Performance Monitoring Plan for the Essex Hope Site

Prepared for:
Essex Specialty Products, Inc.
(The Dow Chemical Company)

URS Project No. 41569831

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PERFORMANCE MONITORING PLAN
FOR THE ESSEX/HOPE SITE

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1.0 INTRODUCTION

On behalf of Essex Specialty Products, Inc. (Essex), a former subsidiary of The Dow Chemical Company (Dow), URS Corporation has prepared this revised Performance Monitoring Plan (PMP) for the Essex/Hope Site, Jamestown, New York. The focus of the PMP is the measurement of soil and groundwater remediation activities in the areas of concern as identified in the March 1994 Record of Decision (ROD) for the site. A NYDEC Consent Order was signed by Dow in 1995 to implement remedial actions at the Essex/Hope Site. The PMP is required as part of the remedial actions.

The PMP is being revised to extend the monitoring period for 3 years (2014-2017) and update the monitoring requirements based on the previous years of monitoring data obtained at the site.

1.1 Site Background

The Essex/Hope Site is located on a 4.7 acre parcel of land that is currently owned and occupied by Custom Production Manufacturing, Inc. (CPM) at 125 Blackstone Avenue in the City of Jamestown, NY (Figure 1). The site is located in a highly industrialized area of the city that has seen various degrees of industrial use for the past 75 years. Contamination onsite is the result of historical practices conducted at the facility as discussed in the Remedial Investigation (RI) Report dated October 1992.

The following three areas (Figure 1) are identified in the ROD as the focus of the original remedial efforts:

- North Parking Lot Sump (NPLS) Area: Located in a parking area on the south side of Hopkins street and adjacent to the facility formerly known as Plant 5. The subsurface soil proximal to the sump as well as the groundwater in the NPLS Area contain trichloroethylene (TCE) above NYSDEC standards. A smaller area of subsurface soil located south of the sump also contains polychlorinated biphenyls (PCBs) at levels up to 33 mg/kg, dry weight. Depth of the impacted soil primarily occurs from 6 to 12 feet below grade;
- Former Aboveground Storage Tank/Underground Storage Tank (AST/UST) Area: Located on the east side of the railroad right-of-way. The subsurface soil and groundwater in this area contain ethylbenzene, toluene, and xylene (ETX) residues; and
- Previously Closed Underground Storage Tanks (USTs) Area: Located south of the former Plant 5. The subsurface soil and shallow groundwater in this area contains primarily ethylbenzene, toluene, and xylenes.

Supplemental site investigations and remedial actions have been conducted since Year 2000. These actions have resulted in modifications to the original remedial measures as well as the definition of the contaminant source and extent. The modifications to the remedial action are summarized in Section 1.3.1.

1.2 Pre-Design Investigation Results

Sampling of soil and groundwater was originally performed during the Remedial Investigation (RI) for the site. The RI report dated October 1992 summarizes this data.

Groundwater and soils were also sampled as part of the Pre-Design Investigation in July and August of 1995 and in August of 1996. Groundwater sampling and carbon treatability results from the Pre-Design Investigation are included in Tables 1 and 1A, respectively. Limited soil sampling data obtained during the Pre-Design studies in the source areas is summarized in Table 2. The original monitoring well and soil sampling locations are provided on Figure 2.

1.3 Remedial System Description

The original remedial action for the site consists of Alternative No. 5 from the ROD. Alternative No. 5 consists of the following:

- Excavation and off-site disposal of the layer of highly contaminated soil containing trichloroethylene and PCBs;
- Collection of groundwater utilizing recovery wells;
- Physical/chemical treatment of groundwater;
- Vacuum extraction of unsaturated soils;
- Air sparging of groundwater and saturated soils to enhance contaminant reduction and reduce the remediation period;
- Installation of an asphalt cap in source areas to inhibit infiltration of precipitation; and
- Implementation of a long term monitoring program which will allow the effectiveness of the selected remedy to be monitored. This long term monitoring program will be a component of the operations and maintenance for the site and will be developed in accordance with Remedial Design.

Figure 3 illustrates the various aspects of the original Remedial Alternative No. 5.

Groundwater has been recovered from the shallow and lower water bearing zone in the NPLS Area using two shallow (RW-1S and RW-2S) and two deep recovery wells (RW-1D and RW-2D). Shallow groundwater recovery in the AST/UST Area used one recovery well (RW-3S) and the UST Area used two recovery wells (RW-4S and RW-5S). Recovered groundwater has been treated using activated carbon at the onsite groundwater treatment plant and discharged to the POTW.

Combined soil vapor extraction and air sparging has been conducted in each area of concern to reduce the levels of chemical constituents in the groundwater and soils to acceptable levels. Each area included a network of air sparging wells screened within the water bearing zone; and a network of vapor extraction wells screened above the water table. Soil vapor has been treated using activated carbon units. Each area was capped with either asphalt or concrete to reduce the infiltration of surface water and optimize the performance of the system.

As part of the remediation effort, the sump and surrounding shallow soils in the NPLS Area were excavated to eliminate the source of chlorinated VOCs and PCBs. More than 400 cubic yards of material were disposed of from this area. The material removed for disposal came from a depth of approximately 6 to over 13 feet below grade. Upon completion of soil excavation, the sump area was backfilled and compacted to grade.

1.3.1 Modifications to the Remedial Action

Modifications to the original remedial action have been made to improve remediation performance. These actions were implemented voluntarily by ESP/Dow with the approval of the NYSDEC. All of these modifications were considered "minor" with respect to the ROD requirements for changes to the remedial action. A summary of the additional remedial activities performed at the Site since the start-up of the original action in 1997, including supplemental investigations, are as follows:

- **Shutdown of Recovery Well RW-1D (1999)**- Groundwater extraction from Recovery Well RW-1D, screened across the deep water-bearing zone in the NPL Area, was discontinued in June 1999 with the approval of the NYSDEC. As reported in the 1999 Annual Performance Monitoring Report (Radian International, April 1999), a pumping evaluation completed in the first half of 1999 revealed that vertical leakage was occurring from the shallow water-bearing zone to the deep water-bearing zone due to pumping from the deep zone. Based upon this information, and the fact that the majority of the groundwater constituents are recovered from RW-2D, NYSDEC recommended that RW-1D be shut down as documented in the June 17, 1999 correspondence from the NYSDEC to Radian International.
- **Shutdown of Air Sparging System in NPL Area (2000)** - The air sparging system in the NPL Area was shut down in July 2000, with the approval of the NYSDEC, to prevent the oxidation of the newly installed Pilot Permeable Reactive Wall (PRW) and zero-valent iron injections in that area. The soil vapor extraction system has continued to be operated in this area as needed to collect potential gases produced by subsurface reactions associated with the Pilot PRW and zero-valent iron injections in that area.

  Air sparging in the UST Area was discontinued in October 2000 after mechanical failure of the air sparge pump. Since the combined soil vapor extraction/air sparging system had reached its practical remedial effectiveness, Essex Specialty Products initiated activities to evaluate conditions in this area in 2000 and implement supplemental remedial activities to replace the original system, with the approval of the NYSDEC. These supplemental remedial activities include the *insitu* cleaning of the former USTs completed in December 2001 and February 2003, and the UST removals completed between November 2002 and January 2003

- **Zero-Valent Iron Permeable Reactive Wall Pilot Test (2000)-** A pilot scale zero-valent iron (ZVI) permeable reactive wall (PRW) was injected around recovery well RW-2D and within the lower semi-confined water-bearing zone beneath Building 5 in July 2000. The pilot PRW was designed to evaluate the effectiveness of this technology to reduce and control the migration of dissolved VOC constituents from the site. As part of this evaluation, additional groundwater piezometers were installed in the upper unconfined water-bearing zone and lower semi-confined water-bearing zone for performance monitoring of the pilot PRW. Collection of pilot test data was completed in July 2001, and further evaluation based upon site performance monitoring data was completed in December 2002. Data concerning this pilot test has been submitted to the NYSDEC as the Interim Results, PRW Pilot Results for First Four Sample Rounds (URS, February 2001). A final pilot test report detailing results through December 2002 was submitted to NYDEC in July, 2003.

- **Plant #5 East Area and UST Area Investigations (2000) -**The former underground storage tanks (USTs) in the UST Area were uncovered in August 2000 and evaluated as a potential ongoing source of VOCs in this area. Additional test borings and groundwater piezometers were installed within the shallow water-bearing zones in this area to evaluate groundwater and soil chemical conditions, and to assess groundwater flow direction and constituent migration. Results of these activities were reported in the Plant #5 East Area and UST Area Investigations Report (URS, March 2001).

  As part of the UST Area investigation, the area east of Building 5 was evaluated at the request of the NYSDEC to determine the source of vinyl chloride (VC) within the lower semi-confined water bearing zone at Monitoring Well MW-19D, located on the Site's eastern property line. A network of test borings and deep piezometers were installed within the UST Area and on the offsite property to the east for evaluation of chemical conditions within the soil and groundwater. Results of these activities were also reported in the Plant #5 East Area and UST Area Investigations Report (URS, March 2001).

