REPORT

Remedial Design Package

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1. Introduction

This Remedial Design (RD) Package has been prepared by Blasland, Bouck & Lee, Inc. (BBL) on behalf of Universal Instruments Corporation (Universal) for the former Dover Electronics Site in Kirkwood, Broome County, New York (Site Number 7-04-026). This document provides the remedial design information that was specified in the *Remedial Design Work Plan* submitted to the New York State Department of Environmental Conservation (NYSDEC) on June 20, 2001 in accordance with the executed Order on Consent between Universal and the NYSDEC, dated January 19, 2001.

1.1 Purpose

This document summarizes the objectives for site remediation and provides detailed descriptions for implementation of the remedial action as described in the *Pre-Design Report* (BBL, February 2003). As discussed in the *Pre-Design Report*, the remedial action to address tetrachloroethene (PCE) affected soils will consist of removing accessible soil "hotspots", extension of the Northwest Catch Basin outfall, installation and operation of an active slab depressurization (ASD) system, and abandonment and replacement of the roof drain leaders from the original Kirkwood North facility building. Also included and/or discussed in the RD Package are the Operation & Maintenance (O&M) Program, site-specific Health and Safety Plan, and Citizen Participation Plan.

The remainder of this report is organized into the following sections:

- Section 2 - Scope of Work – Material and Performance Specifications
- Section 3 - Operation & Maintenance Program
- Section 4 - Health and Safety Plan
- Section 5 - Citizen Participation Plan

Section 2 contains the technical specifications for the excavation of the accessible soils from seven separate excavation areas, extension of the stormwater outfall, installation of the ASD system, and the abandonment and replacement of roof drain leaders. Section 3 presents the O&M Program, which describes the indoor air and stormwater sampling procedures and frequency for assessing the effectiveness of the ASD system and the effort to eliminate the PCE migration pathway along former roof drain leader lines. The site-specific Health and Safety Plan is included as Section 4 and has been revised to include the new remediation tasks so that persons at and in the vicinity of the site during remedial action construction work and during the O&M phase of the remedial action will be protected. Section 5 contains the Citizen Participation Plan for the facility that will be used during the design and construction phases of the remedial program.

1.2 Location, Background, and Description of Work

The former Dover Electronics facility is located at 29 Industrial Park Drive, Kirkwood, Broome County, New York. The facility is located on a site approximately 9.58 acres in size. A site location map is shown on Figure 1 and Figure 2 (oversized drawing in pocket at rear of Figure section) is the site plan.

The property is situated in an industrial setting. Major plants in the area include; Truckstops of America Landfill (0.5 mile southeast), Frito Lay Plant (0.5 mile south), Universal Instruments (147 Industrial Park Drive, 0.5 mile east), Kason Industries (eastern property boundary), Consolidated Freightways (northern property boundary), and the newly developed Pilot Truck Stop to the south. Industrial properties surround the property on north, east, and west. The property consists of an industrial building with areas outside and inside used for drum and chemical storage. The site presently serves as one of Universal Instruments' service facilities with the site's uses including product training, research and development, and Odd Form Assembly (OFA), which involves the engineering and assembly of non-standard/specialty circuit boards.

The facility was first constructed in 1973, with subsequent additions built in 1978, 1982, and 1984. It has been occupied by Universal Instruments and Dover Electronics. In 1993, Dover Electronics was renamed Dovatron, Inc. (Dovatron). In 1995, Dovatron transferred its title to the facility to Universal Instruments. In 1996, Dovatron changed its name to the DII Group. Later the DII Group sold to Flextronics International, Inc. and Universal Instruments became a wholly-owned subsidiary to Dover Corporation. The site currently serves as a service facility for Universal Instruments. The facility has reportedly been used for electronic circuit board manufacturing since 1973.

Previous circuit board manufacturing processes used PCE as a cleaning solvent. Originally, the virgin PCE was stored in 55-gallon drums at an outside drum storage area. During the initial facility expansion, a ramp to the east-side overhead door served as the entry point for PCE drums. As production increased and the facility was again expanded, virgin PCE was stored in a 3,000-gallon aboveground storage tank that has since been removed. An aboveground 5,000-gallon waste PCE flux storage tank was also located on the site. In March 1992, a 10,000-gallon fuel oil tank was reportedly removed from the site, and in March 1993, the aboveground PCE system was dismantled. Two 480-gallon PCE tanks were reportedly dismantled and removed from the building interior at that time. Historical handling and use of PCE has resulted in its documented presence in the soil, stormwater, and groundwater at this site.

The remedial action for soils consists of:

- Excavation of accessible soil "hotspots" at the rear and front of the facility;
- Extension of the Northwest Catch Basin (CB-1547) outfall beyond the initial drainage swale;
- Installation and operation of an active slab depressurization system (ASD) to inhibit the migration of VOC vapors into the facility building; and
- Abandonment and replacement of the roof drain leaders from the original facility building that extend beneath the 1982 building addition.

1.3 Goals

As stated in the *Remedial Design Work Plan* (BBL, 2001), the goals of the soil remedial program at the former Dover Electronics Site are to meet relevant NYSDEC's Standards, Criteria, and Guidance (SCGs) and to be protective of human health and the environment. Specifically, the goals selected for this site for the soils operable unit, as described in the ROD, are:

- to reduce, control, or eliminate, to the extent practicable, the constituents of concern (COCs) present in the subsurface soils at the site;
- to reduce, control, or eliminate, to the extent practicable, the continued migration of impacted stormwater from the site;
- to eliminate, to the extent practicable, exceedances of applicable environmental quality standards related to stormwater;

- to reduce, control, or eliminate, to the extent practicable, the source of the contamination that has been detected in the indoor air samples; and

- to protect human health and the environment through implementation, operation, and monitoring of the remedial program

To meet these goals through the proper application of scientific and engineering principles, the following objectives have been established for the remedial action:

- Excavate and dispose of adversely affected and accessible soils;

- Implement an institutional and engineering control for inaccessible soils until such future time when these soils become accessible and can be addressed;

- Extend the outfall of the Northwest Catch Basin beyond the initial drainage swale to prevent further migration of COCs through soil to groundwater;

- Redirect the present route of stormwater flow from the roof of the original building by abandoning the current roof drain leaders and replacing them;

- Install and operate an ASD system to inhibit migration of VOC vapors emanating from PCE-affected soils beneath the facility floor slabs in the 1978, 1982, and 1984 building additions; and

- Protect human health and the environment through implementation, operation, and monitoring of the remedial program.

2. Scope of Work – Material and Performance Specifications

The scope of work to be performed entails the implementation of the remedial action for PCE-affected soils in the unsaturated zone beneath and adjacent to the facility building at the site. The remedial action work will include:

- Abandonment and replacement of the roof leader from the roof drain system that handles stormwater runoff from the front part of the roof for the original building section of the facility;
- Removal of specified soil from seven separate excavations (see Table 1);
- Off-site transportation and disposal of non-hazardous and possible hazardous soil excavated;
- Extension of the stormwater outfall from the southwest catch basin (CB-1547);
- Restoration of excavated areas using compacted certified clean fill;
- Installation of an active slab depressurization system; and
- Implementation of a deed notice for soils beneath the 1978, 1982, and 1984 building additions at Universal's Kirkwood North facility.

Prior to the commencement of work, the areas of work will be photographed to document pre-existing surface conditions at the site.

2.1 Applicable Remedial Standards

The remedial criteria applicable to this soil remedial action are found in the NYSDEC's *Soil Cleanup Objectives to Protect Groundwater Quality*, dated January 24, 1994 (TAGM #4046) and the *Response to Comments Relative to the 12/20/00 Soil Cleanup Consolidation Memo*, dated April 10, 2001. Other relevant criteria for managing wastes generated during remedial activity include the Resource Conservation and Recovery Act (RCRA) hazardous characteristics. The RCRA characteristics analyses (ignitability, corrosivity, reactivity, and Toxicity Characteristic Leaching Procedure [TCLP]) will be used for waste profiling, waste characterization, and waste disposal activities.

2.2 Mobilization

2.2.1 Site Preparation, Decontamination, and Spill Control

During the site preparation, temporary decontamination areas will be constructed for use throughout the duration of the excavation and restoration phases of the project. These areas will be used to contain contaminated material to the designated work area. The decontamination areas will be located to the front and rear of the facility as shown on Figure 3.

2.2.2 Utility Location

Underground and overhead utility lines will be identified in these areas before excavation and will be avoided to practical extent. Underground utilities and structures are known to run through three excavation areas (Excavations A, B, and D). The backfill and bedding for these utility lines are the targets of the soil removal activities at these locations. The utilities and structures are not intended to be removed or replaced, if practical, so care will be exercised during excavation work so that the utilities are not damaged.

2.2.3 Pre-Excavation Survey

Prior to the start of work, a survey of the proposed excavation areas will be performed by tape and transit measuring. The corners of each excavation will be marked with a stake and flagging tape or by spray painting a mark on an asphalt surface. The survey will be used in conjunction with a post-excavation survey to determine the actual extent of the excavations and to calculate final removal volumes.

2.2.4 Site Security

Site security will be maintained throughout the duration of the project. Personnel and equipment entering and leaving the work zone will be controlled. Measures to prevent access to the excavation/work area until the completion of the project will be implemented. Fencing will be installed and signs posted around excavation areas to restrict access to active work areas and when work has been stopped or during nighttime hours.

2.3 Dust Control

The project site will be maintained so as to minimize the creation and dispersion of fugitive dust. The program for suppressing fugitive dust and monitoring particulate matter will follow NYSDEC's *Technical And Administrative Guidance Memorandum #4031: Fugitive Dust Suppression and Particulate Monitoring Program At Inactive Hazardous Waste Sites.* (TAGM #4031). Dust control measures will be used throughout the course of the site work, as warranted. These measures will include:

- *Applying water to roadways and work area, as needed* – The water used for dust suppression will be free of oil and other deleterious materials. Standing water and collected rainwater may be used for dust control on areas within the active excavation areas, provided runoff is contained within the areas; and
- *Covering stockpiles with plastic sheeting* – The stockpile coverings will be properly overlapped and secured to prevent the plastic sheeting from being dislodged by high winds and rain.

Dust emissions will be visually monitored throughout the period of work. Particulate monitoring for fugitive dust will be performed using real-time particulate monitors that will have automatic alarms and will detect particulate matter less than 10 microns in diameter. Fugitive dust controls will immediately be implemented if conditions warrant.

2.4 Soil Excavation

An approximate planned total of 570 cubic yards will be excavated from seven areas of the facility (see Figures 4 and 5). Excavation A will be a 6-foot-wide by 50-foot-long area located from below the discharge point of the southwest catch basin (CB-1547) outfall and the juncture with the drainage swale along the east side of Colesville Road. This excavation area will be between 2 and 4 feet in depth. Excavation A-1 will be a 5-foot by 5-foot area, 4 feet in depth. A-1 will be located at the former Trench 1 area outside the front employee entrance to the facility. Excavation B will be a 15-foot-wide by 50-foot-long area located along the southeast side of the 1984 building addition at the rear of the facility. Excavations C and D are located to the northwest and east of Excavation B, respectively, and will address residual PCE-affected soils found in test trenches (18 and 8, respectively) that were dug during the remedial investigation (Shield, 2000). Excavation E is located at the former drum storage shed area and will have approximate dimensions of 10 feet wide by 15 feet long by 4 feet deep.

Table 1 shows the proposed depths, areas, and volumes of the excavation areas, which are also shown on Figures 4 and 5.

