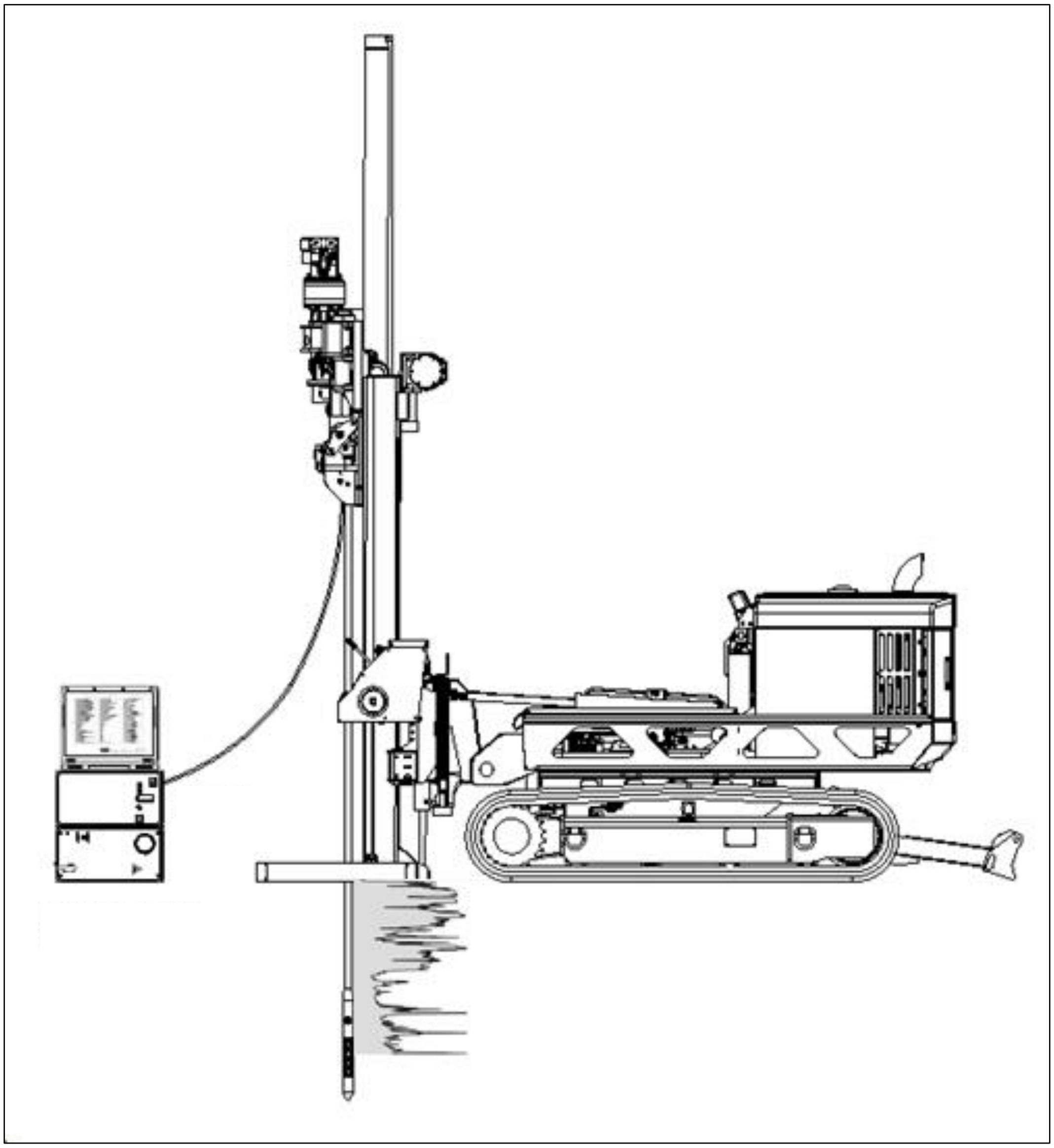
Standard Operating Procedure - Hydraulic Profiling Tool

Geoprobe® Hydraulic Profiling Tool (HPT) System

Standard Operating Procedure

Technical Bulletin No. MK3137

Prepared February 6, 2013



1.0 Objective

This document serves as the standard operating procedure for the Geoprobe® Hydraulic Profiling Tool (HPT) system. In this procedure, the HPT system is used to measure the pressure response of soil to injected water for identifying potential flow paths and to assist with characterization of soil type. This document has been updated from Geoprobe Systems® Technical Bulletin No. MK3137 (March 2007) to show the use of an FI6000 field instrument for HPT system control and data acquisition.

2.0 Background

2.1 Definitions

Geoprobe®*: A brand of high quality, hydraulically-powered machines that utilize both static force and percussion to advance sampling and logging tools into the subsurface. The Geoprobe® brand name refers to both machines and tools manufactured by Geoprobe Systems®, Salina, Kansas. Geoprobe® tools are used to perform soil core and soil gas sampling, groundwater sampling and testing, electrical conductivity and contaminant logging, grouting, and materials injection.

**Geoprobe® and Geoprobe Systems® are registered trademarks of Kejr, Inc., Salina, Kansas.*

Hydraulic Profiling Tool (HPT) System: A system manufactured by Geoprobe Systems® to evaluate the hydraulic behavior of subsurface soil. The tool is advanced through the subsurface at a constant rate while water is injected through a screen on the side of the probe. An in-line pressure sensor measures the pressure response of the soil to water injection. The pressure response identifies the relative ability of a soil to transmit water. Both pressure and flow rate are logged versus depth.

2.2 Introduction

The HPT system has been developed by Geoprobe Systems® for the geohydrologic characterization of soils. The HPT probe and logging system is able to quickly provide logs that are easily interpreted. HPT logs are used to indicate hydraulic conductivity, EC, hydrostatic profile, and areas of EC/permeability anomalies.

The HPT system is designed to evaluate the hydraulic behavior of unconsolidated materials. As the probe is pushed or hammered at 2 cm/s, clean water is pumped through a screen on the side of the HPT probe at a low flow rate, usually less than 300 mL/min. Injection pressure, which is monitored and plotted with depth, is an indication of the hydraulic properties of the soil. That is, a low pressure response would indicate a relatively large grain size, and the ability to easily transmit water. Conversely, a high HPT pressure response would indicate a relatively small grain size and the lack of ability to transmit water.

An electrical conductivity measurement array is built into the HPT probe. This allows the user to collect soil electrical conductivity (EC) data for lithologic interpretation. In general, the higher the electrical conductivity value, the smaller the grain size, and vice versa. However, other factors can affect EC, such as mineralogy and pore water chemistry (brines, extreme pH, contaminants). In contrast, HPT pressure response is independent of these chemical and mineralogical factors.

There are four primary components of the HPT system: the probe assembly, trunkline, HPT Flow Module (K6300 Series), and Field Instrument (FI6000 series). These primary components are shown in Figure 2.1.

The probe assembly consists of the HPT probe and connection section. This assembly houses the downhole HPT pressure transducer, water and electrical connections, and the probe body with the injection screen and electrical conductivity array.

Injecting water at a constant rate is integral to system operation. The HPT Flow Module houses the pump and associated hand crank mechanism used for adjusting the output flow of the HPT pump. The flow module also contains the HPT flow measurement and injection line pressure transducers. HPT flow can be adjusted from approximately 50 to 500 ml/min. The HPT pump is a positive displacement pumping device with minimal decrease in flow over the HPT operating pressure range. The flow module is equipped with an internal bypass that is factory set to open and return flow to the supply reservoir at a pressure of 120 psi. When the soil resistance to water injection becomes sufficiently great, the HPT Flow Module bypass will open, returning some or all of the pumped flow to the supply reservoir. The flow meter only measures flow leaving the module to the HPT probe. The HPT Flow Module is connected to the Field Instrument via a data cable.