- **UST Area Tank Cleaning and Removal (2001-2003)-** The former USTs (Tanks 1 through 5) in the UST Area were uncovered during 2001 and were found to contain residual paint products and soil backfill. A liquid layer was present in the tanks consisting of paint solvents and water. Openings were cut in each tank and the liquid contents were removed, and each tank was rinsed with potable water. Following rinsing, the remaining solid material were treated using the Biox® Process to remove residual organic constituents in the tanks by chemical oxidation and biodegradation. Results of the tank cleaning were submitted to the NYSDEC in the Tank Closure Work Plan (URS, September 2001).

  Based upon the results of the Biox treatment of the USTs, a UST removal program was initiated since VOCs in the residual solids were not reduced below the "clean closure" standard of 5 ug/L (ppb) within Tanks T-1, T-3 and T-4 as required by the NYSDEC. All five (5) of the former USTs in the UST Area, and approximately 1200 tons of nonhazardous soil and debris and 60 tons of hazardous soils were removed between the period of November 2002 and January 2003. Results of this activity have been submitted to the NYSDEC in the UST Removal Interim Report (URS, February 2003). Concurrent with removal of the USTs was demolition of the UST Area SVE System and Recovery Well RW-4S, and disconnection of Recovery Well RW-5S.

- **UST Area SVE and Groundwater Recovery Systems Demolition (2002)-** The soil vapor extraction system and groundwater recovery system (Recovery Wells RW-4S and RW-5S) in the UST Area were shut down in November 2002 for the UST removal activities. Excavation work resulted in complete demolition of the electrical system in the UST Area, Recovery Well RW-4S, and underground piping to the soil vapor extraction/air sparging wells and existing Recovery Well RW-5S. These systems are currently demolished or are inoperable. There are no plans at this time to redesign or reconstruct the UST Area remediation system since additional remedial actions are planned for the UST Area in Year 2008..

- **Supplemental Groundwater Investigations (2003) -** URS initiated supplemental investigations in November 2003 focused on determining the extent of the VOC plumes in the UST Area shallow groundwater and the deep groundwater zone north and east of the Plant #5 building. This was the second supplemental groundwater investigation of VOCs in the shallow and deep zones offsite, this time focusing mainly to the north of Hopkins Avenue, and the extent of the VOCs in the shallow groundwater in the UST Area. The results of these investigations are contained in the *UST Area and Groundwater Vinyl Chloride Investigations* report, June 2004. The previous groundwater investigations in Year 2000 focused on the buried tanks in the UST Area and VC in the deep groundwater zone around MW-19, east of the Plant #5 building.

  Elevated CTEX (>RAOs) was found further south of the UST Area than previously known. Approximately 30 feet south of the former USTs, CTEX soil levels up to 547 ppm were found. The CTEX shallow groundwater plume (1 ppm isocontour) was found to extend across the entire UST Area to the former tank farm on the east, north to MW-20 (beneath Plant #5), and to the southwest, at least to monitoring well MW-24S. The extent of the plume to the southwest and eastern areas of the UST Area was not fully defined from the additional monitoring well locations. Elevated CTEX (>1 ppm) was also found south and southwest of the UST Area. Monitoring wells MW-23S and MW-24S had total CTEX levels of 2,507 ppb and 7,674 ppb, respectively. These wells are approximately 30 feet south of the UST Area. The extent of migration in this direction was not determined.

  Deep groundwater samples were taken from three (3) of the new monitoring wells (MW-21D, MW-22D, and MW-23D) and 12 existing monitoring wells in the area around the northern and eastern sides of Plant #5. TCE was found at the highest levels in site groundwater in monitoring wells MW-21D and MW-22D, at concentrations of 300 ppm and 17 ppm, respectively, representing the highest TCE concentrations found in recent investigations. Both wells are offsite, northeast of Plant #5 along the groundwater flowline, directly downgradient (under non-pumping conditions) of the former NPL Area VOC source. The extent of TCE further northeast of MW-22D was not determined during the investigation.

  VC was found at the highest levels in site groundwater in monitoring wells MW-21D and MW-19D, at concentrations of 5,800 ppb and 1,400 ppb, respectively, representing the highest VC concentrations found in recent investigations. MW-21D is offsite within the right-of-way of Hopkins Avenue. MW-19D, east of the Plant #5 building, has had the highest VC levels historically found at the site. The elevated VC area (>1 ppm) is generally consistent with the TCE deep zone distribution, however, the VC presence is predominantly closer to the site. The extent of the VC further northeast and east of MW-22D and PZ-7D was not determined.

The above investigations indicated that the VOCs in the shallow groundwater in the UST Area and in the deep groundwater has extended offsite and further from the remedial capture zone area than had originally been known at the time of the ROD, and during the ongoing performance monitoring.

- **August 2004 Meeting with NYDEC –** URS met with NYDEC in August 2004 to review the investigation findings and discuss further actions. The conclusion was that an additional investigation was necessary to determine the extent of offsite VOCs in all of the groundwater areas. In addition, NYDEC raised the concern over residential vapor intrusion for the offsite shallow groundwater plumes, and required vapor probes to be installed at the residential properties that were found to overlie shallow groundwater VOCs.

- **Supplemental Groundwater Investigations (2005-2006) –** URS initiated site investigations in April 2005 and the work continued through June 2006. The investigation was performed in stages, first to track the extent of the groundwater VOC plumes, and then to identify potential residential properties of concern for vapor monitoring. Direct-push drilling with dual-casing, discrete groundwater sampling methodology was employed. No new monitoring wells were installed. In general, the investigations indicated that VOC groundwater plumes were migrating off-site to the north (Hopkins Avenue) and from the UST Area to the south and east. The results of these investigations are contained in the *UST Area and Offsite Groundwater Investigations* report, dated December 2006. NYDEC approved this report in August, 2007, with a number of items that were listed for further attention:

  - VOC vapor intrusion at Hopkins Avenue residences,
  - UST Area rainwater sumps,
  - Remediation of shallow and deep groundwater VOCs migrating north of Building 5,
  - UST Area residual VOCs in soils,
  - UST Area, inc MW-20, shallow groundwater VOC migration,
  - Isolated groundwater VOC detections in MW-14S,
  - Groundwater acetone detections in area east of Building 5.

- The AST/UST Area system was shut down since August of 2006 and remains offline pending supplemental remedial action in the AST/UST and UST areas and eventual permanent disconnection. The SVE System in the NPL Area was operated on a voluntary basis as an additional safeguard against potential vapor release. However, the system was shut down in November 2007 following review of air stream sample analyses that indicated this area poses no potential hazard associated with vapor release.

- **Remedial Actions (2007-2008) -** URS initiated Phase I of the Remedial Actions in November, 2007. These included a new recovery well RW-6D and monitoring wells MW-25S and MW-25D to the north of the site along Hopkins Avenue. Residential vapor sampling was also performed at 159 Hopkins Avenue. Recovery Well RW-6D installation was completed in the second half of 2008 and placed on-line in September 2008. *Phase II Supplemental Remedial Activities* commenced in November 2008 with the installation of a residential vapor mitigation system at 159 Hopkins Avenue.

- **Remedial Actions (2010-2011) -** VOCs in the UST Area shallow groundwater and other offsite shallow and deep groundwater zones are currently being evaluated for insitu treatment technologies. A bench-scale chemical oxidation study was completed for UST Area soils and groundwater in 2010. A Remedial Action Work Plan for insitu chemical oxidation of the UST Area was prepared and submitted in August 2011. Continued implementation of Phase II remedial actions commenced in the fourth quarter 2011 with the insitu chemical oxidation (ISCO) for soil and shallow groundwater VOCs in the UST Area. Four (4) shallow monitoring wells (MW-26S, MW-27S, MW-28S, and MW-29S) were installed in the UST Area to better evaluate the extent of VOCs in the area and for monitoring of the subsequent ISCO results. ISCO was conducted in November 2011 to treat the shallow groundwater in the UST Area. The area surrounding RW-6D was also treated at this time to address the acetone plume in the deep groundwater zone. Performance monitoring of groundwater and soils was initiated in December 2011 and continued through 2012. Results of these activities were summarized in a separate report submitted to NYSDEC in the fourth quarter of 2012.

- RW-6D was temporarily shut down in August 2011 due to elevated levels of acetone in excess of permit limits in the treatment system effluent. Due to the difficulty of acetone treatment by carbon, normal operations of the recovery well have been postponed until post-ISCO monitoring results illustrate decreased concentrations of the compound. RW-6D remained offline for most of the 1st half of 2012 while continued efforts were made to address the acetone hotspot. URS' research determined that acetone is not included on the USEPA list of Total Toxic Organics (TTOs) and therefore, not considered a compound of interest. On June 6, 2012, a letter of notification was sent to the City of Jamestown Board of Public Utilities (BPU) advising that acetone would no longer be reported as a TTO. RW-6D was subsequently restarted on June 11, 2012.

- **Supplemental Investigations (October-December 2013) –** Shallow soil and groundwater investigations were conducted in the UST Area West Building to determine the extent of residual VOCs remaining in the UST Area following the completion of the chemical oxidation. Results of these activities were summarized in a separate report.

1.4 Performance Criteria

The performance criteria to evaluate remediation effectiveness are the Remedial Action Objectives (RAOs) as included in the ROD (March 1994) as Appendix A. Table 3 summarizes the RAOs for the site.

1.5 Performance Evaluation Period

Implementation of a long term monitoring program will monitor the effectiveness of the implemented remediation. The ROD indicates that the long term monitoring program should be a component of the operations and maintenance for the site.