Table 1. Proposed Depths, Areas, and Volumes at Excavation Areas

Excavation ID	*Location ID*	*Proposed Excavation Depth*	*Approximate Areal Extent*	*Approximate Excavation Perimeter*	*Approximate Volume*
A	CB-1547 Outfall Area	4 ft	300 ft^2	112 ft	45 yd^3
A-1	Trench 1	4 ft	25 ft^2	20 ft	5 yd^3
B	Trench 11	6 ft	750 ft^2	130 ft	170 yd^3
C	Trench 18	5-8 ft	750 ft^2	130 ft	170 yd^3
D	Trench 8	10 ft	300 ft^2	80 ft	110 yd^3
E	Drum Storage	4 ft	150 ft^2	50 ft	25 yd^3
F	CB-2044	7 ft	120 ft^2	42 ft	45 yd^3
				Total	570 yd^3
				Contingency Factor (15%)	85 yd^3
				Total Excavation Volume (rounded)	**655 yd^3**

The top 3 to 4 feet of soil at excavation areas B and the top 6 feet at excavation area D are anticipated to be clean and suitable for re-use as backfill. This soil will be stockpiled separately from soils excavated from below this depth. Soils excavated from deeper than 3 feet will be field screened. Soils from deeper than 3 feet that do not show evidence of contamination will be segregated separately from soils that do show evidence of contamination. Photoionization detectors (PID) equipped with a 10.6 eV lamps will be used to screen the excavated soil. The remaining soil from 3 to 6 feet below ground surface (bgs) is presumed to be affected by COCs, and will be segregated and stockpiled separately from other excavated soil.

2.4.1 Soil Removal Methods

All soil will be removed by means and methods proposed by the contractor. Hand digging may be required to avoid damaging underground utilities. All excavated material will be handled as potentially contaminated material. All excavated material will be staged onto a minimum of two 10-mil thick liners and be covered by two layers of 6-mil thick plastic (see Section 2.5.3). The plastic cover will be maintained to prevent rainfall infiltration of the stockpiled soil and contaminated runoff from the staging area.

Excavation B will be dug in two stages to preserve the structural stability of the building. The excavated area will not extend more than 25 feet along the building wall at any one time. Once the southern section of Excavation B is completed, it will be backfilled in a stepwise manner as described in Section 2.8 before proceeding on to the excavation of the second section. Similarly, the second section will be backfilled at completion. The northwest wall of Excavation B will extend vertically to the base of the building footing, and then proceed with a 1:1 slope for the remainder of the excavation depth.

To preserve the integrity of County Route 181, the east wall of Excavation C will extend vertically to the base of the asphalt and continue with a 1:1 slope for the remainder of the excavation depth. All other walls of the excavation areas will extend vertically for the full depth.

2.4.2 Stockpiling

Separate stockpiles of excavated soils will be maintained for the clean overburden soils and the deeper COC-affected soils. Both soil-types will be stockpiled within areas with approximate dimensions of 30 feet by 100 feet. These areas will be diked and lined with two layers of 10-mil polyethylene sheeting. They will be located at the former drum storage shed area. Stockpiled soils will be covered with plastic to mitigate VOC vapor emissions and wind erosion. Figure 3 shows the proposed soil stockpile locations.

2.4.3 Waste Classification Sampling

The stockpiles will be characterized for waste classification to satisfy the NYSDEC's requirements for determining hazardous waste. The waste classification samples will be analyzed for NYSDEC Analytical Services Protocol (ASP) VOCs and RCRA metals using the TCLP analysis method. The sampling results will also be used to satisfy selected TSD facility requirements. Additional parameters may be analyzed if required by the TSD facility.

Soil stockpile samples will be collected following the guidance in the NYSDEC's *STARS Memo #1* (Section VI (b)). The number of samples to be collected is estimated as follows (based on assumed stockpile volumes of 160 cubic yards of surface soil and 400 cubic yards of deeper soil):

- For the "Clean Overburden" Stockpile – four grab samples (VOC analysis) and four composite samples (RCRA Metals analysis) with the composite samples consisting of four subsamples collected from each quarter of the subdivided stockpile for metals so that each quarter of the stockpile to produces one metals composite; and
- For the "Deeper Soil" Stockpile – eight grab samples (VOC analysis) and eight composite samples (RCRA Metals analysis) with the composite samples consisting of four subsamples collected from each quarter of the subdivided stockpile for metals so that each quarter of the stockpile to produce one metals composite.

Composite samples, for both VOC and metals analysis, will be collected as discrete grab samples in the field with the compositing procedure performed at the laboratory assigned to perform the TCLP analyses.

Soil that fails toxic characteristic analyses, such as the TCLP, will be classified as hazardous. Soils that pass toxic characteristic analyses but exceed NYSDEC soil cleanup objectives and levels (TAGM # 4046, *Determination of Soil Cleanup Objectives and Cleanup Levels*, Tables 1 and 2) will be classified as non-hazardous. Soils that do not exceed the contaminant concentrations listed in TAGM #4046 will be classified as clean.

2.4.4 Post-Excavation Sampling

Once field personnel have determined through field assessment that the excavation limits are sufficient for the remediation objectives, post-excavation soil samples will be collected using the frequency and location guidance found in NYSDEC's *Draft DER-10, Technical Guidance for Site Investigation and Remediation* (Section 5.4 Remedial Action Performance Compliance, (a)2, dated December 2002) as a minimum[1]. All post-excavation soil samples will be collected as grab samples. Sidewall samples will be collected from the excavation sidewalls at a depth interval coincident with 0 to 6 inches above the excavation base at a frequency of 1 per 15 feet (1 per sidewall minimum). Bottom post-excavation samples will be collected at 10-foot intervals along the central long-axis of each excavation. Excavations with a long-axis length of less than 20 feet will have one bottom sample collected.

The post-excavation sample locations will be biased based on field judgement, towards sidewall and bottom areas that are suspected to most likely contain residual contamination (NYSDEC, at its discretion, may collect split samples and/or sample the base of the excavations during post-excavation sampling). Table 2 below summarizes where a maximum of 63 post-excavation samples will be collected from in each excavation area:

Table 2. Post-Excavation Sampling

Excavation ID	*Number of Samples Bottom/Sidewall*	*Sample Prefix*
Excavation A	2/6	PX-A
Excavation A-1	1/4	PX-A1
Excavation B	3/12	PX-B
Excavation C	3/12	PX-C
Excavation D	2/6	PX-D
Excavation E	1/4	PX-E
Excavation F	1/6	PX-F

Verification post-excavation samples will be collected as undisturbed grab samples and will analyzed off site by a New York State-certified laboratory for VOC SSPL analysis using United States Environmental Protection Agency (USEPA) Method 8260 to assess compliance with New York State groundwater protection requirements (NYSDEC, *TAGM #4046*, 1994). The turnaround time for preliminary laboratory results will be 48-hours.

The excavations will be deemed suitable for closing when both soil sidewall and bottom sample analytical results for COCs do not exceed the NYSDEC standards for impact to groundwater, or when a physical impediment, such as a building foundation or road, is encountered. Table 3 below lists the site COCs and their respective soil cleanup concentrations as specified in TAGM #4046.

[1] Section 5.4 (a)2 states that for subsurface releases and excavations 20 to 300 feet in perimeter; the post-excavation sampling frequency shall be one sidewall sample from each wall for every 30 linear feet of sidewall and one bottom sample for every 900 square feet of excavation. This section further states that sidewall samples shall be collected from the base of the sidewall.

Table 3. Contaminants of Concern

COC	*Soil Cleanup Criteria*
Trichloroethene (TCE)	700 μg/kg
Tetrachloroethene (PCE)	1,400 μg/kg

2.4.5 Post-Excavation Survey

A New York State-licensed surveyor will survey the final excavation perimeter boundaries in order to record the precise locations on the base map of the area of concern. Excavation depths will be estimated using a graduated pole or staff. The locations and depths of collected post-excavation samples will be field documented using a tape measure and fixed site features. Surveying techniques will be based on generally accepted engineering practices and New York State requirements.

2.5 Disposition of Generated Material

Soil classified as hazardous waste, if any, will be loaded and transported off site for disposal. Non-hazardous soil will also be transported offsite for treatment or disposal. Excavated soil that has been classified as clean will be retained on site for re-use as backfill material.

2.6 Soil Loading, Transportation, and Off-Site Disposal

The protocols for the loading and transport of hazardous and non-hazardous soil generated during the remediation are described in the following sections.

2.6.1 Vehicle Loading

The dump trailer, truck bed, or roll off box will be equipped with a watertight liner (6 mil minimum thickness polyethylene sheeting) prior to placing the excavated soils onto the transport vehicle. The plastic liner will cover the bottom and sidewalls of the dump trailer, truck bed, or roll off box such that the edges of the liner can be folded over the soil after the vehicle has been loaded. All transport vehicles will be equipped with watertight tarps or covers. Soils that temporarily accumulate in roll off boxes or staging areas prior to off-site transportation and disposal will be covered by a tarp, synthetic liner, or other appropriate cover.

All loading will be done in a manner to avoid incidental spillage of soil during movement outside the work area. In the case of any incidental spillage, the spilled soil will be recovered, and any contaminated soil removed. The soil should not mound above the side rails of the dump trailer or bed, and should be distributed evenly throughout the transport vehicle to avoid load shifting during transport.

Soil loading into trucks will occur on an asphalt-paved surface covered with a 40-mil thick liner so that any soil dropped or spilled during loading will not come in contact with a clean native ground surface. Soil spilled on the plastic will be removed with mechanical buckets, shovels, and/or brooms, as appropriate, and be placed back in the soil stockpile from which it was taken.

All soil transportation vehicles will be decontaminated prior to exiting the project site. This procedure will consist of pressure washing or steam cleaning the transport vehicles at a vehicle decontamination station.

Decontamination will focus on the tires, undercarriages, and side rails of the transport vehicle. All vehicle decontamination rinsates will be removed from the vehicle decontamination station as needed to prevent overflow of the removal sump. Vehicle decontamination rinsates will be managed as contaminated liquids, including drumming, labeling, and staging.

The vehicle/equipment/personnel decontamination areas will be located within the site parking lots where the excavated soils are to be stockpiled and where vehicle loading will be performed. The decontamination area for Excavation "A" will be located at the start of the second tier in the front parking area below the stockpile/loading area. The decontamination area for Excavations "B", "C", "D", and "E" will be located next to the soil stockpile loading area and just below Excavation "E" (see Figure 3).

Within this decontamination area, separate zones will be set up for decontamination of vehicles, equipment, and personnel so that workers not directly involved with vehicle loading and decontamination are not mixed with vehicles that are being decontaminated. The decontamination area will consist of a bermed area lined with at least a 100-mil thick synthetic liner with ingress/egress points for vehicles (rounded berms to allow for vehicle traffic).

2.6.2 Vehicle Departure

After the loading is complete, the load will be covered and the vehicle inspected. The vehicle inspection will include:

- Freeboard (i.e., soil not mounded above the side rails of the sump trailer or bed);
- Proper closure and locking of the tailgate;
- Cleanliness of the transport vehicle, with particular emphasis on the tires, undercarriage, and side rails of the vehicle;
- Security of the tarp over the dump trailer or bed; and
- Appropriate federal and state labeling and placarding.

The inspection will be documented in an inspection checklist, which will provide space for a signature and comments or notations.

2.6.3 Bills of Lading and Manifests

A bill of lading will be prepared and completed for all non-hazardous waste transport vehicles prior to departing the project site. At least one copy of the completed bill of lading will be retained by the contractor and made part of the project records. One complete copy will also be provided to Universal. The original and any copies not retained by the contractor or Universal will be provided to the driver prior to departure. The disposal of non-hazardous waste will be confirmed with load and time tickets prepared by the disposal facility and submitted to Universal. Universal will be informed on a daily basis of the number of loads and total weight shipped off site.

A hazardous waste manifest will be prepared for all hazardous waste to be transported off site. Waste will be measured by weight. Complete copies of manifests will be provided to Universal prior to the vehicle leaving the site.

All bills of lading and hazardous waste manifests will be retained as part of the project records. Copies of hazardous waste manifests and bills of lading will be included in an Appendix to the Final Remediation Certification Report.

2.7 Earthwork

Once the post-excavation results have shown that no additional soil will need to be excavated and a post-excavation sample location survey has been completed, the excavation areas will be filled in with clean fill and the upper non-contaminated soils from the site. The excavation areas will be graded to approximately pre-excavation conditions.

2.7.1 Foundation Preparation

The foundation for the fill will be prepared by leveling the excavation base as best as is practical and having the first layer of fill leveled and rolled so that the surface materials of the foundation will be as compact and well-bonded with the subsequent layers of fill. All areas to be backfilled will be proof-rolled.