Water and power are transmitted from the controller to the probe assembly via the HPT trunkline. The probe rods must be pre-strung with the trunkline before advancing the probe.

Data collection occurs in real time by connecting the controller to the field instrument. The field instrument collects, stores and displays transducer pressure, flow rate and electrical conductivity, line pressure, probe rate, and diagnostic parameters, with depth.

Since the HPT pressure response is analogous to the soil's ability to transmit water (and therefore the to the soil's dominant grain size), the HPT system can be used to identify potential contaminant migration pathways. Similarly, it can help identify zones for remedial material injection or provide qualitative guidance on how difficult injection may be in different zones of the formation.

The HPT system may be used to direct other investigation methods, such as soil and groundwater sampling and slug testing. HPT pressure response and EC data can help target zones of geologic and hydraulic interest, minimizing the number of soil and groundwater samples required to adequately develop a site conceptual model. When hydraulic conductivity values are required, the HPT system can also help the user identify zones to slug test, as well as the length of the screen required to adequately test the zone.

The HPT system also can be used to collect static water pressure data at discrete intervals during the logging process. These static pressure data can be used to calculate static water levels or to create a hydrostatic profile for the log.

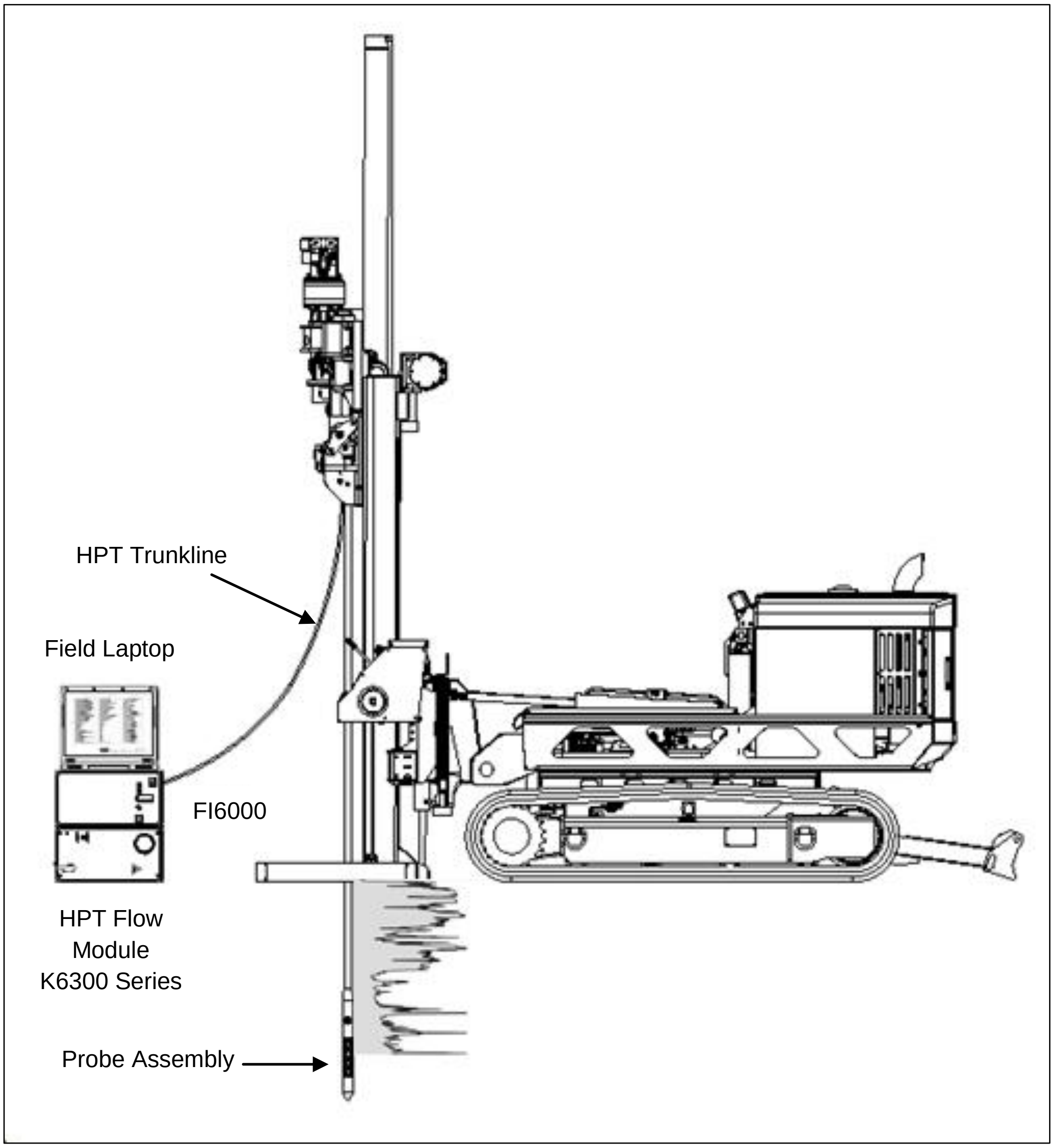


Figure 2.1: HPT Components

3.0 Tools and Equipment

The following equipment is required to perform and record an HPT log using a Geoprobe® 66- or 78-Series Direct Push Machine. Refer to Figures 3.1, 3.2, and 3.3 for identification of the specified parts.

Basic HPT System Components	Quantity	Part Number
Field Instrument, 120V	-1-	FI6000
Field Instrument, 220V	*	FI6003
HPT Acquisition Software	-1-	K6020
HPT Flow Module, 120V	-1-	K6300
HPT Flow Module, 220V	*	K6303
HPT Probe, 1.75 inch	-1-	K6050
MIP/HPT Connection Tube	-1-	31641
MIP/HPT Adapter 1.5 Pin x LB Box	-1-	20712
HPT Probe, 2.25 inch	**	K8050
2.25 Probe Rod, 24 inch	**	32656
2.25 Inch Water Seal Adapter	**	45170
2.25 Inch Water Seal Drive Head	**	48866
HPT Reference Tube 1.75 in HPT Probe	-1-	50344
HPT Reference Tube 2.25 in HPT Probe	**	50344
HPT Trunkline 150 ft.	-1-	K6415
HPT Trunkline 200 ft.	(optional)	K6420
HPT Service Kit *(contains the following)*	-1-	29028
O-Ring Pick	*-1-*	*AT102*
Term Block 4 POS Green	*-4-*	*7700*
Electrical Tape, 0.75-in. x 60-ft.	*-1-*	*6167*
Membrane Ratchet Wrench Asm	*-1-*	*48877*
Coupling 1/8 to 1/8 Tube	*-5-*	*48842*
Oetiker #7 Band Clamp 5.8 x 7mm	*-10-*	*48724*
HPT Sensor Module	*-2-*	*43327*
Silicone Dielectric Compound	*-1-*	*41274*
Butt Connector Red (10 pak)	*-2-*	*39807*
HPT Trunkline Seal Asm.	*-4-*	*37031*
Trunkline Seal Spacer (1 pair)	*-2-*	*36378*
O-Ring 120 BUNA 70	*-10-*	*3537*
HPT Screen Asm	*-4-*	*28895*
HPT Spring Washer (pkg 10)	*-1-*	*52399*
Tube Nylon 0.25 OD x 0.04 W Flexible	*-1-*	*20727*
Tubing 0.125 ID x 0.25 OD Polyur Yellow	*-1-*	*17957*
EC Probe Test Jig	-1-	SC563
EC Test Load	-1-	37785
Stringpot, 100-inch	-1-	SC160-100
Stringpot Cordset, 65-feet (19.8 m)	-1-	16401

*Use in place of 120V components if desired.