Original PMP Monitoring Period- An overall time period of five years was selected for a long term monitoring program for the original PMP. This 5-year period was from 1998 through 2002 and was intended to evaluate remedial measures to determine whether these measures are achieving significant progress toward meeting the remedial action goals. The monitoring period was extended through 2003 pending revision of the PMP. This 6-year period consisted of quarterly and annual groundwater and soil sampling, along with physical measurements conducted quarterly, to evaluate affected soils and groundwater. The PMP indicated that the sampling and monitoring frequency was to be “re-evaluated periodically and adjusted as needed with the approval of the Agency.”

Revised PMP Monitoring Period- The revised long term monitoring period was changed to three (3) years in 2003, for the period 2004 through 2006. Year 2007 monitoring was consistent with years 2004 through 2006. The PMP was not revised in year 2007 because of the pending remedial actions (Phase I). New monitoring wells were constructed as part of those actions and were added to the revised PMP, dated February 2008 to address years 2008 through 2010. The PMP was revised in February 2011 to address years 2011 through 2013. The monitoring period will continue on a 3-year schedule for this PMP which includes years 2014 through 2017.

1.6 Revisions to the Performance Monitoring Plan

This March, 2014 PMP has been revised to update the monitoring period and add the following groundwater monitoring locations:

- UST Area- Monitoring wells MW-23S through MW-29S, and HW-6 in the shallow groundwater zone,
- NPL Area- Monitoring well MW-12 in the shallow groundwater zone.

These additional locations will provide data to assess the performance of remedial actions in the UST Area of the site.

2.0 PERFORMANCE MONITORING

2.1 Groundwater Monitoring

Monitoring of groundwater will consist of both chemical and physical measurements. Physical measurements will consist of water level measurements at the monitoring and recovery well locations. Chemical measurements will consist of laboratory analysis of groundwater from recovery wells and selected monitoring wells for target constituents. Table 4 provides a list of all monitoring points, and Figure 4 outlines the monitoring schedule. Figure 5 provides the monitoring locations.

To establish a baseline condition, an initial round of physical and chemical measurements was taken prior to startup of the remediation system. The physical measurements from this sample round documented static groundwater flow conditions prior to pumping. The chemical measurements established a baseline for constituent concentrations from which the effectiveness of remediation can be measured.

2.1.1 Physical Measurements

All monitoring wells will continue to be measured quarterly for water level elevation. The data obtained from this task will be utilized to create a water level contour map for both the shallow and lower fine sand water bearing zones. These maps will be compared to static (baseline) conditions to evaluate the effective radius from the recovery well system. This data will be used to document hydraulic control of site groundwater and as a guide to optimize system operation if the effective radius requires modification.

2.1.2 Chemical Measurements

North Parking Lot Sump Area and Off-site Groundwater to North

To effectively monitor the two water bearing zones that occur in these areas, the following well network will be used:

- Shallow monitoring wells MW-6, MW-7S, MW-12, MW-14S, MW-15S, and MW-25S;
- Shallow recovery wells RW-1S and RW-2S;
- Lower fine sand monitoring wells MW-7D, MW-8, MW-14D, MW-15D, MW-16D, MW-19D, MW-21D, MW-22D, MW-25D, VP-6D, PZ-7D, and
- Lower fine sand recovery wells RW-2D and RW-6D (planned startup in Q1/2, 2008).

Table 4 also provides a summary of the rationale, sample frequency, and parameters for each of the monitoring points. All selected monitoring wells will continue to be sampled annually. All recovery wells will continue to be sampled semi-annually to monitor groundwater extraction concentrations over time. Semi-annual monitoring dates will be staggered for each monitoring point each year so that the same annual “seasons” are not sampled in consecutive years. For example, a specific well would be monitored on a 2 year frequency schedule of Q1, Q3 for one year and Q2, Q4 for the succeeding year. The next monitoring year would restart with the Q1, Q3 cycle, etc.

Underground Storage Tank Area

The following network will be used to monitor the shallow groundwater zone:

- Shallow monitoring wells HW-6, MW-20, MW-23S, MW-24S, MW-26S, MW-27S, MW-28S, and MW-29S.

Former Above Ground/Underground Storage Tank Areas

The former AST/UST area will be monitored by monitoring well MW-2 and recovery well RW-3S (see Table 4). MW-2 will be sampled annually and compared to baseline conditions and RW-3S will be monitored semi-annually.

2.2 Soil Sampling

Soil sampling will be conducted in the UST and Former AST/UST areas in order to compare constituent concentrations in soil to the site RAOs. Soil sampling in the NPLS area was originally conducted prior to the excavation of the NPL sump and contiguous areas during the initial remedial action. Data from this sampling is provided in Table 5. Further sampling has not been performed in the NPLS Area since this area has achieved compliance with RAOs. Monitoring plans for the UST and AST/UST Areas will be assessed after completion of proposed remedial actions (see Section 1.3.1).The following subsections provide the sampling rationale for each area.

2.2.1 NPLS Area

Figure 6 provides the confirmatory soil sample locations which set the limits for the original excavation for the NPL sump and contiguous area. Sampling of the confirmatory borings occurred in August 1996 and excavation of the NPLS area was conducted in September 1996. Following excavation, soil sampling and analyses conducted in this area achieved site RAOs, therefore, further sampling was precluded. Results also confirmed that any remaining VOC constituents are located below the water table and would be addressed through groundwater extraction.

2.2.2 UST Area and Former AST/UST Area

Figure 2 depicts soil sampling locations conducted during the Remedial Investigation and subsequently repeated during the Pre-Design studies in 1995. The soil samples collected during the Pre-Design studies were taken from the same general vicinity and depth as those from the RI to compare the effectiveness of a Pilot SVE program conducted in these two VOC source areas. Table 2 summarizes soil sampling data from each of the two areas prior to (1988) and after (1995) SVE-pilot testing. The data representing soil concentrations after SVE-pilot testing represent “baseline” concentrations in these areas.

Soil samples for ethylbenzene, toluene, and xylene analyses U.S. EPA Method 8260) were taken annually up to Year 2001 in the approximate locations of the previous sampling to provide an indication of achievement of RAOs. Although VOC levels were found to be significantly reduced from baseline levels, RAOs were not achieved throughout the treatment areas. When annual soils sampling analytical results in a given area attain remediation goals, a confirmatory sampling program will be conducted to verify soil cleanup

Annual soil sampling in these 2 treatment areas was temporarily halted in Year 2002 as indicated in a January 2, 2003 correspondence to NYDEC. The sampling was stopped primarily because of the remediation work in the UST Area and the planned soil remediation measures that were under consideration for both of the areas. The five (5) tanks in the UST Area were removed and the SVE System was demolished as part of the tank removal work. Approximately 1200 tons of soil and debris were also excavated from the UST Area and disposed of offsite, VOCs significantly above RAOs were found in remaining soils in the UST Area in subsequent site sampling. In Year 2001 sampling, VOC levels in the AST/UST Area soils were found to be near or below detection levels.

Insitu treatment for the UST Area was implemented in 2011. (see Section 1.3.1). Soil and groundwater performance sampling have been summarized in the *Performance Monitoring Report for ISCO- 6 Months Post-Treatment, URS 2012,* which was submitted to NYDEC in December, 2012.

Confirmatory Soil Sampling

The confirmatory soil sampling program will be based on a random sampling method for verification of soil remediation. In accordance with this method, eight confirmatory soil samples will be collected in the former AST/UST and UST Areas. The boundary limits of the “areas” will be based on both operating history and the results of completed investigations in these areas. The area will be divided into four equal sub-sections using a gridding system. Sample borings will be placed at the approximate center of each sub-section. In addition, borings will be located to collect (one from each side) four samples on the outer-edge of the area. The depth of sample collection will be determined through field screening (Section 2.4.2). Soils will also be analyzed for VOCs and SVOCs by U.S. EPA Methods 8260 and 8270 to verify compliance with site RAOs (Table 3).

2.3 Statistical Evaluation of Soil Analytical Data

Analytical results from annual soil sampling and analysis will be evaluated to determine if Site RAOs have been met before confirmatory soil sampling and analysis is performed. If constituent concentrations are significantly reduced between annual soil sampling events and Site RAOs are met, confirmatory soil sampling may also be performed. Analytical results from confirmatory soil sampling will be subjected to statistical evaluation to determine the 90 percent upper confidence level (UCL). If the resulting 90 percent UCL meets or exceeds (is less than) the applicable RAO, the remedial action will be deemed effective and the area will be considered remediated. Ongoing remedial actions in these areas will be halted upon receipt of written approval of achieving cleanup by NYDEC.

2.4 Field Methods

The field methods necessary for measurement of performance monitoring data involve groundwater sampling procedures and soil sample acquisition procedures. Groundwater samples from monitoring wells will be obtained by collecting samples via a well sampling pump or disposable Teflon bailers. Recovery well samples will be collected from the sampling valve on the well influent piping in the wastewater treatment plant. Soil samples will be obtained by utilizing a hydraulic push probe sampling device such as a direct-push drill soil sampler or by a conventional geotechnical drill rig utilizing the split spoon sampling procedure. The following sections provide detail for sampling each media.