Any areas that are noted to pump, deflect, or be unsuitably soft will be excavated and replaced with suitable material or stabilized by other means. Backfill will not be placed on peat, sludge, marsh deposits, topsoil, or any other organic or compressible strata, or on a frozen subgrade. The areas where fill will be placed will be clean and free of debris or standing water, ice, frozen ground, or soft zones.

Prior to backfilling, Area A will have a 6 mil polyethylene impermeable liner placed along the length of the excavation base to prevent oxygen-rich surface water from infiltrating into the primary groundwater source area near this location.

2.7.2 Backfill

2.7.2.1 Material and Placement

Relatively low permeability soil, such as a silt with sand and fine gravel, will be used to replace the soil removed from the excavation base to the approximate surface from which clean native soil, if present, can be used. Clean soil, removed from the surface of the excavations that have clean surface soils, will be reused to complete the backfilling process. The fill material used will be consistent with the following specifications (similar to Soil Class E-1):

- 50% by weight passing the No. 120 sieve and 80% passing the No. 30 sieve;
- Fraction passing the No. 30 sieve shall have a minimum plasticity index of 15; and
- Minimum Atterburg liquid limit of 30.

Because moisture content is a critical component in fill compaction, measures will be taken to prevent the accumulation of stormwater within the excavations. Hay bales and tarps will be kept available so that open excavations can be shielded from stormwater runoff and rain, should a rain event occur during soil excavation activities.

The volumes of the reused surface soil and clean low-permeability replacement fill materials to be used are summarized in Table 4. These quantities are based on the assumption that impacted soil is encountered 2 feet bgs.

Table 4. Quantities of Native and Replacement Fill Material

Excavation ID	*Depth*	*Length of Excavation*	*Width of Excavation*	*Approximate Volume of Fill Material*	
				Surface soil	*Clean, Imported Fill*
A	0-2 ft bgs	50 ft	6 ft	---	22 yd^3
	2-4 ft bgs	50 ft	6 ft	---	23 yd^3
A-1	0-4 bgs	5 ft	5 ft	---	5 yd^3
B	0-3 ft bgs	50 ft	15 ft	85 yd^3	---
	3-6 ft bgs	50 ft	15 ft	---	85 yd^3
C	0-2 ft bgs	50 ft	15 ft	---	85 yd^3
	2-6 ft bgs	50 ft	15 ft	---	85 yd^3
D	0-6 ft bgs	30 ft	10 ft	70 yd^3	---
	6-10 ft bgs	30 ft	10 ft	---	40 yd^3
E	0-4 bgs	15 ft	10 ft	---	25 yd^3
F	0-4 ft bgs	10 ft	6 ft	12 yd^3	
	4-7 ft bgs	20 ft	6 ft	---	33 yd^3
			Total	167 yd^3	403 yd^3
			Contingency factor (15%)	28 yd^3	57 yd^3
			Total Fill Volume (rounded)	**195 yd^3**	**460 yd^3**

Brush, roots, sod, organic matter, and other unsuitable materials will not be placed within the fill. All unsuitable items within the fill encountered during dumping or spreading will be removed and disposed. Soil fill will be spread in horizontal uniform lifts with each lift uniformly compacted.

Fill will not be placed in any part of the work area until the area has been inspected. Loose lift thickness will not exceed 8 inches. Successive fill layers will not be placed until the layer under construction has been properly compacted.

The fill will be maintained and protected in a satisfactory condition at all times until final completion and acceptance of the work. Any rainwater entrapped in the depression after removal of soil will be removed and pumped to the ground surface.

When placing fill against an existing slope, the slope will be properly benched not more than 5 feet into the existing slope. When fill is placed within a completed section of an excavation, the fill will be stepped back within then excavation where the fill meets the face of the next section of soil to be removed within the excavation so that subsequent fill layer can be properly keyed into the existing fill during compaction activities.

2.7.2.2 Compaction

The load-bearing fill lifts will be compacted with appropriately heavy, properly ballasted compaction equipment. All compaction equipment will be suitable to the slope and area conditions of the project site. If necessary, hand-operated compaction equipment such as mechanical tampers will be used for working in confined areas.

Each lift of soil fill will be compacted to a minimum density of 92% of its maximum dry density as determined by the Modified Proctor Test (ASTM D1557). Field density and moisture content measurements of the fill will be performed at least once for every 100 cubic yards placed using nuclear density methods (ASTM D2922 and D3017).

At the end of each day's construction activities, completed lifts will be sealed by rolling with a rubber tired or smooth-drummed roller or by back dragging with a bulldozer. All open work areas will be covered with a minimum 6-mil plastic sheeting. Areas which do not meet density requirements or are unstable under the loading of compaction equipment will be corrected by appropriate moisture control, re-compaction, or removal and replacement with additional fill.

2.8 Stormwater Outfall Extension

The stormwater outfalls from the southwest catch basin (CB-1547) and catch basin CB-1537 will be extended to the junction with the drainage swale along the east side of Colesville Road. This will eliminate further infiltration of stormwater that has passed through the facility's stormwater drainage system into the southwest catch basin drainage basin. These extensions will be made of polyvinyl chloride (PVC) pipe that will be connected to the outfalls.

The extension from the CB-1547 outfall will be approximately 60 feet in length. This extension will be made of 12-inch diameter PVC pipe, which will be connected to the existing 12-inch diameter PVC pipe. The pipe extension from the CB-1537 outfall will be approximately 25 feet in length and be made of 18-inch diameter PVC pipe.

This pipe extension will be joined to the existing 18-inch diameter corrugated steel pipeline with a Fernco-type fitting (or equivalent) or by using a pre-cast concrete box. An 18-inch diameter "Y" slip couple housing will be used where the two extension join to make the outfall. A reducer fitting will be required to join the 12-inch line to the final outfall.

The extensions will be placed on top of a sand bed that rests on compacted fill. A sheet of 6-mil plastic will separate the sand from the compacted fill. The pipe extensions will be covered with a minimum of one foot of compacted fill and six inches of top soil.

The proposed outfall extension locations are shown on Figures 6. Details and specifications for the outfall extensions are shown on Figure 7.

2.9 Active Slab Depressurization System

An ASD system will be installed within the 1978 and 1984 additions to provide a means of control for the soil to indoor air exposure pathway for VOC vapors. The ASD system is a mitigation measure for VOC concentrations detected within the indoor air of the 1978 and 1984 additions, and a part of the original building that is adjacent to the additions. The ASD system is not intended to serve as a soil remedy for areas beneath the facility building that have subsurface soils affected by PCE contamination.

Based on the SVE pilot study and site geology, we concluded in the *Pre-Design Report* (BBL, 2003) that SVE was not an appropriate remediation for soil contamination at this site. This conclusion was reached because observed airflow rates were extremely low indicating a tight subsurface (this agreed with borehole data [silty clay with some gravel]) and quickly declining VOC removal rates indicated that flow was predominantly through one slightly higher permeability zone that was rapidly stripped of VOCs during the pilot study. The rest of the subsurface area monitored by the SVE pilot test was not affected by SVE.

The ASD system installation will be performed as a field fabrication. The ASD system will use typical design criteria, specifications, and technology common to the radon control industry (see ASTM International Standard Practice E 212-01, March 2001). United States Environmental Protection Agency (USEPA) documents *Radon Prevention in the Design and Construction of Schools and Other Large Buildings* (USEPA Document No. EPA/625/R-92/016), *Radon Reduction Techniques for Existing Detached Houses* (USEPA Document No. EPA/625/R-93/011), and *Radon Mitigation Standards* (USEPA Document No. EPA 402-R-93-078 will be consulted for technical design guidance.

A site meeting will be held with the plumbing contractor to discuss the preliminary engineering specifications and assess the site field conditions. NYSDEC and NYSDOH will be notified of any such meetings in advance so that representatives of the two departments can attend. A 50-percent design will be produced for review and approval by Universal. Once the design is approved the ASD system will be installed and tested.

A minimum 4-inch thick gravel bed is considered necessary for an ASD system to be able to promote sufficient air flow for proper slab depressurization (see page 12 of USEPA Document No. EPA/625/R-92/016). If gravel bed less than 4 inches in thickness is encountered, a qualitative test for negative pressure field extension will be performed as described in *Radon Mitigation Standards* (USEPA Document No. EPA 402-R-93-078, revised 4/94 and ASTM International Standard Practice E 212-01, March 2001).

During the test a vacuum consistent with design criteria will be applied to the first suction pit. Small diameter (less than 0.5 inch) holes drilled 5, 10, and 20 feet away will be monitored for negative pressure by observing if smoke is drawn into the holes. Should the test fail to demonstrate downward air flow into the slab, additional testing will be performed at the other three proposed suction pits. Should the tests fail at all three locations, NYSDEC and NYSDOH will be consulted regarding the test results and future action.

ASD system as-built drawings will be provided in the Remediation Certification Report (see Section 2.13).

2.9.1 ASD Extraction Points

Four extraction points, E-1 through E-4, will be installed in at the approximate locations shown on Figure 8. These locations coincide with the PCE-affected soil "hotspot" detected beneath the 1984 building addition (soil sample locations GP-1 and GP-6 [Shield, 2000]), the indoor air sampling point location in the 1978 additon, and the foundation area between the 1978/1984 additions and the original facility building. The PCE-affected soils beneath the 1984 addition are believed to be the primary source of VOC vapors that are affecting the facility's indoor air.

Soil gas data and soil sample analytical data were collected during the baseline investigation (see Shield, 1999 – Tables 6 through 8 and Figures 4 and 5) beneath the floor slabs of the 1978 and 1984 building additions of the Kirkwood North facility. These data show that soil gas and soil sample detections of PCE were highest beneath the 1984 addition.

Soil gas detections of PCE and its daughter products (except vinyl chloride), and toluene as well, were approximately a factor of 10 less beneath the 1978 addition. Soil sample results show that PCE were detected as a "hotspot" beneath the 1984 addition. This "hotspot" is centered near the location of soil sample location GP-1 (Figure 8). The PCE concentrations detected in the "hotspot" at depths of 3 feet to 8 feet ranged from 52 mg/kg to 2,700 mg/kg. PCE concentrations detected in the three soil samples from beneath the 1978 addition were all less than 0.08 mg/kg.

The outer wall that existed where the 1978 and 1984 addition are joined was removed during the construction of the 1984 addition. The result is a large open air space. Depressurization of the floor slab beneath the 1984 addition and resulting minimization of vapor migration into the 1984 addition will benefit indoor air quality in both the 1984 addition and the 1978 addition because air circulates freely inside the shared air space.

The suction pit volume will be at least one cubic foot. The extraction point riser pipe shall be constructed of schedule 40 PVC with a 3-inch diameter. The slab penetration for the depressurization point shall be cleaned, prepared, and sealed in an air-tight manner with a compatible sealant that will not shrink or crack. Slab penetrations will be kept to a minimum to so that the potential for new vapor pathways will be lessened to the greatest degree practical. The conceptual specifications and construction details are shown on Figure 9.

2.9.2 ASD Fan Manifold

One ventilation fan will be used to operate the ASD system. This fan will operate the four sub-slab depressurization points through a manifold setup. The fan will be an exterior mount of a type similar to Radonwaway brand GP series GP501 fans. These fans are Underwriter's Laboratory (UL)-approved for outdoor use (UL standard 507) and meet all electrical code requirements.

The performance range of this fan is: electrical usage 60-140 watts, 4.2 inches of water maximum pressure, 95 standard cubic feet per minute (scfm) at 1 inch of water to 10 scfm at 4 inches of water. The fan selected shall be able to provide depressurization coverage for approximately 4,000 square feet or 1,300 square feet per slab penetration. If typical for the area, a condensate bypass shall be installed at the bottom of the outlet stack to allow water vapor condensation to drain past the vent fan. Fan installation shall follow the manufacture's instructions.

All ASD system electrical components shall be UL listed or of equivalent specifications. All plastic vent pipes and fittings shall be made of schedule 40 PVC.