**Use in place of 1.75 inch probe and components if desired.

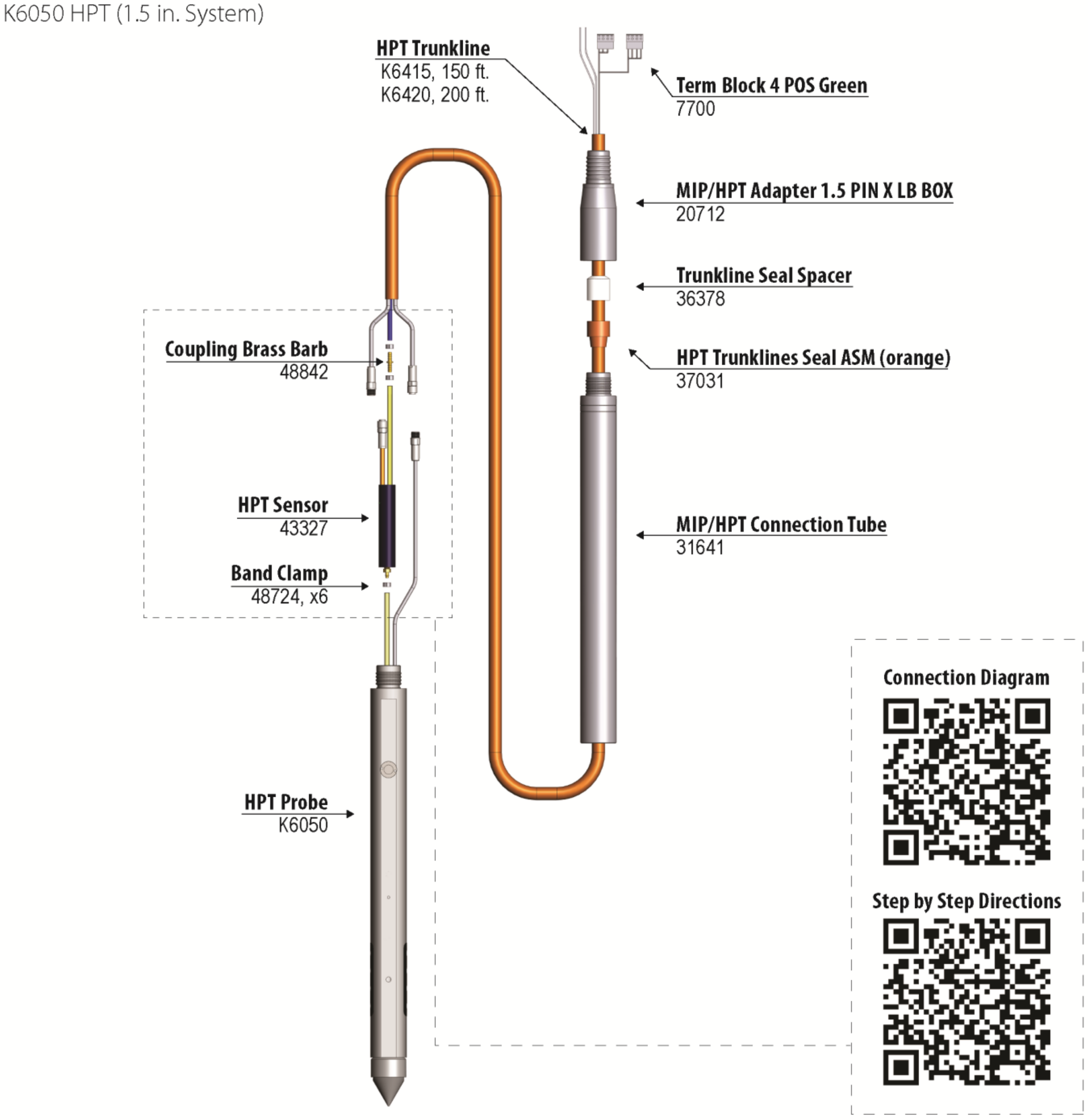


Figure 3.1 PN K6050 1.75 inch HPT Probe and components

http://geoprobe.com/tool-string-diagrams/k6050-hpt

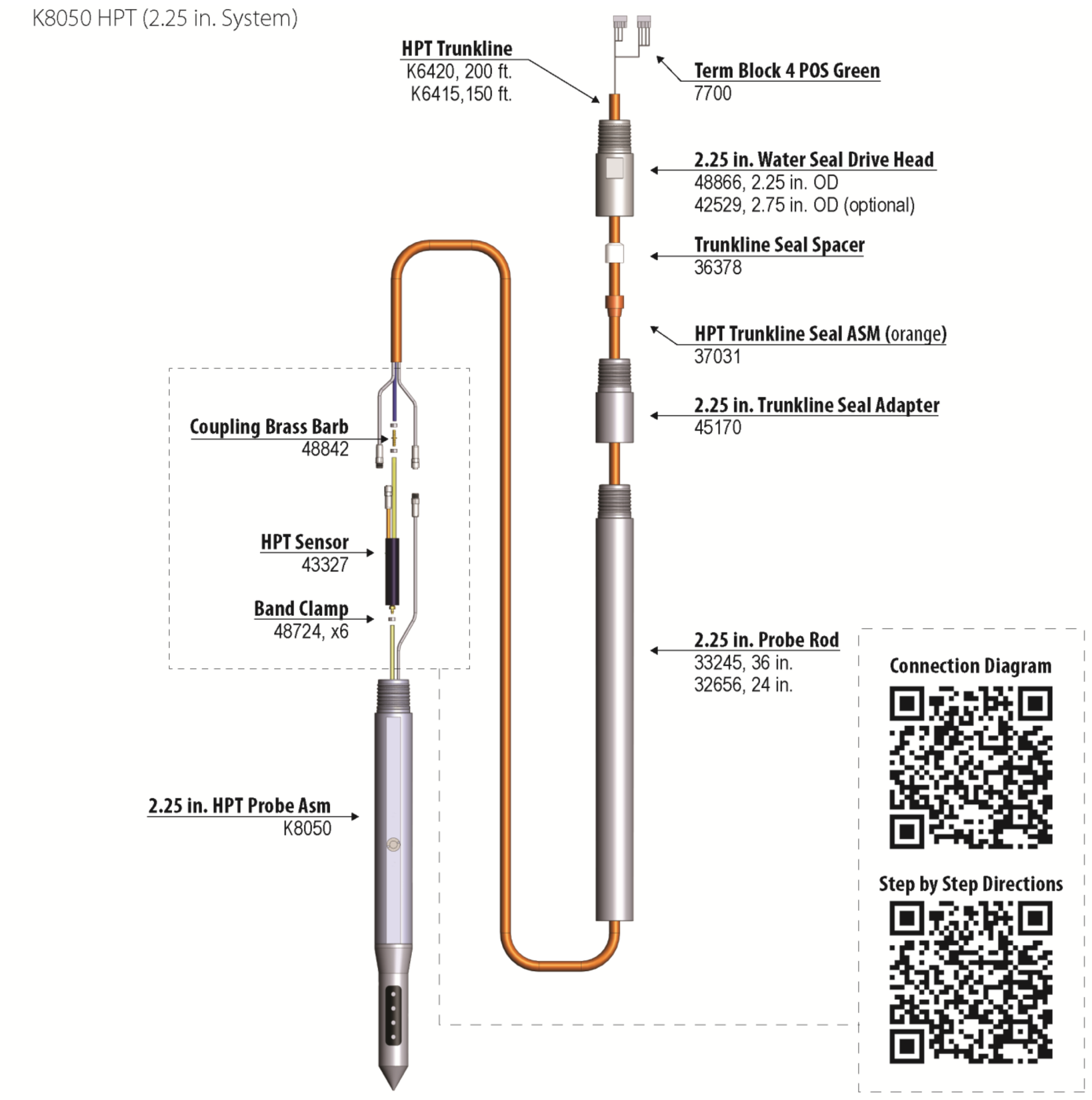
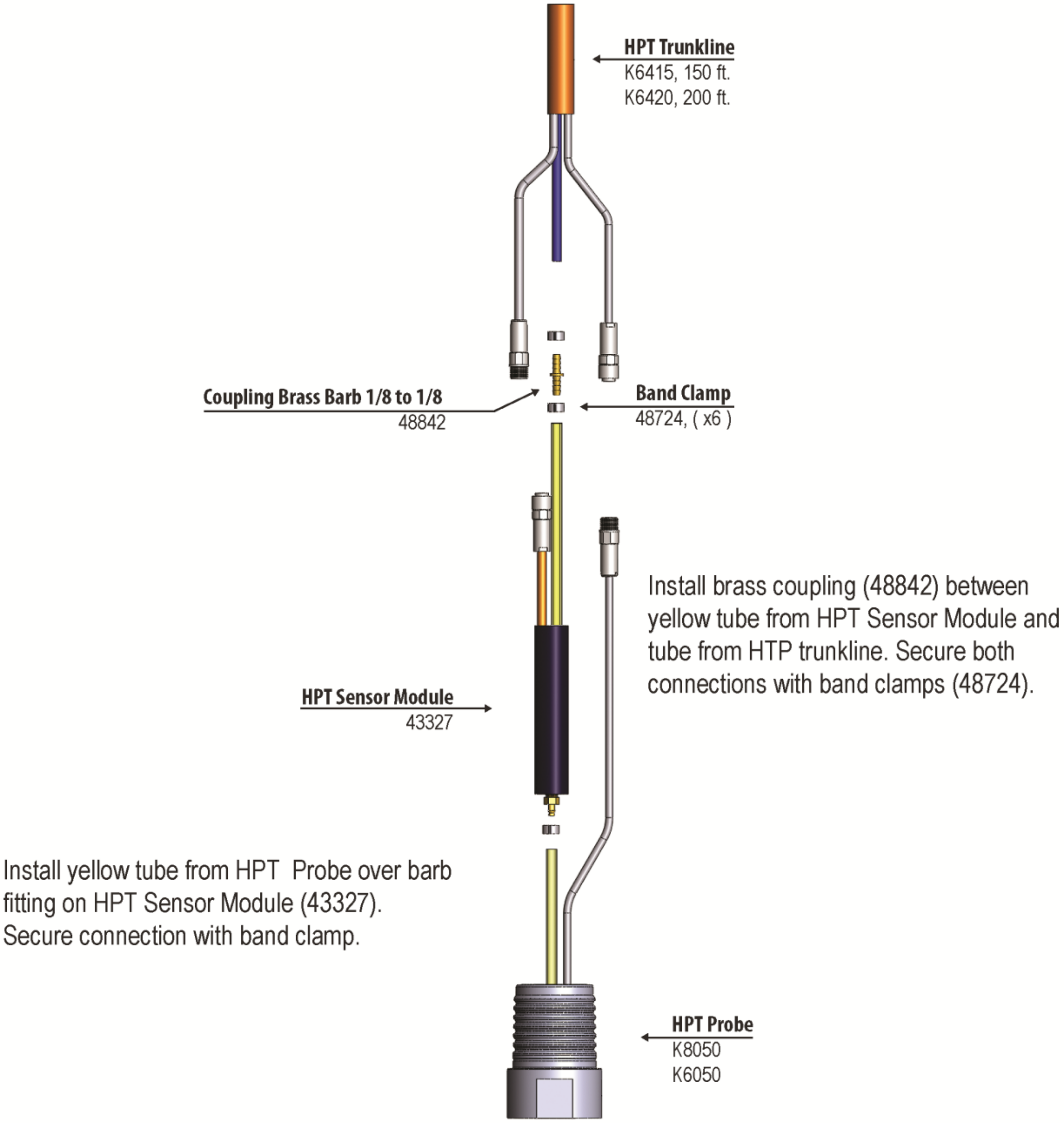


Figure 3.2 PN-K8050 2.25 inch HPT Probe and components

http://geoprobe.com/tool-string-diagrams/k8050-hpt

HPT Sensor Connection Diagram



Install brass coupling (48842) between yellow tube from HPT Sensor Module and tube from HTP trunkline. Secure both connections with band clamps (48724).

Install yellow tube from HPT Probe over barb fitting on HPT Sensor Module (43327). Secure connection with band clamp.

Figure 3.3 PN 43327 HPT Sensor Module Connection Diagram

http://geoprobe.com/tool-string-diagrams/hpt-sensor-connection-diagram

4.0 HPT Assembly

Refer to Appendix A

Threading the Rods

- Protect the end to be threaded through the rods with electrical tape or shrink tubing.
- Probe rods must alternate directions prior to threading the trunkline.
- The end of the HPT trunkline with chrome connectors is the downhole or probe end.
- The probe end of the trunkline will always enter the male end and exit the female end of the probe rods.
- The instrument end (no chrome connectors) will always enter the female end and exit the male end of the probe rods.