2.4.1 Monitoring Wells Sampling Procedures

Groundwater sampling will be conducted in accordance with the procedures utilized during the Pre-design Investigation. Water level measurements will be made prior to purging each well. Shallow wells will be purged with a submersible pump or bailer. Deep wells will be purged with a submersible pump. Purging will be conducted until three to five well volumes of water have been removed form the well (provided well yields support this) and until field measurements of temperature, specific conductance, and pH, which will be made after each volume, have stabilized.

All sampling will be performed after purging is completed using decontaminated sampling pumps with LDPE tubing or disposable teflon bailers attached to polyethylene rope. Any water level measuring or purging equipment that contacts the groundwater (e.g., submersible pump, discharge line) will be decontaminated between wells or discarded, as described below.

Purge water removed form the monitoring wells during the course of sampling will be collected and discharged into the wastewater treatment plant surge tank onsite.

Equipment and materials to be used for the sampling activities may include:

- Sample bottles;
- Submersible pump;
- Discharge line;
- Suction pump;
- Portable generator;
- Water-level measuring device;
- Bailers;
- Polyethylene rope;
- Thermometer;
- pH meter;
- Specific conductance meter.

Decontamination of Water Sampling Equipment

Decontamination of water sampling equipment, such as bailers, pumps, filtering apparatus, and water level measuring devices, will be conducted in accordance with the procedures described below. Decontamination is needed to prevent the potential transfer of chemical contaminants between various wells and samples. This is especially important since analytical detection limits are typically in the parts per billion (ppb) range and cross contamination can lead to erroneous indications of contamination, when none may actually be present. A new length of bailer line will be used at each monitoring well. Pumps, discharge line, filtering apparatus, and water level indicator probes will be decontaminated before initial use and between wells.

The submersible pump will be decontaminated by rinsing it with deionized water prior to and between uses at each well location. For decontamination of the discharge hose, the exterior surface of the hose will be rinsed with distilled/deionized water prior to its use at each well. An exception to this procedure will be made with the recovery well sampling locations, where samples will be obtained directly from the discharge line at these wells in the wastewater treatment plant.

The decontamination procedure includes:

- Potable water rinse;
- Detergent (Alconox) wash;
- Potable water rinse;
- Distilled/deionized water rinse.

2.4.2 Annual and Confirmatory Soil Sampling Methods

Annual and confirmatory soil samples can either be obtained by direct-push probe methods or by a geotechnical drill rig utilizing hollow stem auguring and split spoon sampling procedures. The auger sample collection method will conform to ASTM Method D1586. Samples will be obtained continuously at each designated location between depths of 2.0 to 6.0 feet. All samples collected will be field screened for head space analysis with a photoionization detection.

A representative portion of each soil sample will be retained for field screening of organic vapors by headspace analysis. The soil will be placed into a clean 8-ounce sample jar and filled to one-half capacity. The sample jar will be sealed with aluminum foil and then warmed to room temperature before screening. A photoionization detector (11.7 eV) will used to measure the headspace vapor concentration by inserting the instrument probe through the foil into the headspace volume. The maximum instrument reading will then recorded for each sample.

Samples will be collected for three consecutive sampling intervals of 0-2, 2-4, and 4-6 ft-bgs. The soil sample taken for laboratory analysis from each boring will be the sample associated with the highest headspace reading.

The confirmation samples will be placed in clean laboratory-supplied sample jars and secured with Teflon-lined lids. The sample jars will be labeled with the following information:

- Sample number, location, and depth interval;
- Date and time collected;
- Sampler's initials; and
- Compounds for analysis.

Decontamination of sampling equipment will occur at the beginning and end of the entire sampling event. Sampling equipment used in the collection of subsurface soil samples at discrete depths will be decontaminated between the collection of the individual samples.

Downhole equipment will be decontaminated between boring locations. Trowels/scoops used for discrete soil sampling will be decontaminated prior to and following collection of each sample.

A portable decontamination station will be set up at a predetermined location. Necessary equipment and materials include: brushes for dry and wet removal of soils adhering to equipment; pails to collect wash waters, rinse water(s), and potable rinse water; deionized water; and detergent wash.

The following procedures will be employed for the proper decontamination of sampling equipment:

- Soils adhering to equipment are brushed off (dry);
- Rinse and/or wet brushing of equipment in a pail of potable water;
- Detergent washing of equipment over a wash water collection pail;
- Second potable water rinse over the waste collection pail;
- Deionized water rinse over the rinsate water collection pail; and
- Air-drying of equipment prior to reuse.

Waste waters generated by the decontamination process will be treated through the onsite wastewater pretreatment system (activated carbon) prior to discharge to the City of Jamestown sewer system.

2.4.3 Sample Packaging/Shipping

All samples collected will be appropriately labeled and immediately containerized within a sample cooler and maintained at a temperature of 4°C. The samples collected will be submitted to the analyzing laboratory within 24 hours of sample collection. Chain of custody procedures will be strictly adhered to throughout sample acquisition, shipping, and analyzing.

2.5 Laboratory Analysis

All submitted samples will be analyzed by a New York State certified analytical laboratory. All water samples for the baseline period will be analyzed for the target VOCs listed in Section 2.1.2 by U.S. EPA Method 8260 and PCBs by Modified U.S. EPA Method 8081. Soil samples in the Former AST/UST and UST areas will be analyzed on an annual basis for ethylbenzene, toluene, and xylene by U.S. EPA Method 8260. Confirmatory sampling as described in Section 2.2.2 will also include analysis for SVOCs by U.S. EPA Method 8270. These methods have reporting limits consistent with the cleanup goals listed on Table 3.

3.0 REPORTING REQUIREMENTS

Recovery well groundwater sample results and water level contour maps will be prepared semi-annually as part of the operation and maintenance Semi-Annual Performance Monitoring report. The mid-year report will be submitted to NYSDEC in August and the other set of water level data (Q3-Q4) will be included in the Annual Report.

An Annual Periodic Review Report, formerly the Annual Performance Monitoring Progress Report, will be submitted to NYSDEC that summarizes all of the monitoring results for that calendar year as described in Sections 2.1 and 2.2. The report will be submitted by the end of the first quarter of the following calendar year and will discuss remediation progress in comparison to baseline conditions and RAOs.

4.0 REFERENCES

1. Dow Environmental, Inc., Remedial Design/Remedial Action Work Plan, Essex/Hope Site, Jamestown, New York, March 1995.
2. ERM-Midwest, Inc., Site Investigation at Essex Specialty Products, Inc., May 2, 1989.
3. NYSDEC, Record of Decision, Essex/Hope Site, Jamestown, New York, March 1994.
4. O'Brien & Gere Engineers, SVE Pilot Study Status Report, Jamestown, New York, June 3, 1994.

TABLES

Table 1. Groundwater Analytical Results – Organic Compounds
Pre-Design Investigation

Volatile Organic Compounds	MW-1	MW-2	MW-3S	MW-3D	MW-4	MW-5	MW-6	MW-7S	MW-7D
Vinyl Chloride	<10	180	1,900	47	<500	<10	<10	<10	<10
Carbon Disulfide	<10	<500	<1000	<10	<500	<10	<10	<10	<10
1,1-Dichloroethene	<10	<500	150	<10	<500	<10	<10	<10	<10
1,2-Dichloroethene (total)	<10	370	53,000	27	<500	<10	42	210	7
2-Butanone	<10	<500	<1000	<10	<500	<10	<10	<10	<10
Trichloroethene	<10	<500	640,000	71	<500	<10	48	200	25
Tetrachloroethene	<10	<500	670	<10	<500	<10	<10	<10	<10
Toluene	<10	99,000	140	<10	6,700	<10	<10	<10	<10
Ethylbenzene	<10	4,100	<1000	<10	450	<10	<10	<10	<10
Xylenes (total)	<10	21,000	580	<10	2,200	<10	<10	<10	<10
Total VOCs	**0**	**124,650**	**696,400**	**145**	**9,350**	**0**	**90**	**430**	**32**
Polychlorinated									
AROCLOR-1254	<1	<1	730	<1	<1	<1	<1	<1	<1

Table 1. Groundwater Analytical Results – Organic Compounds
Pre-Design Investigation

Volatile Organic Compounds	MW-7DD	MW-8	MW-10	MW-11S	MW-11D	MW-12	MW-13	MW-14S	MW-14D
Vinyl Chloride	<10	4	<10	8	<10	230	4	170	13
Carbon Disulfide	<10	<10	<10	<10	<10	<20	2	<10	<10
1,1-Dichloroethene	<10	<10	<10	<10	<10	<20	<10	45	<10
1,2-Dichloroethene (total)	<10	19	<10	17	4	280	<10	850	<10
2-Butanone	<10	<10	<10	<10	<10	4	<10	<10	<10
Trichloroethene	5	25	2	8	<10	45	<10	920	1
Tetrachloroethene	<10	<10	<10	<10	<10	<20	<10	<10	<10
Toluene	<10	<10	<10	<10	<10	<20	<10	<10	<10
Ethylbenzene	<10	<10	<10	<10	<10	<20	<10	<10	<10
Xylenes (total)	<10	<10	<10	<10	<10	<20	<10	<10	<10
Total VOCs	**5**	**48**	**2**	**33**	**4**	**559**	**6**	**1,985**	**14**
Polychlorinated Biphenyls									
AROCLOR-1254	<1	<1	<1	<1	<1	<1	<1	<1	<1

Table 1. Groundwater Analytical Results – Organic Compounds
Pre-Design Investigation