The ASD system shall include mechanisms to monitor system performance and warn of system failure (shut-off). The electrical monitor shall be installed on non-switched circuits and be designed to reset automatically after a power supply interruption. Manometer-type pressure gauges shall be clearly marked to indicate the pressure readings that existed prior to system start. The circuit breakers controlling the circuits on which the vent fan and electrical system monitor operate shall be labeled "ASD System".

2.9.3 ASD System Performance Monitoring Plan

The performance of the ASD system will be monitored by the collection and evaluation of operating data. Because typical radon-venting systems operate without monitoring or maintenance for 8 to 11 years (timeframe for fans to wear out), this ASD system is not anticipated to require much operational oversight once operating parameters are known.

Initially, the system will be checked weekly during the first 3-months to verify that anticipated air flow is occurring at the depressurization points and negative pressure is detectable. If after this period air-flow and pressure readings have not stabilized to an acceptable tolerance (+/- 20 percent of mean) monitoring will be continued on a monthly basis until the air flow and pressure readings have been determined to be stable, after which monitoring will no longer be performed.

During the start-up phase, emissions from the system will be monitored hourly for the first 4 hours using a PID calibrated to detect VOC concentrations in parts per billion by volume. Air emissions will be monitored daily thereafter for the next 2 days. Because the know indoor air concentrations are low and the volatilization rates from the subsurface soils should be low, we do not anticipate that air pollution controls, such as granulated activated carbon (GAC) will be necessary.

The VOCs comprising the detected vapors are primarily non-combustible gases (PCE, Freon 113, and Freon 11). Trace concentrations of flammable VOC vapors (for example, acetone and toluene) are at least four orders of magnitude below their respective lower explosive limits (LELs).

Indoor air quality will be monitored during the initial operation of the ASD system through the collection of 8-hr time-weighted averaged (TWA) samples. The samples will be collected following the protocols presently in place and as described in BBL's *Indoor Air Sampling Plan* dated January 21, 2002. Two additional sampling locations will be added to the four locations previously tested. The new locations will be located in the 1982 addition near the front of the building and in the kitchen area of the original building.

The first set of indoor air samples will be collected 30 days after the start up of the ASD system. Additional samples will be collected at 90-days and 180-days after ASD system startup. Indoor air sampling will be performed semi-annually thereafter.

The effectiveness of the ASD system will be evaluated by indoor air quality monitoring as presented above.

2.10 Roof Drain Leader Abandonment and Replacement

The roof drain leaders associated with the removal of stormwater from the south side of the original facility building will be abandoned and replaced at Universal's Kirkwood North Facility. The roof drain system from the original building (1973) has leaders that are located beneath the present 1982 building addition. One set feeds stormwater to a leader to the north and another feeds stormwater to a leader to the south.

The roof leader to the north was previously abandoned and re-routed as an interim remedial measure in 1998. The southern roof drain system leaders tie into a larger trunk line that connects to Catch Basin CB-1534. These roof drain leaders, as well as the trunk line, will be abandoned and replaced. The abandoned lines will be grouted. The trunk line is made of 15-inch diameter CSP pipe. The roof leaders at the site are typically made from 4-inch diameter PVC pipe. Stormwater runoff will be re-routed to CB-1534 through a new connection. The new trunk line will run overhead within the building until the exterior wall is reached. At that point the drain line will either run down the interior of the exterior wall and exit the building at the base of the wall or exit the building at the top of the wall and run down the exterior part of the wall. Figure 10 shows the location and conceptual details for this work. This work will be performed as a field fabrication task with as-built drawings provided in the Remediation Certification Report (see Section 2.13).

2.11 Deed Notice Areas

A deed notice with environmental restrictions will be filed with the Broome County Clerk's Office to provide an institutional control for inaccessible soils that remain below facility floor slabs. The deed notice is for the areas beneath the footprints of the 1978, 1982, and 1984 building additions. The deed notice will be filed after remedial construction is complete and prior to submission of the Remediation Certification Report. A copy of the filed deed notice will be provided in the Remediation Certification Report.

As stated above in Section 2.9, active slab depressurization will be used to mitigate the exposure pathway from volatilization of VOCs in soil beneath the floor slab into indoor air within the building additions at the facility rear. The areas that have environmental restrictions on the deed notice are shown on Figure 11.

2.12 Site Restoration and Demobilization

Any collected sediment from erosion control devices and structures will be removed and disposed. Any temporary utilities, facilities, and structures will be disconnected and removed. All on-site surfaces and facilities will be restored to pre-construction conditions, including:

- Landscaping;
- Paving and curbing;
- Utilities; and
- Structures.

A final cleaning will be performed, including removal of incidental construction debris, surplus materials, rubbish, and construction facilities from the work area. A certificate of decontamination will be prepared for each piece of equipment once the equipment has been decontaminated prior to leaving the site.

2.13 Remediation Certification Report

Upon completion of the remedial action activities described in this document, a Remediation Certification Report will be prepared for submission to NYSDEC. This report will present a summary of the remedial work performed, including the following:

- A description of the soil excavations performed including dimensions and locations, types of material removed, volumes of material removed, and air monitoring results;
- A description of the disposition of all soil removed from the excavations including waste classification results and offsite disposal;
- A description of ASD system installation and start up, with as-built drawings provided;
- A description of the CB-1547 stormwater outfall extension;
- A description of the roof leader abandonment and replacement, with as-built drawings provided;
- A description of verification (post-excavation) soil sampling results; and
- A description of site restoration including excavation backfill and asphalt paving.

Supporting documentation will include summary data tables, figures and plates, well construction logs, hazardous waste manifests and bills of lading, soil treatment certifications, laboratory analytical reports for soil and groundwater sampling, and photographic logs.

3. Health and Safety Plan

The existing Health and Safety Plan will be revised to include the new on-site work tasks associated with the remedial action. The revised Health and Safety Plan will describe the policies and procedures to be followed by employees of BBL during implementation of the remedial action at the site. Activities to be performed by BBL will include:

- Observation and supervision of excavation work;
- Observation and supervision of soil stockpiling work;
- Observation and supervision of roof leader abandonment and replacement work;
- Observation and supervision of ASD installation and start up work;
- Collection of post-excavation and soil stockpile samples;
- Observation and supervision of soil loading and/or soil treatment;
- Observation and supervision of stormwater outfall extension work;
- Observation and supervision of site restoration; and
- Other site activities as Universal's representative.

The objective of the Health and Safety Plan is to provide a mechanism for establishing safe working conditions for BBL personnel. Employees of subcontracted companies must work in accordance with their own independent Health and Safety Plan, which must comply with BBL's health and safety standards and requirements.

The Health and Safety Plan provides for a safety organization, procedures, and protective equipment that have been established based on an analysis of potential physical, chemical, and biological hazards. Specific hazard control methodologies have been evaluated and selected to minimize potential accidents or injuries.

A copy of the revised Health and Safety Plan is included as Appendix B.

4. Citizen Participation Plan

The Citizen Participation Plan will include the appropriate activities outlined in the NYSDEC's publication entitled "Citizen Participation in New York's Hazardous Waste Site Remediation Program: A Guide Book" (June 1998) and any subsequent revisions, and 6 NYCRR Part 375-1.5. The NYSDEC will is responsible for coordinating and implementing the Citizen Participation Plan. This section provides a brief summary of the Citizen Participation Plan activities that will take place as a part of the remedial action.

During the remedial investigation, a number of Citizen Participation activities were undertaken to inform and educate the public about conditions at the site and the potential remedial alternatives, including establishing a repository of documents pertaining to the site and a compiling a site mailing list that included nearby property owners, local political, officials, local media, and other interested parties. These activities will help continue the Citizen Participation activities that will be undertaken during the implementation of the remedial action at the site described in this document.

The Citizen Participation activities for the remedial action will be coordinated by the NYSDEC, and will include:

- Maintaining the document repository;
- Preparing a Fact Sheet that will be sent to the site mailing list prior to implementation of the remedial design to describe and announce the initiation of the remedial action at the site, including a summary of the construction and operation requirements of that proposed remedy; and
- Holding a public meeting or public availability session, if determined to be necessary, at or near the site to provide an opportunity for the submission of oral comments on the remedial design. The NYSDEC will summarize the comments received at the public meeting and make the summary available to the public.

Once implementation of the remedial design is complete, NYSDEC will provide to the site mailing list a notice of the completion of the remedial construction activities, a discussion indicating how the remedy has mitigated site conditions that had been present, and a discussion of post-remedy O&M activities.

5. References

ASTM International. March 2001. *Standard Practice for Radon Mitigation Systems in Existing Low-Rise Residential Buildings.* Washington, D.C.

Blasland, Bouck & Lee, Inc. February 2003. *Pre-Design Report: Universal Instruments Corporation, Kirkwood, New York.* Cranbury, New Jersey.

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New York State Department of Environmental Conservation (NYSDEC). March 2002. *Record of Decision: Former Dover Electronics Site, Kirkwood (T), Broome County, Site Number 7-04-026.* Albany, New York.

New York State Department of Environmental Conservation (NYSDEC). January 2001. *Order on Consent: Index #B7-0515-97-05.* Albany, New York.

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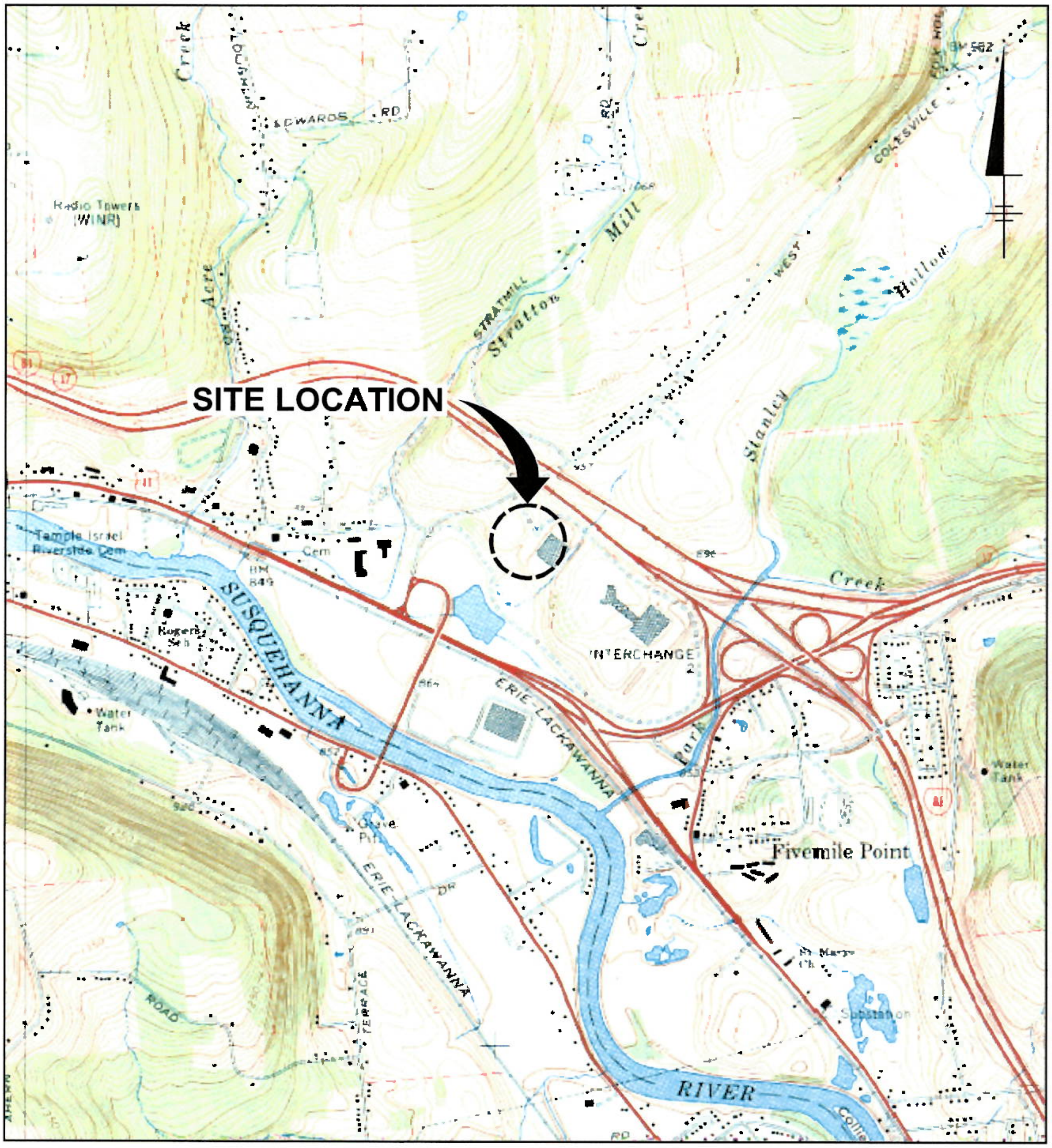
New York State Department of Environmental Conservation (NYSDEC). December 20, 2000. *Determination of Soil Cleanup Levels.* Memorandum from Michael J. O'Toole, Director, Division of Environmental Remediation.