- After the trunkline is through the probe rods make sure the downhole end is threaded through the male end of the drive head and connection tube prior to connecting to the probe.
- The trunkline is now ready to connect to the instrument and HPT pressure sensor and probe.

5.0 Field Operation

5.1 Instrument Setup

1. Connect the HPT Controller (K6300), Field Instrument (FI6000) and laptop (Fig. 5.1) to an appropriate power source.

2. Connect the FI6000 to the K6300 using the 62-pin serial cable inserted into the acquisition port of each instrument.

3. Secure the EC wires into the Green terminal block connector and insert into the FI6000. The wires match to the EC dipoles in the following top down order when the probe tip is on the ground – white, black, yellow and blue (Fig 5.2).

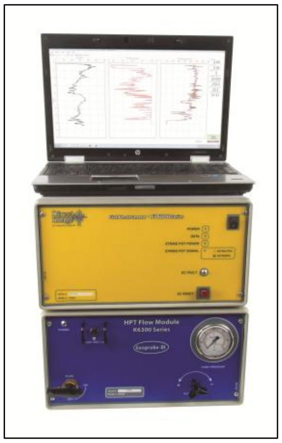


Figure 5.1: HPT Instrument Setup

4. Secure the HPT sensor wires to the appropriate inputs on the green terminal block connector and connect to the rear of the K6300. The top down order of the wires which is listed on the back of the instrument is: brown, orange, red and reserved (open).

5. Insert the nylon water line tubing from the trunkline into the water output connector on the back of the K6300.

6. Connect the HPT water supply hose into the input port on the rear of the K6300 and insert the filtered end of the supply line into a water supply tank. The bypass line connects to the bypass port and will follow the supply line back to the supply tank.