Volatile Organic Compounds	MW-15S	MW-15D	MW-16S	MW-16D	MW-17	MW-18	MW-19S	MW-19D	MW-20
Vinyl Chloride	<10	2	<10/<10	<10	<10	<10	<10	410	<200
Carbon Disulfide	<10	<10	<10/<10	<10	<10	<10	<10	<20	<200
1,1-Dichloroethene	<10	<10	<10/<10	<10	<10	<10	<10	<20	<200
1,2-Dichloroethene (total)	76	33	<10/<10	<10	<10	39	14	<20	<200
2-Butanone	<10	<10	<10/<10	<10	<10	<10	<10	<20	<200
Trichloroethene	140	26	<10/<10	<10	<10	210	15	2	<200
Tetrachloroethene	<10	<10	<10/<10	<10	<10	<10	<10	<30	<200
Toluene	<10	<10	<10/<10	<10	<10	<10	<10	<30	<200
Ethylbenzene	<10	<10	<10/<10	<10	<10	<10	<10	<30	2,100
Xylenes (total)	<10	<10	<10/<10	<10	<10	<10	<10	<30	20,000
Total VOCs	**216**	**61**	**0**	**0**	**0**	**249**	**29**	**412**	**22,100**
Polychlorinated									
AROCLOR-1254	<1	<1	<1	<1	<1	<1	<1	<1	<1

All results provided in µg/L (part per billion).
<# indicates not detected at laboratory detection limit.
#/# indicates replicate analysis.
Volatile organic analysis conducted by U.S. EPA SW-846 Method 8260.
Polychlorinated Biphenyls analyzed by U.S. EPA SW-846 Method 8080.
Only compounds detected are shown. Additional compounds sampled for not detected are provided on laboratory data sheets in Volume 2 of The Basis of Design Report (Nov. 1995) (All pages).

Table 1A. Groundwater Treatability Analytical Results – Organic Compounds
Pre-Design Investigation

Volatile Organic Compounds	RW-1S: PRE-CARB at 5.5 hours	RW-1S: POST-CARB at 5.5 hours	RW-1S: PRE-CARB at 29 hours	RW-2D at 5 hours	RW-2D at 21 hours	RW-2D Carbon Effluent	RW-2S
Vinyl Chloride	240	<10	200	32	31	<10	100/81
Methylene Chloride	<17	<13	<13	<10	<10	<10	<10/<10
Acetone	10	8	<12	<10	<10	<10	<10/<10
Carbon Disulfide	<10	<10	<10	3	2	<10	<10/<10
1,1-Dichloroethene	11	<10	13	7	4	<10	13/11
1,2-Dichloroethene (total)	1,200	9	1,700	180	200	<10	<2,200/2,600
Trichloroethene	1,900	10	3,500	3,600	5,600	<10	<7,700/10,000
Tetrachloroethene	2	<10	4	<10	1	<10	<15/14
Xylenes (total)	3	<10	4	<10	<10	<10	<10/<10
Polychlorinated							
AROCLOR-1254	<1	<1	<1	<1	<1	<1	<1/<1

All results provided in µg/L (part per billion).
<# indicates not detected at laboratory detection limit.
#/# indicates replicate analysis.
Volatile organic analysis conducted by U.S. EPA SW-846 Method 8260.
Polychlorinated Biphenyls analyzed by U.S. EPA SW-846 Method 8080.
Only compounds detected are shown. Additional compounds sampled for not detected are provided on laboratory data sheets in Volume 2 of The Basis of Design Report (Nov. 1995) (All pages).

Table 2. SVE Pilot Testing Confirmatory Soil Sample Results

Sample Boring	TB-3A	SB-3	TB-4A	SB-4	TB-12A	12	TB-14A	14(1)
Sample Depth	**4' - 6'**	**4' - 6'**	**6' - 8'**	**6' - 8'**	**6' - 8'**	**4' - 6'**	**8' - 10'**	**8' - 10'**
Collection Date	**7/95**	**1988**	**7/95**	**1988**	**7/95**	**8/89**	**7/95**	**8/89**
Parameters	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**	**mg/kg**
Ethylbenzene	3.8	<0.03	0.310	200	<1.4	15	11	16
trans-1,2-Dichloroethene	<1.4	N/A	<1.4	N/A	<1.4	<1.2	<1.4	<1.1
Trichloroethene	<1.4	N/A	<1.4	N/A	<1.4	<1.2	<1.4	<1.1
Toluene	<1.4	<0.03	<1.4	<6	<1.4	66	29	34
Methylene Chloride	<1.7	<0.03	<1.6	<6	<1.6	<1.2	<1.6	<1.1
Xylenes (total)	30	N/A	1.8	N/A	<1.4	73	180	120

All results provided in mg/kg (part per million).
<# indicates not detected at laboratory detection limit.
Volatile organic analysis conducted by U.S. EPA SW-846 Methods 8240 or 8260.
N/A = Not Analyzed.
Only compounds detected are shown. Additional compounds sampled for not detected are provided in Volume 2 of The Basis of Design Report (Nov. 1995)
See Figure 2 for sample locations

Table 3. Soil and Groundwater Remedial Action Objectives (RAOs)

Media	Parameter	RAO
Soil	Total Volatile Organics Compounds (VOCs)	10 ppm
	Each individual VOC	1 ppm
	Total Semi-Volatile Organic Compounds (SVOCs)	500 ppm
	Each Individual SVOC	50 ppm
	Polychlorinated Biphenyls (PCBs)	10 ppm
Groundwater[(1)]	Trans-1,2-Dichloroethylene	5 ppb
	Trichloroethene (trichloroethylene)	5 ppb
	Vinyl Chloride	5 ppb
	Ethylbenzene	5 ppb
	Toluene	5 ppb
	Xylene	5 ppb
	PCBs	0.1 ppb

(1) = Other compounds, not listed, would have RAOs in compliance with NYSDEC Ambient Groundwater Quality Standards.

ppm = part per million

ppb = part per billion

Table 4. Groundwater Performance Monitoring Program Summary

Well	Water Bearing Zone	Rationale	Sampling Frequency	Analytical Parameters
NPLS Area and Off-site North Area				
MW-6	Shallow	Evaluate western extent of plume area near facility boundary.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-7S	Shallow	Evaluate eastern extent of plume area near facility boundary.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-12	Shallow	Evaluate western extent of plume area near facility boundary.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-14S	Shallow	Evaluate downgradient (off-site north) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-15S	Shallow	Evaluate downgradient (off-site north) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-25S	Shallow	Evaluate downgradient (off-site northeast) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-1S	Shallow	Evaluate groundwater extraction concentration	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-2S	Shallow	Evaluate groundwater extraction concentration	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-7D	Deep	Evaluate eastern extent of plume area near facility boundary.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-8	Deep	Evaluate western extent of plume area near facility boundary.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-14D	Deep	Evaluate downgradient (off-site north) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-15D	Deep	Evaluate downgradient (off-site north) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-16D	Deep	Evaluate downgradient (off-site north) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-19D	Deep	Evaluate downgradient (off-site east) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs

Well	Water Bearing Zone	Rationale	Sampling Frequency	Analytical Parameters
MW-21D	Deep	Evaluate downgradient (off-site northeast) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-22D	Deep	Evaluate downgradient (off-site northeast) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-25D	Deep	Evaluate downgradient (off-site northeast) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
VP-6D	Deep	Evaluate downgradient (off-site east) system effectiveness.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
PZ-7D	Deep	Evaluate downgradient (off-site east) system effectiveness	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
PZ-11D(2)	Deep	Evaluate downgradient (off-site east) system effectiveness	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-1D(2)	Deep	Evaluate groundwater extraction concentration	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-2D	Deep	Evaluate groundwater extraction concentration	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-6D *(Well operable Q1 2008)*	Deep	Evaluate groundwater extraction concentration.	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs
UST and UST/AST Areas				
MW-2	Shallow	Evaluate source area concentrations.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-3S	Shallow	Evaluate groundwater extraction concentration	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs
HW-6	Shallow	Evaluate shallow groundwater concentrations from UST Area plume	Water levels quarterly. Annual water quality	Constituents listed in Table 3 with groundwater RAOs
MW-20	Shallow	Evaluate downgradient plume concentrations (north of UST Area)	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-23S	Shallow	Evaluate source area concentrations.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs

Well	Water Bearing Zone	Rationale	Sampling Frequency	Analytical Parameters
MW-24S	Shallow	Evaluate source area concentrations.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-26S	Shallow	Evaluate downgradient plume concentrations (East UST Area)	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-27S	Shallow	Evaluate downgradient plume concentrations (East UST Area)	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-28S	Shallow	Evaluate downgradient plume concentrations (East UST Area)	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
MW-29S	Shallow	Evaluate source area concentrations.	Water levels quarterly. Annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-4S *(Well inoperable as of 11/02)*	Shallow	Evaluate groundwater extraction concentration	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs
RW-5S *(Well inoperable as of 11/02)*	Shallow	Evaluate groundwater extraction concentration	Water levels quarterly. Semi-annual water quality.	Constituents listed in Table 3 with groundwater RAOs

Notes:

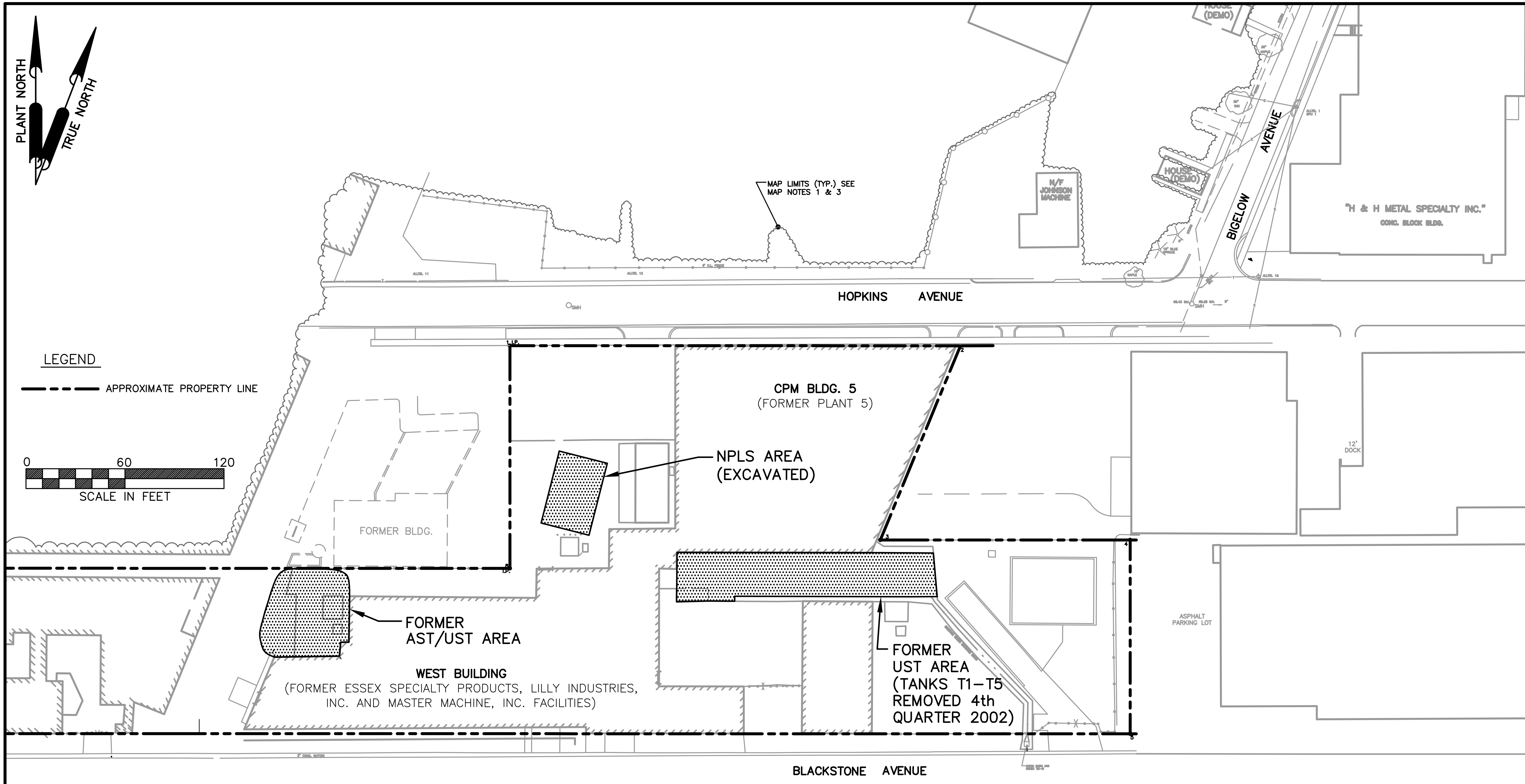
1. In addition to the performance monitoring wells listed above, all other existing monitoring wells will have quarterly groundwater levels taken to define capture zone geometry.
2. PZ-11D obstructed and samples unable to be retrieved from 2007. RW-1D removed from list.

Table 5. NPLS Area Confirmatory Soil Sampling Results for PCBs

Analyte	Sample ID and Depth									
	TB-1B (10-12ft)		TB-2C (11-12ft)		TB-2C (11-12ft) Duplicate		TB-3B (14-16ft)		TB-4 (12-13ft)	
	Conc (ppb)	QL (ppb)	Conc (ppb)	QL (ppb)	Conc (ppb)	QL (ppb)	Conc (ppb)	QL (ppb)	Conc (ppb)	QL (ppb)
Arochlor-1016	ND	40	ND	420	ND	41	ND	42	ND	400
Arochlor-1221	ND	80	ND	840	ND	82	ND	84	ND	400
Arochlor-1232	ND	40	ND	420	ND	41	ND	42	ND	400
Arochlor-1242	ND	40	ND	420	ND	41	ND	42	ND	400
Arochlor-1242	ND	40	ND	420	ND	41	ND	42	ND	400
Arochlor-1254	ND	40	1340	420	335	41	267	42	1400	400
Arochlor-1260	ND	40	ND	420	ND	41	ND	42	ND	400
ND = not detected QL = quantitation limit										

See Figure 1 for sampling locations.

FIGURES



MAP REFERENCE AND CONTROL NOTES:

1. BASE MAPPING INCLUDING THE LOCATIONS OF SOME OF THE BUILDINGS, ROADS, CURBS/SIDEWALKS, FENCING, PAVED AREAS, ALL UTILITIES (UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE), AND PROPERTY BOUNDARY WAS PROVIDED BY MICHAEL J. RODGERS AND ASSOCIATES, LAND SURVEYORS, BEMUS POINT, NEW YORK, N.Y.S. LICENSE No. 49232. THE BASE MAP WAS A SEPIA HARD COPY AT A SCALE OF 1"=20', DATED APRIL 15, 1992, LAST REVISION DATE MARCH 10, 1993. RECOVERY WELLS, SPARGE WELLS, AND SVE WELLS WERE SURVEYED AUGUST, 1997. MONITORING WELLS IN THE VICINITY OF THE REMEDIAL ACTION CONSTRUCTION WERE SURVEYED AUGUST, 1997, OTHER MONITORING WELLS WERE EITHER PART OF THE APRIL, 1992 MAP/SURVEY OR NOT SURVEYED AT ALL. SEE MONITORING WELL TABLE AND MONITORING WELL NOTES FOR MORE INFORMATION. COORDINATE INFORMATION SHOWN AT THE BUILDING CORNERS CAME FROM THE MICHAEL J. ROGERS SURVEY DONE ON JANUARY 9, 1998. ALL OTHER BUILDING CORNERS ARE APPROXIMATE. THE SITE AREA BEYOND THE 1998 SURVEY WAS MAPPED BY URS CORPORATION IN AUGUST 2006. THIS MAPPING USED THE SAME VERTICAL AND HORIZONTAL REFERENCE DATA AS THE PREVIOUS SURVEY. THE MAPPING WAS MERGED WITH THE 1998 DATA TO PRODUCE A COMPOSITE SITE BASE MAP. THE LIMITS OF THE COMPOSITE SURVEY MAP ARE SHOWN ON THE DRAWING. SEE MAP REFERENCE 3.

2. VERTICAL BENCH MARK INFORMATION CAME FROM U.S.G.S. PLAQUE U–88–S.E. ABUTT. ERIE R.R. BRIDGE OVER BUFFALO ST., ELEV.=1296.034 (NATIONAL GEODETIC VERTICAL DATUM, 1929).
HORIZONTAL COORDINATES PROVIDED FOR THE MONITORING WELLS AND THE PROPERTY CORNERS ARE BASED ON A LOCAL GRID ESTABLISHED BY THE SURVEYOR. N10000, E10000 IS A PK NAIL SET IN THE CONCRETE CURB/GUTTER AND IS PART OF THE ORIGINAL TRAVERSE. IRON STAKES WERE SET AT THE PROPERTY CORNERS.

3. AREAS OUTSIDE OF CLOUD LINE: PROPERTY LINES AND MAPPING ADJACENT TO BIGELOW AVENUE, NORTH & SOUTH OF HOPKINS AVENUE & EAST OF BIGELOW AVENUE, AND SOUTH OF BLACKSTONE AVENUE WERE TAKEN FROM A VARIETY OF SOURCES INCLUDING SEPIA MYLAR SITE MAP (SEE REFERENCE 1), USGS 7.5 MINUTE TOPOGRAPHIC MAP – JAMESTOWN, NY, CITY OF JAMESTOWN TAX MAP RECORDS, AND URS FIELD RECONAISSANCE. LOCATIONS AND DIMENSIONS IN THESE AREAS ARE APPROXIMATE.