New York State Department of Environmental Conservation (NYSDEC). April 10, 2001. *Response to Comments Relative to 12/20/00 Soil Cleanup Consolidation Memo.* Memorandum from Michael J. O'Toole, Director, Division of Environmental Remediation.

New York State Department of Environmental Conservation (NYSDEC). July 10, 2001. *Soil Cleanup Consolidation – Further Clarifications.* Memorandum from Michael J. O'Toole, Director, Division of Environmental Remediation.

Shield Environmental Associates, Inc. February 1999. *Baseline Summary Report.*

Shield Environmental Associates, Inc. July 2000. *Remedial Investigation Report.*



REFERENCE: Base Map Source USGS 7.5 Minute Quad. Series Binghamton East, New York, 1968, Photorevised 1976.

2000' 0 2000'

Approximate Scale: 1" = 2000'

AREA LOCATION

07/18/01 CRA-54-IY
05203003/05203n01.cdr

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK

LOCATION MAP

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FIGURE 1

COUNTY ROUTE 52 (FORMERLY CR 74)
HIGHWAY BOUNDARY
COLESVILLE ROAD
INDUSTRIAL PARK DRIVE
COUNTY ROUTE 181 (FORMERLY CR 317)
NEW YORK TELEPHONE COMPANY EASEMENT L. 1443 P. 146 REC. APRIL 22, 1985
1 STORY BRICK & STEEL BUILDING
BITUMINOUS
162.01-1-8
417684 SQ.FT.
9.5887 ± AC.
L. 1859 P. 1446
REC. 11/29/1995
LEGEND
MONUMENTATION FOUND
868.10' MEASURED DIMENSION
(868.10') REFERENCE DIMENSION
MANHOLE
POWER POLE
GAS VALVE
WATER VALVE
FIRE HYDRANT
LIGHT POLE
SIGN
CATCH BASIN
GUIDE WIRE
SPOT ELEVATION
CONTOUR INTERVAL
GRAPHIC SCALE
SOURCE:
BASEMAP PROVIDED BY HAWK ENGINEERING, P.C.
BINGHAMTON, NY, @ A SCALE OF 1"=50'.
X: 05203X02.DWG
L: REF=OFF*
P: PAGESET/PLT-DL
02/19/03 CRA-54-TLF
05203007/05203B03.DWG
UNIVERSAL INSTRUMENT CORPORATION
KIRKWOOD, NEW JERSEY
REMEDIAL DESIGN PACKAGE
EXISTING SITE TOPO MAP
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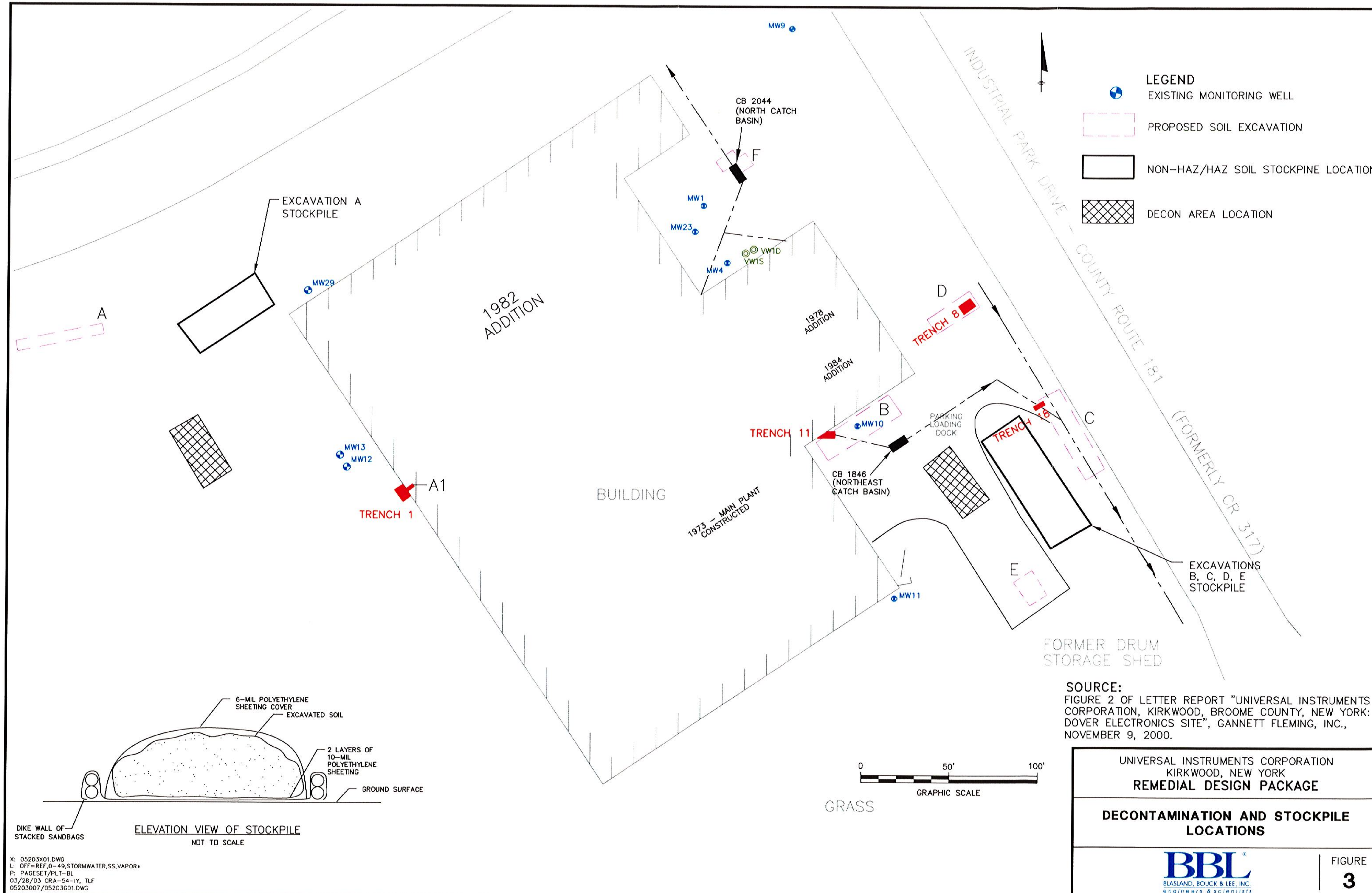
FIGURE
2



SOURCE:
FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

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DECONTAMINATION AND STOCKPILE LOCATIONS

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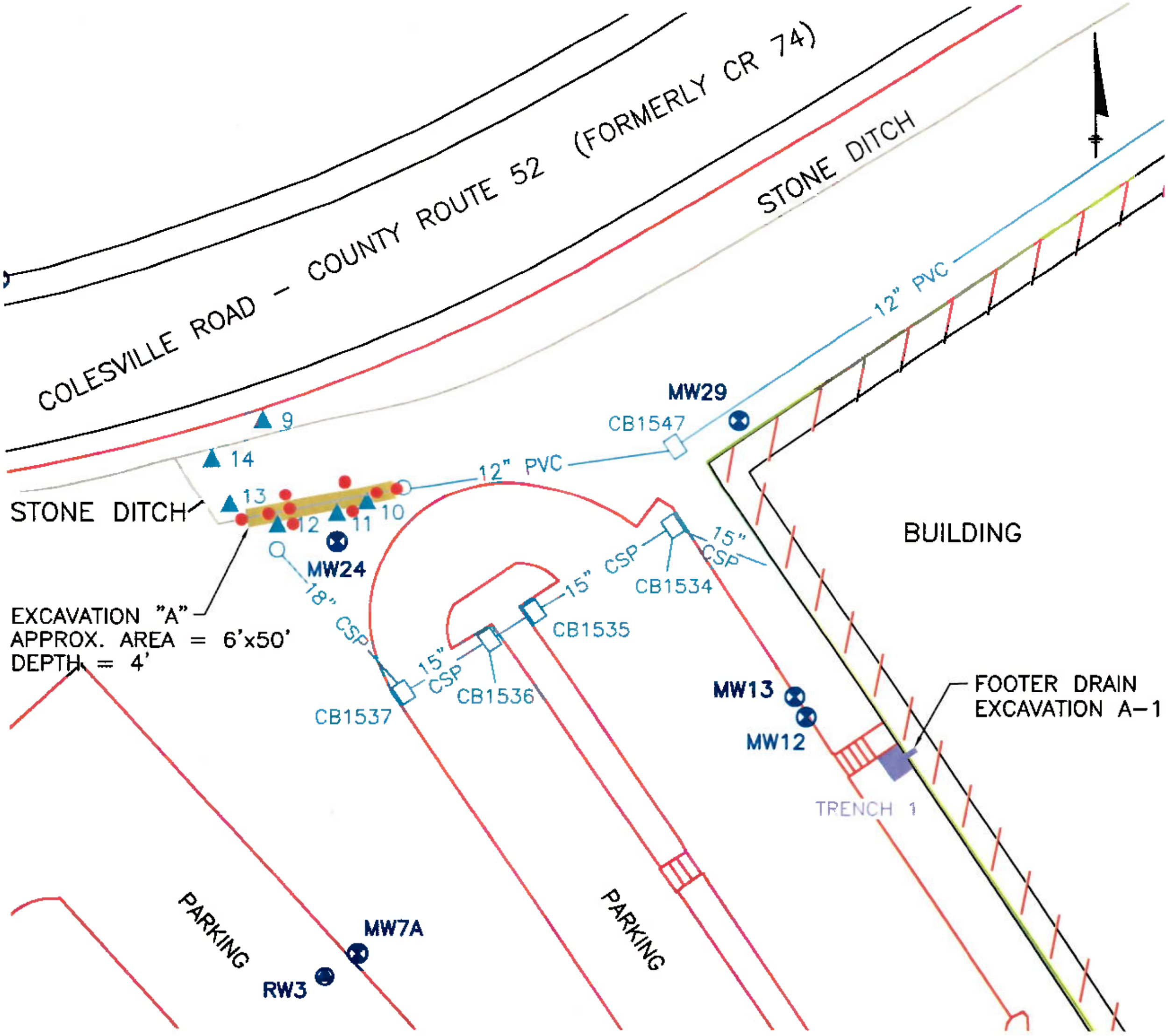
FIGURE
3



LEGEND

- STAIRS
- MONITORING WELL
- SOIL BORING LOCATION
- CATCH BASIN
- OUTFALL
- POST-EXCAVATION SOIL SAMPLING

SOURCE: ADAPTED FROM FIGURES FROM REMEDIAL INVESTIGATION REPORT, SHIELD ENVIRONMENTAL ASSOCIATES, INC., JULY 2000.