Figure 5.2: EC Wire Connections

7. Connect the USB cable between the USB interface port on the rear of the FI6000 to USB input on the field laptop computer.

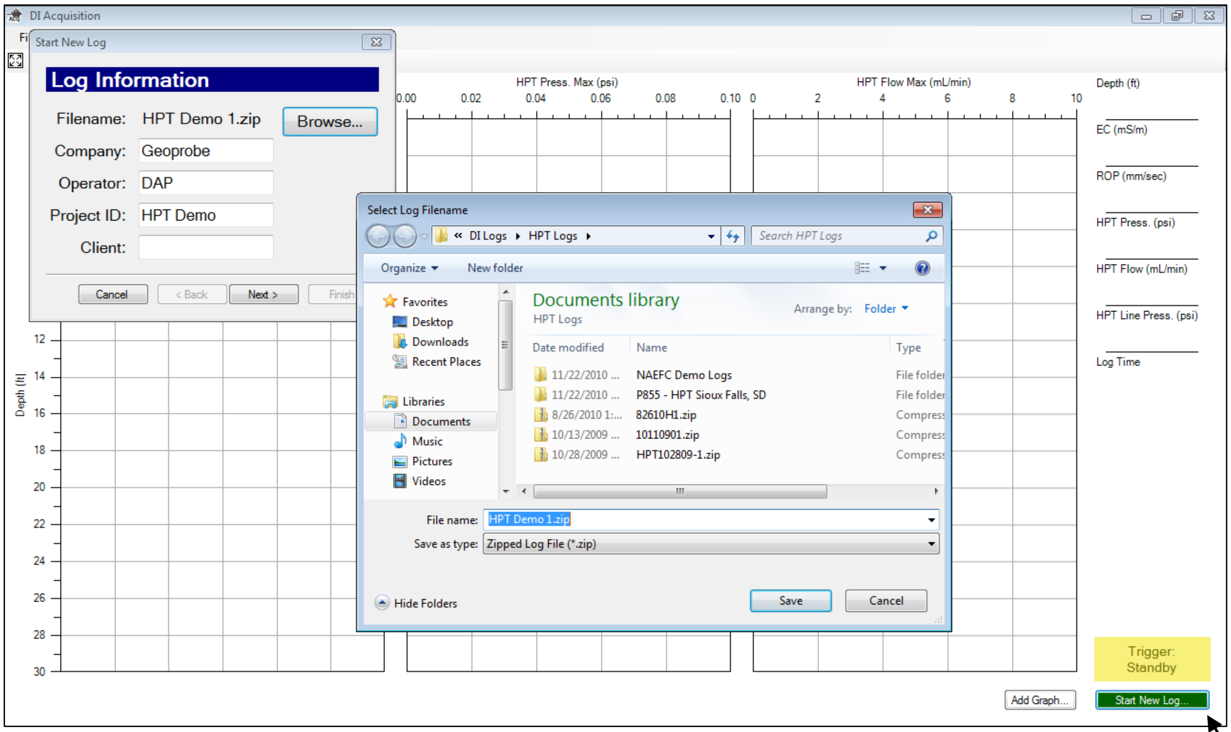
8. A stringpot is required to measure depth. Bolt the stringpot onto the machine and the stringpot onto the bracket. Connect the plastic connector end of the stringpot cable to the “Stringpot” connector on the back of the Field Instrument and the metal connector to the stringpot. Pull the stringpot cable and attach to the stringpot piston weight which should be mounted to the probe machine foot and pull the keeper pin so the weight is free to move.

5.2 Starting the Software

1. Make sure the FI6000 and K6300 are connected together with the 62 pin cable, powered on and connected to the computer by the USB cable for the software to load properly.

2. Start the DI Acquisition Software which should open in HPT mode.

3. Select “Start New Log”. The software will request log information and have you browse for a storage location and create and save a file name for the log (Fig. 5.3).



Filename: HPT Demo 1.zip
Company: Geoprobe
Operator: DAP
Project ID: HPT Demo
Client:

Date modified	Name	Type
11/22/2010 ...	NAEFC Demo Logs	File folder
11/22/2010 ...	P855 - HPT Sioux Falls, SD	File folder
8/26/2010 1:...	82610H1.zip	Compress
10/13/2009 ...	10110901.zip	Compress
10/28/2009 ...	HPT102809-1.zip	Compress

File name: HPT Demo 1.zip
Save as type: Zipped Log File (*.zip)

Figure 5.3: DI Acquisition Software – Start New Log Sequence

4. Select “Next”. If the software has been run before it will show a list of previous settings including Probe Type, EC Configuration, Stringpot length, rod length and HPT Transducer. If any of these have changed or you are unsure select “No” but if they are all the same select “yes”. If you select “No” the software will have you select the proper settings after the EC Load Test, if you selected “Yes” the selection of these settings will be bypassed.

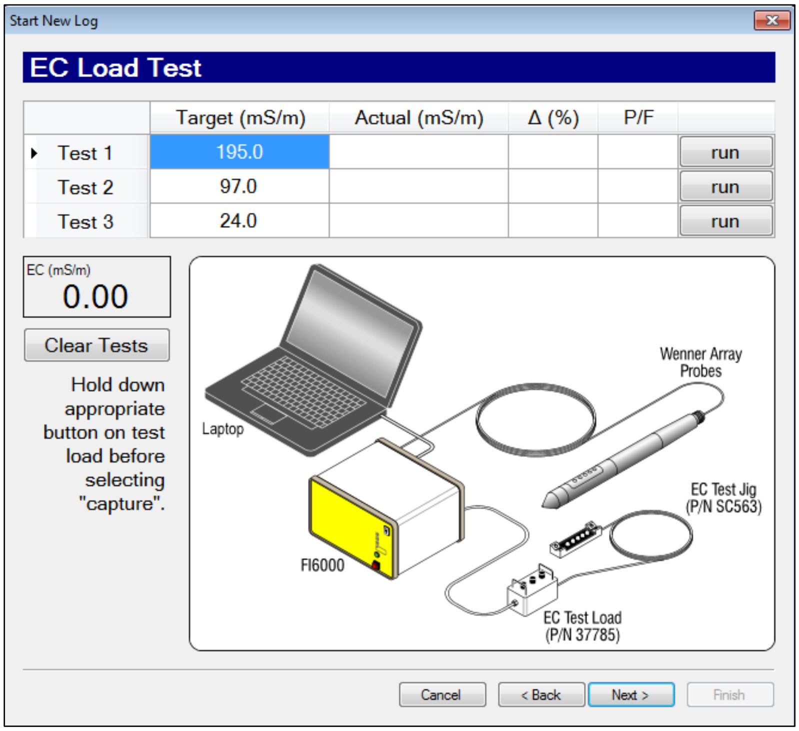
5.3 QA Testing the EC and HPT Systems

Both the EC and HPT components must be tested before and after each log. This is required to ensure that the equipment is working properly and capable of generating good data before and after the log.

A. Electrical Conductivity Load Test

1. Secure the EC 3 position test load connector (37785) to the test input jack on the back of the Field Instrument.

2. Secure the EC Probe Test Jig into the input on the EC 3 position test load.



EC Load Test

	Target (mS/m)	Actual (mS/m)	Δ (%)	P/F	
Test 1	195.0				run
Test 2	97.0				run
Test 3	24.0				run

EC (mS/m) 0.00

Clear Tests

Hold down appropriate button on test load before selecting "capture".