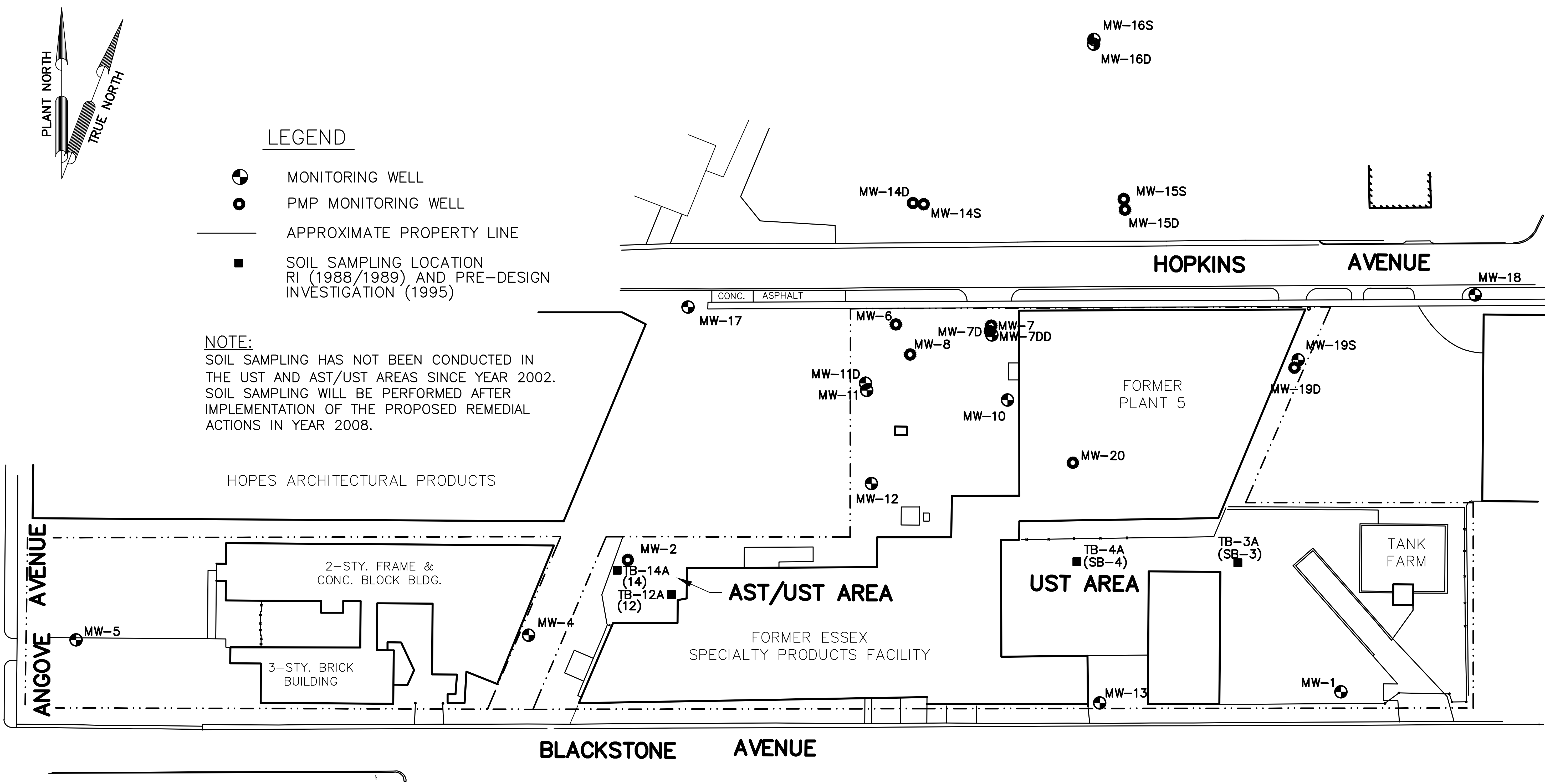
FILE: \ESSEXHOP\2011–OandM\FIGURE–1n5–AUG–2006–MAP

URS

PITTSBURGH, PENNSYLVANIA

PERFORMANCE MONITORING PLAN
SITE PLAN INDICATING REMEDIAL ACTION AREAS

ESSEX/HOPE SITE	JAMESTOWN, NY
CLIENT: ESSEX SPECIALTY PRODUCTS, INC.	JOB NUMBER: 41569831
SCALE: AS SHOWN	FIGURE NUMBER 1 — REV 0



FILE: \ESSEXHOP\2011-PMP-OandM\FIGURE-2

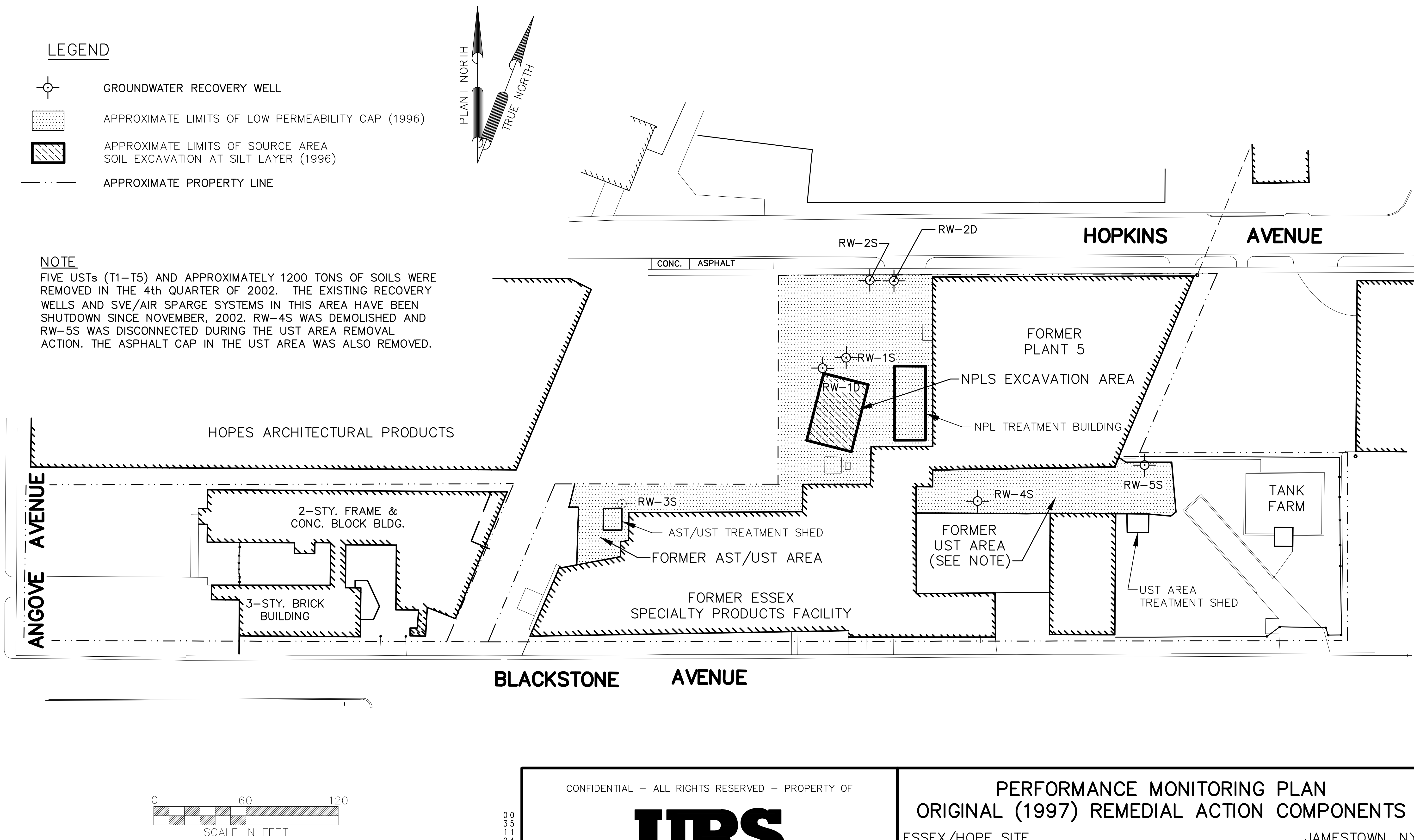
00311971048KKGG

URS

PITTSBURGH, PENNSYLVANIA

PERFORMANCE MONITORING PLAN
PRE-DESIGN MONITORING WELL & SOIL SAMPLING LOCATIONS

ESSEX/HOPE SITE	JAMESTOWN, NY
CLIENT: ESSEX SPECIALTY PRODUCTS, INC.	JOB NUMBER: 41569831
SCALE: AS SHOWN	FIGURE NUMBER 2 — REV 0