0 60' 120'
GRAPHIC SCALE

X:
L: OFF = REF*
P: PAGESET/PLT-AP
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KIRKWOOD, NEW YORK
REMEDIAL DESIGN PACKAGE

PROPOSED SOIL EXCAVATION LOCATION "A"

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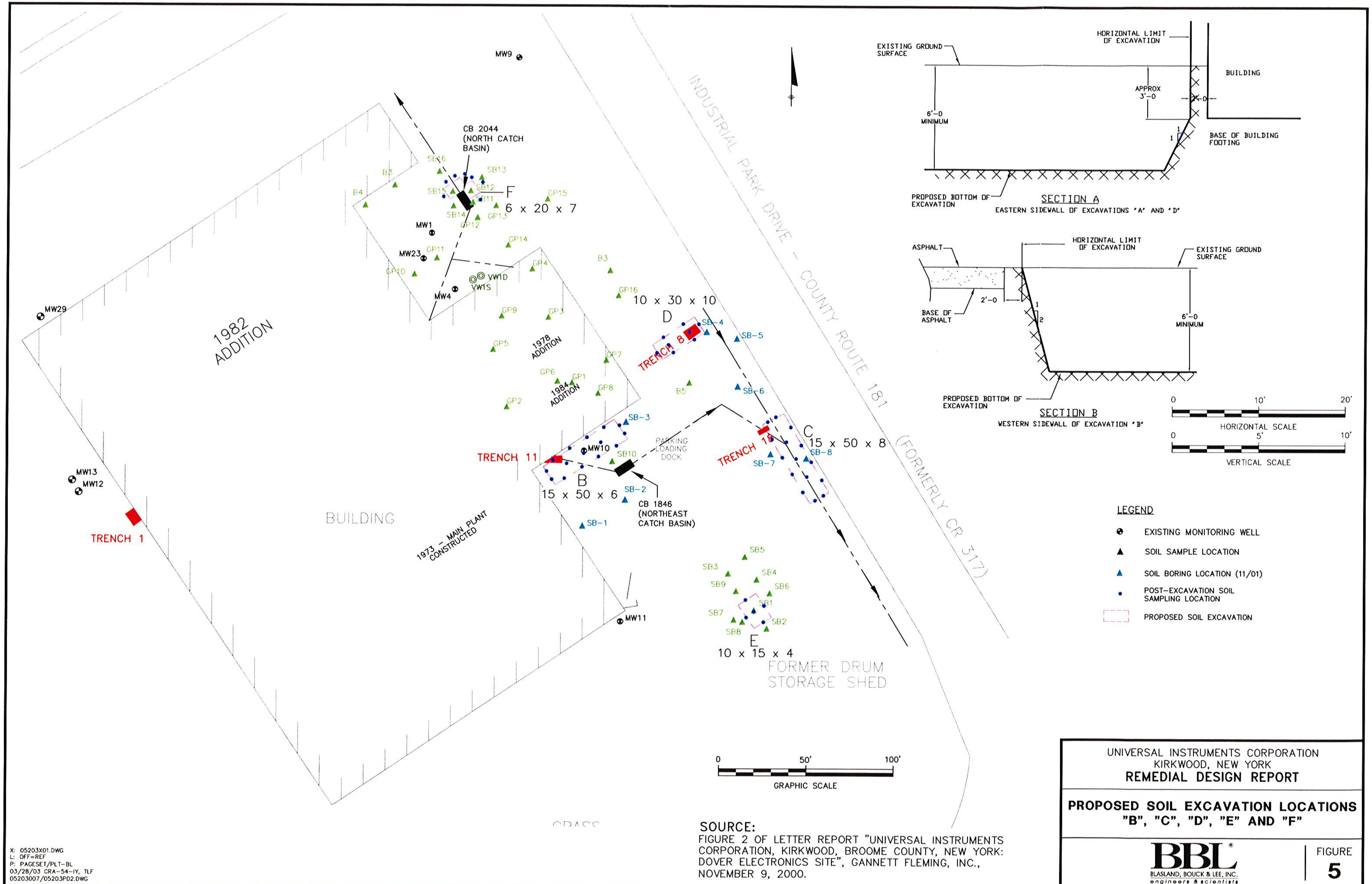
FIGURE
4



SOURCE:
FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW YORK
REMEDIAL DESIGN REPORT

PROPOSED SOIL EXCAVATION LOCATIONS "B", "C", "D", "E" AND "F"

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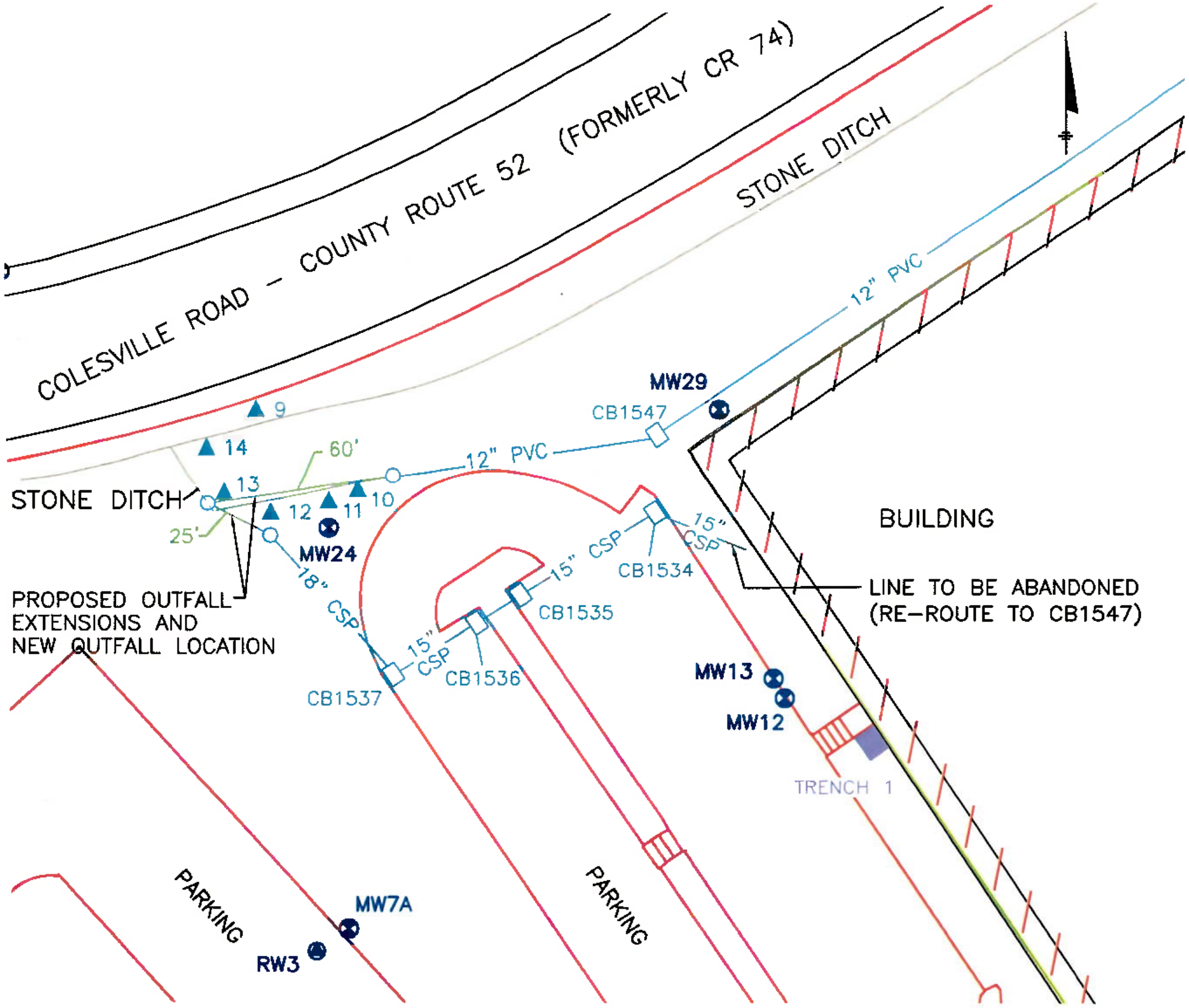
FIGURE 5



LEGEND

- STAIRS
- MONITORING WELL
- SOIL BORING LOCATION
- CATCH BASIN
- OUTFALL

SOURCE: ADAPTED FROM FIGURES FROM REMEDIAL INVESTIGATION REPORT, SHIELD ENVIRONMENTAL ASSOCIATES, INC., JULY 2000.

0 60' 120'
GRAPHIC SCALE

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STORMWATER OUTFALL PIPE EXTENSION LOCATION

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FIGURE
6

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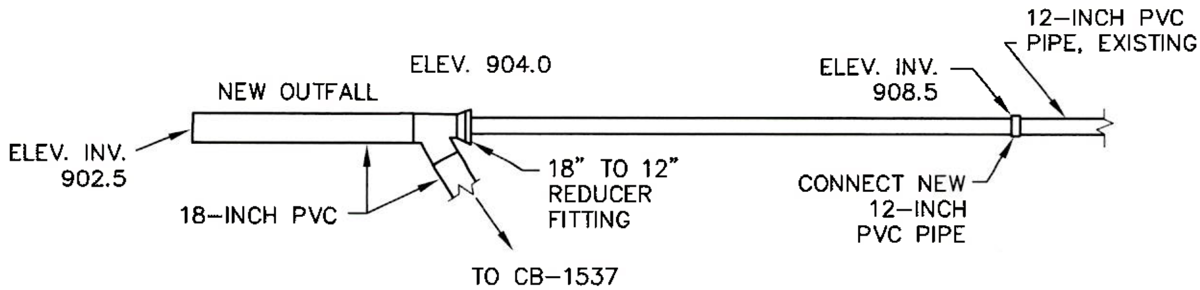
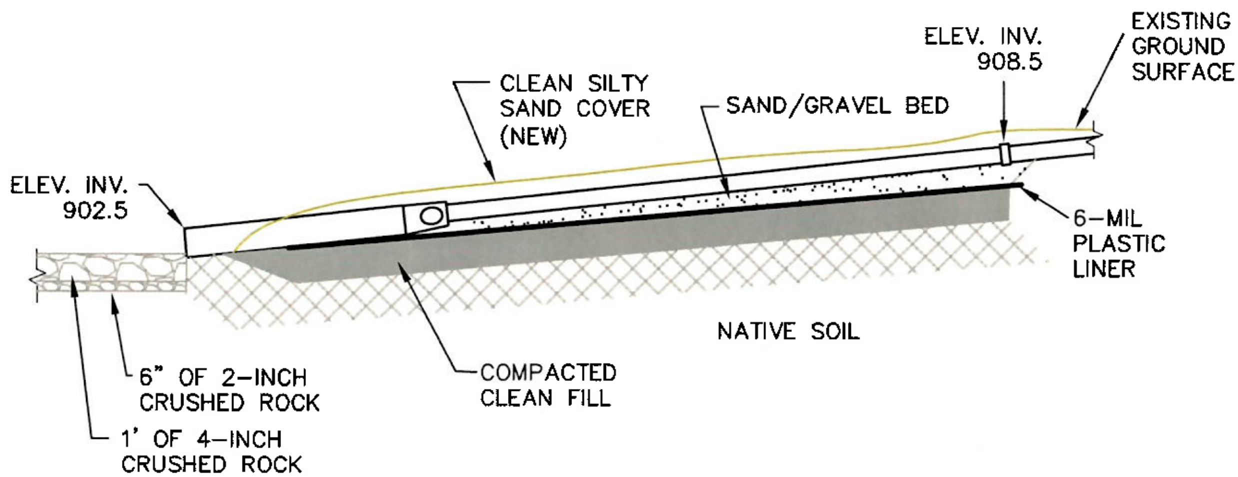


PLAN VIEW



CROSS-SECTION (LONG AXIS)

NOT TO SCALE

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STORMATER OUTFALL EXTENSION DETAILS