Figure 5.4: EC Load Test Screen

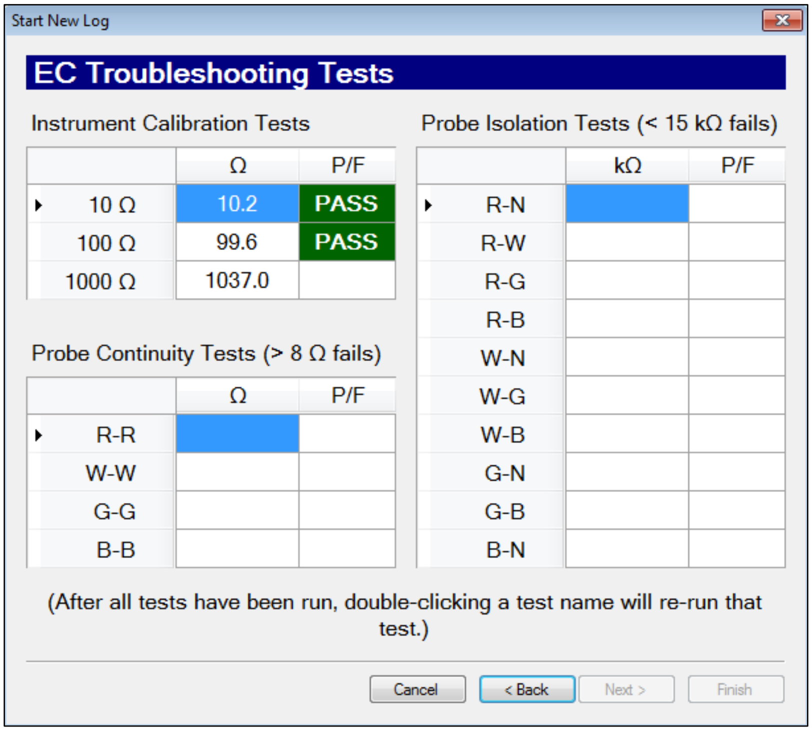
3. Clean and dry the EC dipoles as well as several inches of the probe body above the pins.

4. Place the EC Test Jig (SC563) so that the four springs on the test jig touch the four dipoles of the Wenner EC array (Fig. 5.4). Make sure the trunkline and test jig wires go in the same direction. The other spring on the test jig will ground the probe body above the Wenner array. Make sure the springs are pulled out far enough to make a solid contact on the dipoles.

5. When you get to the EC Load Test Screen and the EC test load and test jig are in place on the probe press down on the test 1 button on the test load and select “run” of Test 1 (Fig. 5.4). After 5 seconds the actual value will acquire and will pass if within 10% of the target value. Continue on with Test 2 and 3.

6. If any of the EC load tests fail do not pass within the allowed 10% acceptance range you can make adjustments on the test jig and rerun the test by just re-clicking the “run” button for an individual test.

7. If the tests continue to fail, select “Next” and the software will conduct the “EC Troubleshooting Tests.” The Instrument Calibration Tests (Fig. 5.5) checks of the calibration within the FI6000. If these are far out of range it will influence the EC Test load values and will need to return to Geoprobe® for repair. The “Probe Continuity and Isolation Tests” confirm each of the wires is a complete circuit and is fully isolated from one another. If a probe continuity test fails just outside the target range of <8ohms this is typically a contact issue with the test jig and the dipoles. If the continuity is in the thousands of ohms this is a break in the EC wire circuit – either in the probe, the trunkline or the connection between them.



EC Troubleshooting Tests

Instrument Calibration Tests

	Ω	P/F
▸ 10 Ω	10.2	PASS
100 Ω	99.6	PASS
1000 Ω	1037.0	

Probe Continuity Tests (> 8 Ω fails)

	Ω	P/F
▸ R-R		
W-W		
G-G		
B-B		

Probe Isolation Tests (< 15 kΩ fails)

	kΩ	P/F
▸ R-N		
R-W		
R-G		
R-B		
W-N		
W-G		
W-B		
G-N		
G-B		
B-N		

(After all tests have been run, double-clicking a test name will re-run that test.)

Figure 5.5: EC Troubleshooting Test Screen

8. When these tests are complete select next. In the next screen, the software will provide an EC option, if one is available. The EC Load Test will only work if EC can be operated in Wenner array meaning all of the EC wires in the continuity test pass with results <8ohms on the individual circuits. EC can be operated and collect good data in one odf the dipole areas: top, middle or bottom dipole. If the R-R test fails but the others pass the software will provide the option in the next screen to run either middle dipole or bottom dipole arrays. If R-R and G-G are both an incomplete circuit then no EC array is available to run and a new probe must be connected or the problem fixed. In the Wenner configuration it requires 2 adjacent dipoles to operate in dipole mode. If an EC array is chosen and run in this last manner then all of the EC information collected will be bad data.

B. HPT Reference Testing

Reference testing is done to ensure that the HPT pressure sensor is in working order and to evaluate the condition of the HPT injection screen. The HPT reference test calculates atmospheric pressure which is required to obtain static water level readings and to determine the estimated K values for the log in our post log processing software the DI Viewer.

Reference Test Procedure

1. Connect a clean water source to the HPT controller and turn on the pump.
2. Allow water to flow through the system long enough so that no air remains in the trunkline or probe (air in the system can cause inaccurate flow and pressure measurements).
3. Insert the probe into the HPT reference tube and allow the water to flow out the valve adjusting the flow rate to between 250-300ml/min (Fig. 5.5). Ensure that the reference tube is close to vertical.
4. With a stable pressure reading and the water flowing out of the valve select “capture” - bottom with flow (Fig. 5.6)

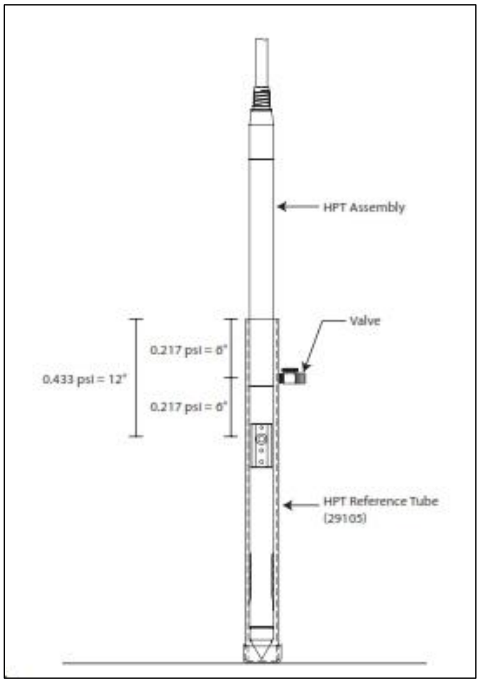
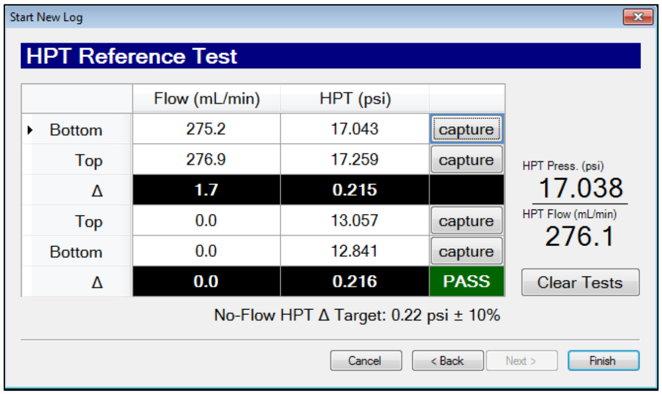


Figure 5.5: HPT Reference Test Setup

5. Close the valve and allow the water to overflow the top of the tube. When the pressure stabilizes select “capture” - top with flow.
6. Shut off the water flow. When the pressure stabilizes select “capture” - top flow = 0.
7. Open the valve and allow the water to drain out. When the pressure stabilizes select “capture” - bottom flow = 0.