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URS

PITTSBURGH, PENNSYLVANIA

PERFORMANCE MONITORING PLAN
ORIGINAL (1997) REMEDIAL ACTION COMPONENTS

ESSEX/HOPE SITE — JAMESTOWN, NY

CLIENT: ESSEX SPECIALTY PRODUCTS, INC. — JOB NUMBER: 41569831

SCALE: AS SHOWN — FIGURE NUMBER 3 — REV 0

FILE: J:\ESSEXHOP\2014-PMP-OandM\FIGURE-4

FIGURE 4

PERFORMANCE MONITORING SCHEDULE

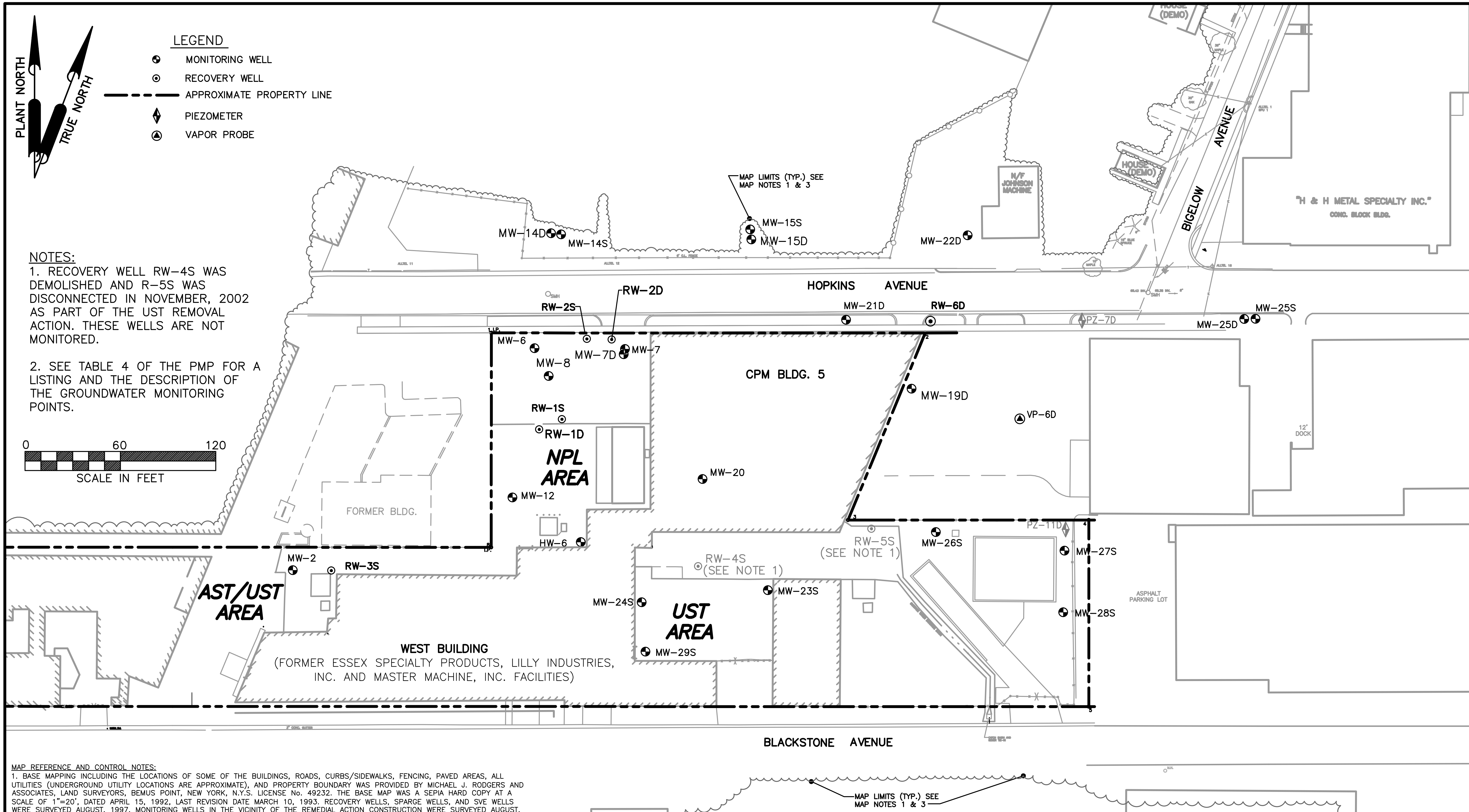
ACTIVITY	CALENDAR YEAR					
	1997	1998–2003	2004–2013	2014	2015	2016
SYSTEM PROVE OUT (AUGUST)	▲					
SYSTEM START UP (SEPTEMBER)	▲					
RECOVERY WELL SAMPLING AND MONITORING WELL WATER LEVEL MEASUREMENT	B ●	(QUARTERLY)	(SEMI–ANNUALLY)	Q2 ● Q4 ●	Q1 ● Q3 ●	Q2 ● Q4 ●
PERFORMANCE MONITORING WELL GROUNDWATER SAMPLING (ANNUALLY)	B	(ANNUALLY)	(ANNUALLY)	●	●	●
UST AND FORMER AST/UST SOIL SAMPLING (ANNUALLY) SEE NOTE		(ANNUALLY)	(NO SAMPLING)	●	●	●
ANNUAL PERFORMANCE MONITORING REPORT SUBMITTAL (Q1)		(ANNUALLY)	(ANNUALLY)	R	R	R R

LEGEND

- ● – SAMPLING EVENT
- **B** – BASELINE SAMPLING
- **R** – ANNUAL REPORT SUBMITTAL

NOTE:

1.) CONFIRMATORY SOIL SAMPLING IN A GIVEN AREA WILL BE CONDUCTED UPON ACHIEVING RAOS FOR SOIL DURING AN ANNUAL SAMPLING EVENT OR UPON A SIGNIFICANT REDUCTION IN VOC EMISSIONS FROM THE SVE UNIT AS DESCRIBED IN SECTION 2.2.2 OF THE PERFORMANCE MONITORING PLAN. SOIL SAMPLING IN THE UST AND AST/UST AREAS WILL BE PERFORMED CONTINGENT ON THE RESULTS OF THE REMEDIAL ACTIONS IN THE UST AREA.



NOTES:

1. RECOVERY WELL RW-4S WAS DEMOLISHED AND R-5S WAS DISCONNECTED IN NOVEMBER, 2002 AS PART OF THE UST REMOVAL ACTION. THESE WELLS ARE NOT MONITORED.

2. SEE TABLE 4 OF THE PMP FOR A LISTING AND THE DESCRIPTION OF THE GROUNDWATER MONITORING POINTS.

MAP REFERENCE AND CONTROL NOTES:

1. BASE MAPPING INCLUDING THE LOCATIONS OF SOME OF THE BUILDINGS, ROADS, CURBS/SIDEWALKS, FENCING, PAVED AREAS, ALL UTILITIES (UNDERGROUND UTILITY LOCATIONS ARE APPROXIMATE), AND PROPERTY BOUNDARY WAS PROVIDED BY MICHAEL J. RODGERS AND ASSOCIATES, LAND SURVEYORS, BEMUS POINT, NEW YORK, N.Y.S. LICENSE No. 49232. THE BASE MAP WAS A SEPIA HARD COPY AT A SCALE OF 1"=20', DATED APRIL 15, 1992, LAST REVISION DATE MARCH 10, 1993. RECOVERY WELLS, SPARGE WELLS, AND SVE WELLS WERE SURVEYED AUGUST, 1997. MONITORING WELLS IN THE VICINITY OF THE REMEDIAL ACTION CONSTRUCTION WERE SURVEYED AUGUST, 1997, OTHER MONITORING WELLS WERE EITHER PART OF THE APRIL, 1992 MAP/SURVEY OR NOT SURVEYED AT ALL. SEE MONITORING WELL TABLE AND MONITORING WELL NOTES FOR MORE INFORMATION. COORDINATE INFORMATION SHOWN AT THE BUILDING CORNERS CAME FROM THE MICHAEL J. ROGERS SURVEY DONE ON JANUARY 9, 1998. ALL OTHER BUILDING CORNERS ARE APPROXIMATE. THE SITE AREA BEYOND THE 1998 SURVEY WAS MAPPED BY URS CORPORATION IN AUGUST 2006. THIS MAPPING USED THE SAME VERTICAL AND HORIZONTAL REFERENCE DATA AS THE PREVIOUS SURVEY. THE MAPPING WAS MERGED WITH THE 1998 DATA TO PRODUCE A COMPOSITE SITE BASE MAP. THE LIMITS OF THE COMPOSITE SURVEY MAP ARE SHOWN ON THE DRAWING. SEE MAP REFERENCE 3.

2. VERTICAL BENCH MARK INFORMATION CAME FROM U.S.G.S. PLAQUE U-88-S.E. ABUTT. ERIE R.R. BRIDGE OVER BUFFALO ST., ELEV.=1296.034 (NATIONAL GEODETIC VERTICAL DATUM, 1929).
HORIZONTAL COORDINATES PROVIDED FOR THE MONITORING WELLS AND THE PROPERTY CORNERS ARE BASED ON A LOCAL GRID ESTABLISHED BY THE SURVEYOR. N10000, E10000 IS A PK NAIL SET IN THE CONCRETE CURB/GUTTER AND IS PART OF THE ORIGINAL TRAVERSE. IRON STAKES WERE SET AT THE PROPERTY CORNERS.

3. AREAS OUTSIDE OF CLOUD LINE: PROPERTY LINES AND MAPPING ADJACENT TO BIGELOW AVENUE, NORTH & SOUTH OF HOPKINS AVENUE & EAST OF BIGELOW AVENUE, AND SOUTH OF BLACKSTONE AVENUE WERE TAKEN FROM A VARIETY OF SOURCES INCLUDING SEPIA MYLAR SITE MAP (SEE REFERENCE 1), USGS 7.5 MINUTE TOPOGRAPHIC MAP – JAMESTOWN, NY, CITY OF JAMESTOWN TAX MAP RECORDS, AND URS FIELD RECONAISSANCE. LOCATIONS AND DIMENSIONS IN THESE AREAS ARE APPROXIMATE.

FILE: \ESSEXHOP\2014-PMP-OandM\FIGURE-5-AUG-2006-MAP

URS

PITTSBURGH, PENNSYLVANIA

PERFORMANCE MONITORING PLAN
GROUNDWATER MONITORING POINTS

ESSEX/HOPE SITE — JAMESTOWN, NY

CLIENT: ESSEX SPECIALTY PRODUCTS, INC.		JOB NUMBER: 41569831	
SCALE: AS SHOWN	FIGURE NUMBER 5		REV 0