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FIGURE
7

X:
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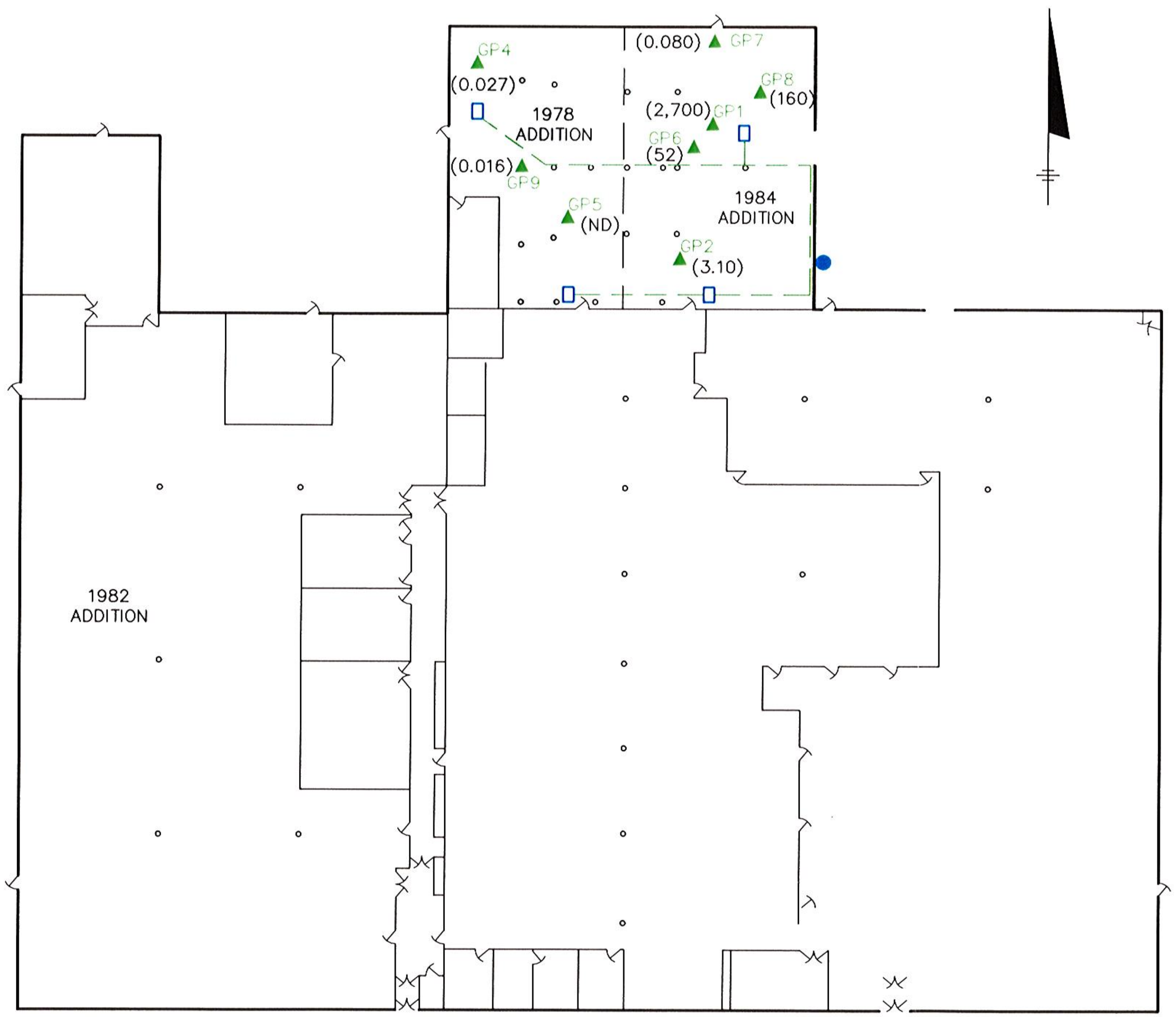

LEGEND:

- PROPOSED ACTIVE SUB-SLAB DEPRESSURIZATION POINT LOCATION
- PIPING RUN
- VERTICAL BUILDING POST
- EXTERIOR FAN AND EXHAUST LOCATION
- SOIL SAMPLE LOCATIONS
- (2,700) PCE CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)
- INACCESSIBLE AREAS

SOURCE:

BUILDING LAYOUT DIGITIZED FROM PHOTOCOPY OF DRAWING FAXED FROM UNIVERSAL INSTRUMENTS CORPORATION FACILITIES DEPARTMENT. NO FILE NAME OR SCALE PROVIDED.

X:
L: OFF-REF*
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ASD EXTRACTION POINT LOCATIONS

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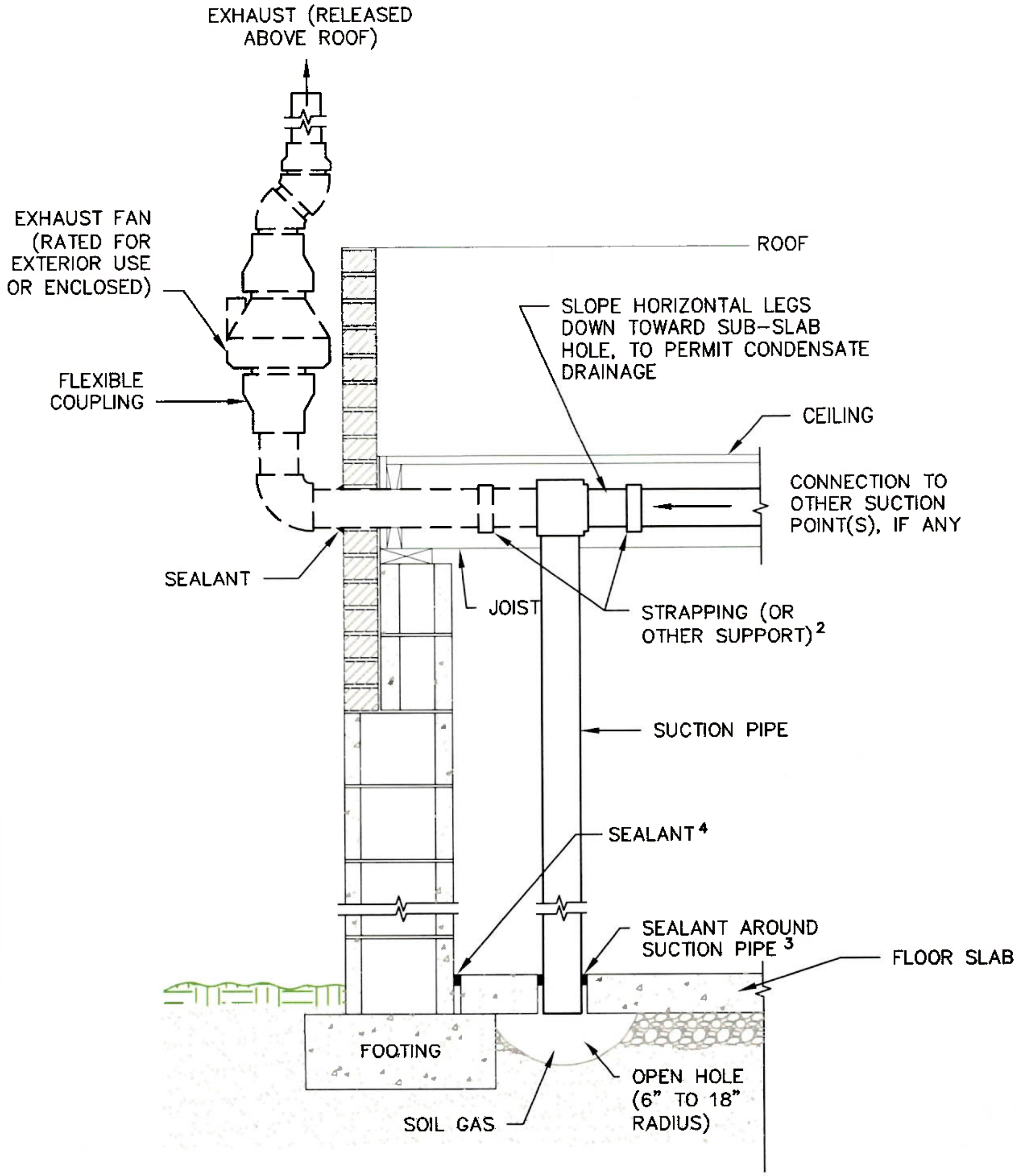
FIGURE
8



NOTES:

1. DETAIL FOR INTERIOR AND EXTERIOR STACKS SHOWN IN LATER FIGURES.
2. OPTIONS FOR EFFECTIVELY SUPPORTING HORIZONTAL AND VERTICAL PIPING RUNS SHOWN IN LATER FIGURES.
3. DETAIL SHOWN FOR PIPING PENETRATIONS THROUGH SLAB IS ONE OPTION AMONG SEVERAL. OTHER OPTIONS SHOWN IN LATER FIGURES.
4. CLOSING OF VARIOUS SLAB OPENINGS WILL SOMETIMES BE IMPORTANT FOR GOOD SSD PERFORMANCE.

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EXHAUST STACK ON FACILITY EXTERIOR

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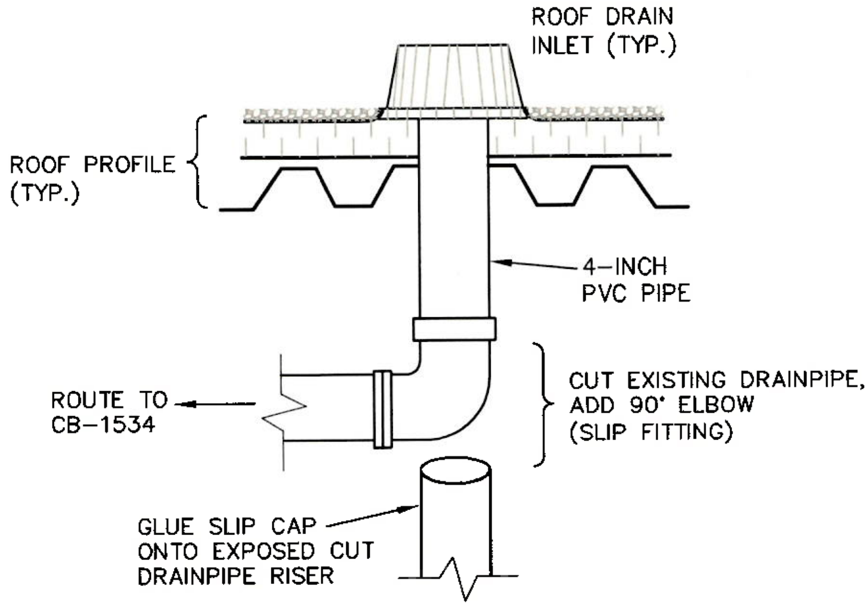
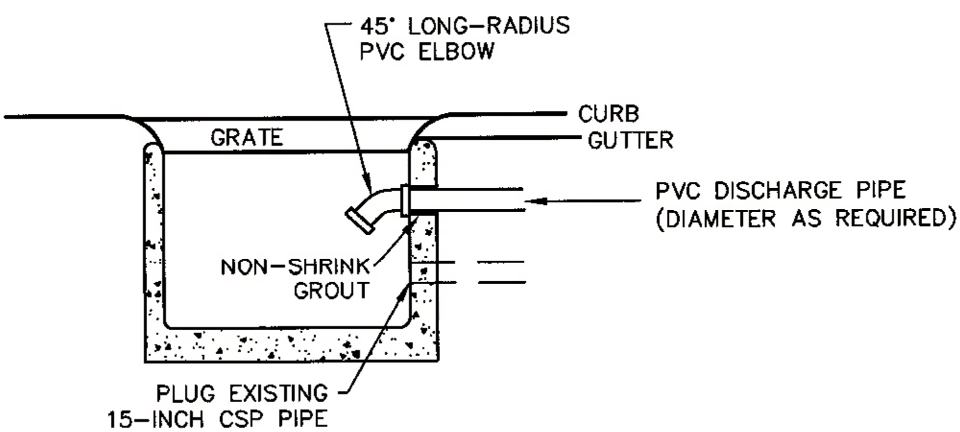
FIGURE
9