	Flow (mL/min)	HPT (psi)	
Bottom	275.2	17.043	capture
Top	276.9	17.259	capture
Δ	1.7	0.215	
Top	0.0	13.057	capture
Bottom	0.0	12.841	capture
Δ	0.0	0.216	PASS

HPT Press. (psi) 17.038

HPT Flow (mL/min) 276.1

No-Flow HPT Δ Target: 0.22 psi ± 10%

Figure 5.6: HPT Reference Test Screen

The HPT reference test reading flow = 0 is the true test of the condition of the pressure sensor and is the only sensor test to have a pass/fail reading on it. Ideally, the pressure difference between the top and bottom values will be 0.22 psi (1.52kPa). Typical pressure readings of the sensor will be in the 12PSI-15PSI (83kPa-104kPa) range.

5.4 Running an HPT Log

1. Place the rod wiper on the ground over the probing location and install the drive cushion in place of the anvil of the probing machine.

2. Place the probe tip in the center of the rod wiper, and place the slotted drive cap on top of the HPT probe.

3. Start the HPT water flow. **Note**: It is important that there is always water flowing when the probe is advanced to avoid soil particles from moving through the screen and causing problems with the pressure readings or causing a blockage behind the screen.

4. Adjust the probe so that it is vertical and advance the probe until the HPT screen is at the ground surface.

5. Click the trigger button in the lower right hand corner of computer screen. (The Trigger label will flash and the background will change from yellow to green).

9. Advance the probe at a rate of 2 cm/s. If necessary, feather the hammer to maintain this advance rate.

10. Perform a dissipation test (Section 5.4) in a zone of higher permeability indicated by lower HPT pressure.

11. After completing the log, press the trigger button again and select “Stop Log”.

12. Pull the rod string using either the rod grip pull system or a slotted pull cap. Run a post-log EC test and HPT response test (Section 5.2).

5.5 Performing a Dissipation Test

At least one dissipation test must be performed in order to calculate the static water level and estimated K readings from the log. Dissipation tests need to be performed below the water table and are best in zones of high permeability where the injection pressure can dissipate off quickly once the flow is shut off.

1. Stop in a zone of higher permeability which is indicated by lower HPT inject pressure.

2. Switch the DI Acquisition display view from the depth screen to the time screen by pressing the F10 key (F9 and F10 toggle between the depth and time screen of the acquisition software).

3. The screen will be grayed out which means that the data up to that point has not been saved. Select “Start Dissipation Test” which will turn the screen from gray to a white background indicating that you are now saving the time data.

4. Now shut the pump switch off and when the line pressure reaches zero, turn the flow valve off.

5. The HPT Pressure will begin to drop (dissipate the hydrostatic increase) and allow it to stabilize so very little visible drop in pressure is seen. When the pressure has fully dissipated turn the flow valve and the pump switch back on. When the flow and pressure are reestablished select “End Dissipation test.”

6. Select F9 to return to the depth screen and advancing the tool into the ground.

   Note: Performing a dissipation test in zones of higher permeability may only take 30 seconds or so but if the HPT pressure was higher to start with it may take a long time up to several hours to dissipate off to equilibrium. This is why targeting the most permeable zone to perform the dissipation tests is most desirable.

6.0 HPT Log Interpretation

Below is a typical HPT log, which consists of both the HPT pressure response and electrical conductivity. In general, both HPT pressure and EC values increase with decreasing grain size, and decrease with increasing grain size. The log in Figure 6.1 shows good consistency between EC and HPT pressure for the majority of the log. It is only between 32’-42’bgs that we see some divergence of the graphs with higher HPT pressure while the EC readings remained low. This can happen for reasons such as poor mineralogy of the soil. Refusal was encountered in a shale layer beginning at 75’bgs and it can be noted that as we enter this layer the HPT flow gets suppressed as the pressure reaches a maximum value of 100PSI (690kPa). The second graph of the log shows the hydrostatic profile on the secondary series of the graph. The hydrostatic profile has 2 black triangles which indicate where dissipation tests were run and used to calculate the profile. The red circle indicates the calculated water table based upon where the hydrostatic profile intersects atmospheric pressure. The fourth graph is the estimate K or groundwater flow graph. This is calculated based upon HPT pressure and HPT flow relationships. Less permeable soil will have less groundwater flow.

It is fairly common to see zones where EC readings and HPT pressure contradict one another. In cases where EC readings are low and HPT pressure trends higher as in the log in Figure 6.1 the following are possible reasons:

- Poor mineralogy of the soil particles resulting in silt and clay soils with very low EC readings. This is seen in many locations along the east coast of the United States.
- Silts intermixed with sand particles.
- Weathered bedrock may have low EC but would have low permeability.

Where we have cases of higher EC and lower HPT pressure typically is due to an ionic influence in the soil or groundwater. These higher EC readings can range from very slight to higher than typical soil readings. Very high EC readings can occur when the probe contacts metallic objects in the soil which will ground them out and typically will cause hard sharp spikes in the EC data.

- Chloride or other ionic contaminant (sea water, injection materials)
- Sea Water intrusion
- Wire, metal objects or Slag

In cases where HPT and EC do not confirm one another it is important to take confirmation soil and/or groundwater samples to help understand the difference between the two graphs.

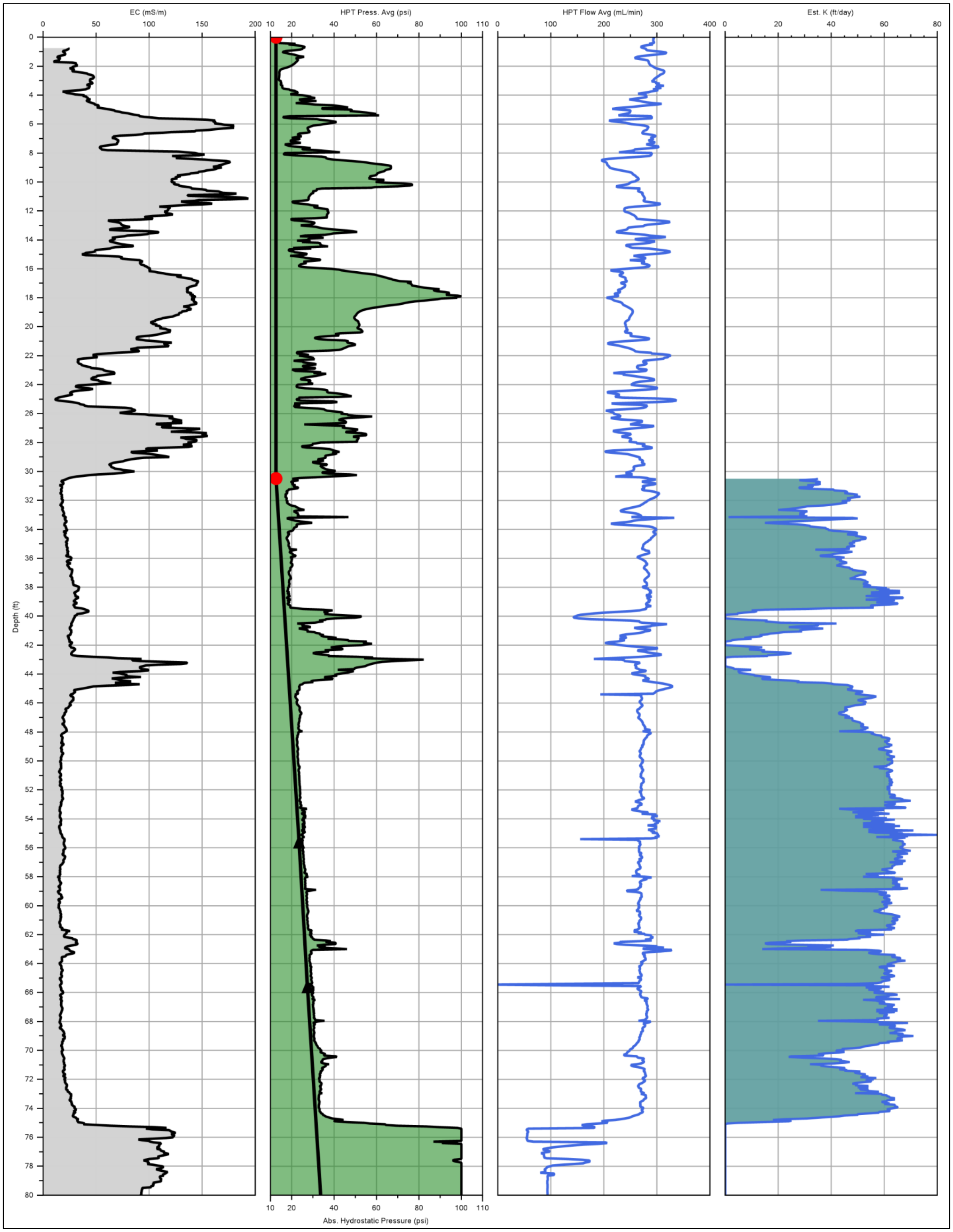


Figure 6.1: HPT Log file showing (left to right):
Electrical Conductivity (EC), HPT Injection Pressure with Hydrostatic Profile, HPT Flow, and Estimated K

7.0 Troubleshooting

7.1 Using the HPT Controller Test Load

The HPT Controller Test Load (32441) is included with the HPT Controller to help troubleshoot the HPT pressure sensor, trunkline, and controller. If there is a major problem with the HPT pressure sensor or the system wiring the system will not read anywhere close to atmospheric pressure with the probe at the surface. Commonly if the HPT sensor has broken the software will read either a maximum or minimum value which would be 100PSI or 0PSI (690kPa or 0KPa). If there is damaged wiring or nothing is connected to the controller the system typically reads 50PSI (345kPa).

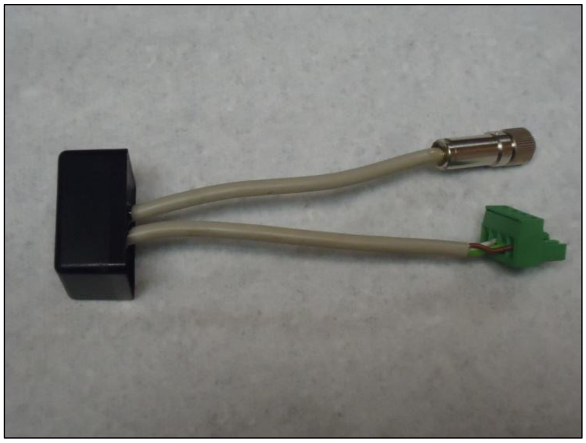


Figure 7.1: HPT Test Load PN32441

When connected to either the trunkline (in place of the pressure sensor), or the controller (in place of the trunkline and pressure sensor), the test load will cause the pressure sensor value to read a pressure ranging from approximately 25PSI-35PSI (172kPa – 241kPa).

To use the test load, set up the system as previously described. Turn on both the field instrument and HPT controller and start the HPT software. Plug the green wire connector of the test load into the HPT sensor connector on the back of the HPT controller. If the pressure sensor value reads somewhere around 30PSI (207kPa), the controller is able to properly read pressures so the problem is in the trunkline or the HPT sensor. If HPT controller has not moved from what it was reading or is way out from the expected value of the load test the HPT controller may require servicing. Contact Geoprobe Systems® for service.

Next, connect the HPT sensor wires of the trunkline to the controller with the green connector and then connect the test load to the female chrome connector on the downhole end of the trunkline in place of the pressure sensor. Again, the pressure value displayed on the field instrument should be somewhere around 30PSI (207kPa) and should be the same as what was seen with the load test connected into the controller. If the load test through the trunkline is around 30PSI (207kPa), then both the trunkline and the controller are working properly and the problem is in the HPT sensor. If it is not, the trunkline may be defective and should be replaced. Before restringing another HPT trunkline, first connect the new trunkline sensor wires into the HPT controller and the downhole end into the test load. If the system now reads in the expected test load range the trunkline needs replacing.

Finally, connect the pressure sensor to the trunkline. If it reads atmospheric pressure, approximately 12PSI-15PSI (83kPa-104kPa), then the pressure transducer is functioning properly. However, if it does not, replace the sensor with a new one and re-check the pressure reading. Be sure to enter the new sensor calibration values into the software prior to starting the new log. Additional pressure sensors purchased from Geoprobe®.

7.2 Common Problems

Problem: The pressure transducer is hooked up to the trunkline, but the software is reporting a reading of ~ 50PSI (345kPa).
Solution: Make sure that the trunkline wires are secured to the green terminal blocks and plugged in to the back of the HPT controller. Check components using the HPT Controller Test Load (Section 7.1).

Problem: The pressure transducer is hooked up to the trunkline, but the software is reporting a reading of 100PSI or 0PSI (690kPa or 0KPa).
Solution: Make sure all of the connections are good and recheck the pressure reading. If still bad connect a new HPT pressure sensor onto the trunkline and see if it reads atmospheric pressure. If not check all the components using the HPT Controller Test Load (Section 7.1).

Problem: The pressure with flow values keep drifting when water is flowing out the port or over the top of the reference tube.
Solution 1: If the trunkline was just connected and flow was just started air may still be in the lines. Allow the water to continue to flow through system which will purge out the remaining air. When it appears that most of the air is out of the lines pressing your finger over the injection screen for a few seconds can help to drive out any remaining air from the trunkline.
Solution 2: There may be debris behind the screen. Remove the HPT injection screen with the membrane wrench and turn the water flow on, place your finger over the open port to drive out debris. Replace the screen and retry the reference test with flow.
Solution 3: If the with flow pressure values continue to not settle down and provide close to the expected difference for a 6" water column then the problem may be inside the HPT control box. When you remove the cover of the HPT controller there will be a brass filter located on the left side when viewing from the front of the instrument (Fig 7.2). Particulates and precipitates can collect inside this filter causing problems with HPT pressure stability. Remove this filter and open up using appropriate wrenches. The filter can be easily cleaned by rinsing water over the screen. Reassemble and return to its proper location inside the control box. Resume reference testing the system.

Figure 7.2: Location of Inline Filter in K6300 and buildup of particulates in filter.

Problem: EC won't pass the QA tests.

Solution: Check the trunkline to probe EC connections ensuring they are tight. Run the troubleshooting tests (Section 4.3A), test EC on a new probe.

APPENDIX A

Making HPT Probe, Sensor and Trunkline Connections

http://geoprobe.com/literature/hpt-sensor-connection-tutorial

A DIVISION OF KEJR, INC.
-Corporate Offices-
601 N. Broadway • Salina, KS 67401
1-800-436-7762 • Fax 785-825-2097
www.geoprobe-DI.com