ROOF DRAIN



CATCH BASIN

NOT TO SCALE

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ROOF DRAIN LEADER ABANDONMENT AND DETAILS

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FIGURE
10

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02/13/03 CRA-54-TLF
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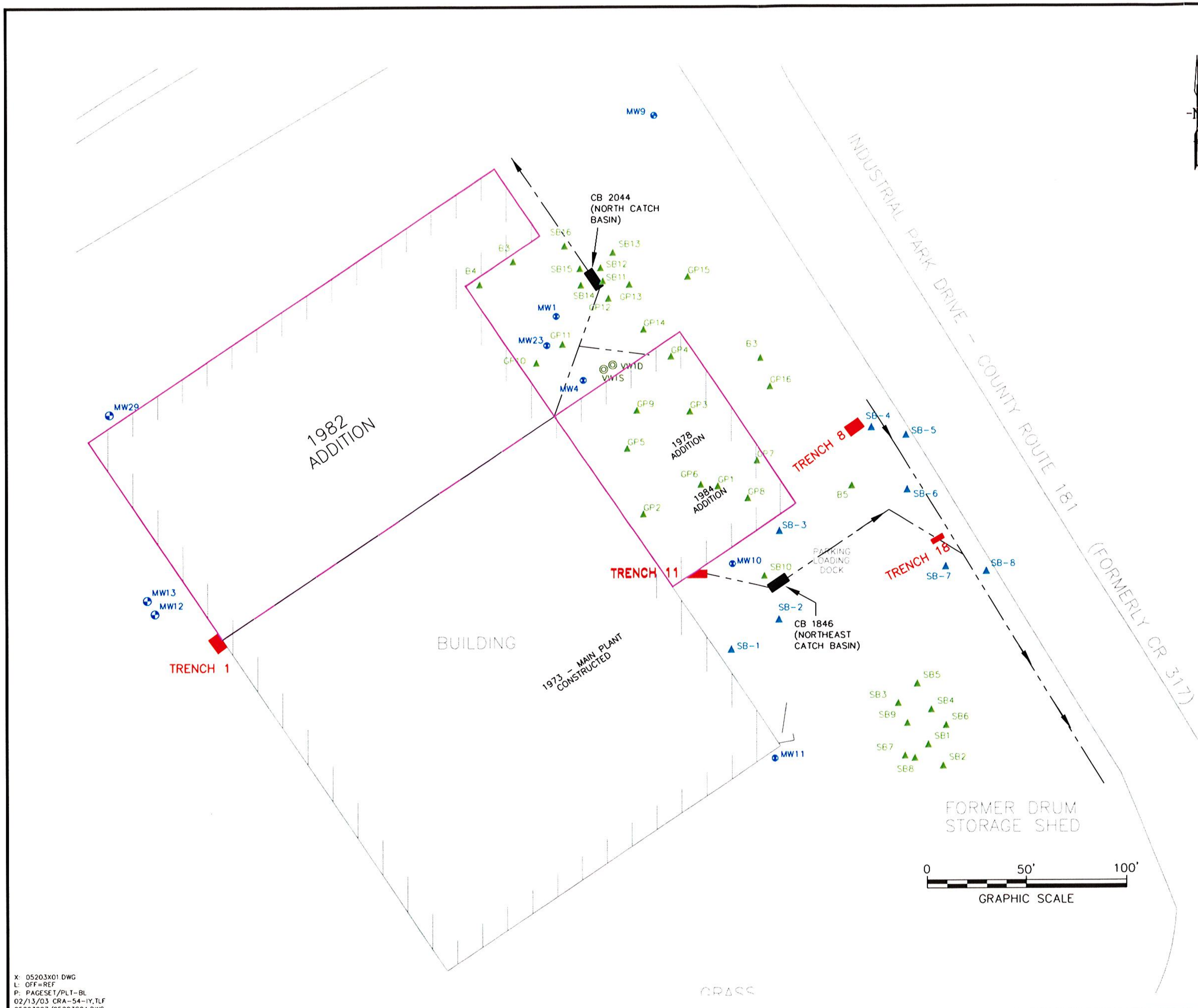

LEGEND

- EXISTING MONITORING WELL
- SOIL SAMPLE LOCATION
- SOIL BORING LOCATION (11/01)
- PROPOSED DEED NOTICE AREA

SOURCE:
FIGURE 2 OF LETTER REPORT "UNIVERSAL INSTRUMENTS CORPORATION, KIRKWOOD, BROOME COUNTY, NEW YORK: DOVER ELECTRONICS SITE", GANNETT FLEMING, INC., NOVEMBER 9, 2000.

X: 05203X01.DWG
L: OFF=REF
P: PAGESET/PLT-BL
02/13/03 CRA-54-IY,TLF
05203007/05203G04.DWG

UNIVERSAL INSTRUMENTS CORPORATION
KIRKWOOD, NEW JERSEY
REMEDIAL DESIGN PACKAGE

DEED NOTICE AREAS

BLASLAND, BOUCK & LEE, INC.
engineers & scientists

FIGURE
11

APPENDIX A
FIELD SAMPLING AND ANALYSIS PLAN

FIELD SAMPLING PLAN

DOVER ELECTRONICS SITE
ORDER ON CONSENT INDEX # B7-0515-97-05
SITE CODE #704026

Universal Instruments/Dover Electronics Site
29 Industrial Park Drive
Kirkwood, New York

Prepared by:

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
Lexington, Kentucky
October 14, 1998

Job No. 395-0430

REVISIONS TO QUALITY ASSURANCE PROJECT PLAN (QAPP) dated October 14, 1998
As approved in Shield Environmental Associates, Inc. RI/FS Work Plan dated Oct. 14, 1998

Section 2.1 Key Personnel and Quality Assurance Responsibilities

The key personnel are changed to the following:

- Project Director – Leonard Eder, P.E. of Eder Consulting, Inc.
- Project Manager – Gregory R. Albright, R.G., C.HG. of Blasland Bouck & Lee, Inc.
- Quality Assurance Officer – D. Robert Gan, P.E. of Blasland Bouck & Lee, Inc.
- Site Supervisor – David Gwozdz of Blasland Bouck & Lee, Inc.
- Site Health and Safety Officer – David Gwozdz of Blasland Bouck & Lee, Inc.
- Sample Custody Officer – David Gwozdz of Blasland Bouck & Lee, Inc.
- The laboratories have been changed to Compuchem (Cary, NC) and Columbia Analytical Services (Rochester, NY), both NYSDOH and NYSDEC ASP-approved analytical laboratories.

Personnel QA responsibilities remain the same in each category.

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1.0 INTRODUCTION

The Field Sampling and Analysis Plan (FSAP) for the Dover Electronics State Superfund Site, Town of Kirkwood, Broome County, New York, supplements information found in the Remedial Investigation/Feasibility Study (RI/FS) Work Plan. The Work Plan develops the objectives and scope of work, and defines what and how site activities will occur. The FSAP consists of two documents: the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP describes how various field sampling and analytical activities will be performed. The FSP also identifies the sampling and analytical objectives and provides detailed procedures for sample collection, handling, shipping, and analysis. Quality assurance/quality control (QA/QC) procedures are specified in the QAPP.

Since the Work Plan has delineated specific field operation procedures, the FSP will concentrate solely on specific sampling and analysis protocols. This FSP will conform, where appropriate, to *Superfund Remedial Design and Remedial Action Guidance* [United States Environmental Protection Agency (USEPA) 1986].

1.1 Site Location and Description

The facility, located at 29 Industrial Park Drive, Broome County, New York (Figure 1), is situated in an industrial setting. Major plants in the area include Truckstops of America Landfill (½ mile southeast), Frito Lay Plant (½ mile south), Universal Instruments (½ mile east), Kason Industries (eastern property boundary), and Consolidated Freightways (northern property boundary). Surrounding properties are either industrial or undeveloped. The site is bounded by industrial property to the north, east, and west, and undeveloped land to the south (Figure 2).

1.2 Site History

The site has been occupied by Universal Plastics and Dover Electronics (Division of Dover). In 1993, Dover Electronics separated from Dover as a stand-alone corporation and renamed Dovatron, Inc. In 1995, Dovatron, Inc. transferred its title to the facility to Universal Instruments. In 1996, Dovatron, Inc. changed its name to The DII Group. The site currently serves as the corporate headquarters for Universal Instruments. The facility has been used as an electronic circuit board manufacturing company and has reportedly been in operation since its construction in 1973.

2.0 SAMPLING OBJECTIVES

2.1 General Objectives

The objectives for representative sample collection are:

- To perform sampling such that the sample taken is truly representative of the material or medium being sampled;
- To use proper sampling, sample handling, preservation, and QC techniques;
- To properly identify the collected samples and document their collection in permanent field records;
- To maintain sample chain-of-custody forms; and
- To protect the collected samples by properly packing and transporting (shipping) them to a laboratory for analysis.

This section briefly outlines only those field sampling and analysis procedures required to conduct the various site investigations during this sampling event. Detailed descriptions of the procedures that will be used to accomplish these tasks are given in the following sections. The site investigation activities to be performed as part of this event have been devised based upon the available data. Some adjustments to these prepared activities may be required as additional data become available or as field conditions dictate. The following sections provide specific sampling objectives for the proposed drilling, excavation/trenching, sampling, and air monitoring activities. A description of the waste sampling activities is also included in this document. The schedule for these activities is provided in the Work Plan prepared for the site entitled *Remedial Investigation/Feasibility Study Work Plan, Dover Electronics Site, Town of Kirkwood, Broome County, New York.*

2.2 Subsurface Soil Sampling

Soil sampling activities will be conducted using an excavator (test trenches) and a drill rig (soil borings and monitoring wells). The purpose of the sampling activities is to locate source areas and to define the extent of site-related contaminants at the study area and their existing concentrations. Procedures for soil sampling are outlined in Section 5.3 of this document.

The objectives of these activities will be to further evaluate the extent of the affected soils at the site; refine chemical concentrations at suspected exposure locations; and amend and modify the Health and Safety Plan (HASP) and other pertinent documents, as appropriate. The data collected will be used to further refine estimated volumes of affected soils requiring treatment.

2.3 Sediment Sampling

Surface sediment samples will be collected from selected catch basins and catch basin outfalls on-site. The purpose of these samples is to establish the presence or absence of contaminants in sediments that have been transported through the storm water sewer system at the site. Procedures for sediment sampling are outlined in Section 5.3 of this document.

The objective of the sediment sampling is to establish the extent and concentration of contaminants in sediments associated with storm water run-off. The data collected will be used to refine the estimated volume of affected sediments and treatment options.

2.4 Ground Water Sampling

All existing and newly installed monitoring wells will be sampled. The purpose of these samples is to establish contaminant concentrations in the newly installed wells and to evaluate the current contaminant concentrations in existing wells and compare them to past sampling events. Procedures for ground water sampling are outlined in Section 5.4 of this document.

The objective of the ground water sampling is to establish the extent and concentration of contaminants in the ground water on- and off-site. The data collected will be used to refine the extent of affected ground water.

2.5 Surface Water Sampling

Surface water samples will be collected from selected catch basins and catch basin outfalls on-site. The purpose of these samples is to establish the presence or absence of contaminants in run-off water that passes through the storm sewer system at the site. Procedures for surface water sampling are outlined in Section 5.4 of this document.

The objective of the surface water sampling is to establish the extent and concentration of contaminants in storm water run-off. The data collected will be used to establish the presence of contaminants within the storm water utility conduits at the site.

2.6 Waste Disposal

Waste will be produced during the trenching operations and drilling/soil boring and water sampling activities. The waste produced during exploratory trenching activities will be stockpiled on and covered with plastic. A plastic berm will be constructed around the stockpile perimeter to prevent potential run-off. After the completion of trenching activities, a composite sample will be collected from the stockpile for profiling and disposal.

The soil produced from the soil sampling and monitoring well installation will be placed into 55-gallon drums. After the completion of drilling activities, a sample will be collected from the drummed soil for profiling and disposal. The drums will be covered with plastic and stored in the northeast parking lot while awaiting disposal. Waste water produced from sampling activities will be containerized in drums and transferred to the on-site water treatment system.

3.0 SAMPLE LOCATION, FREQUENCY, AND DESIGNATION

Samples to be collected at the site and surrounding areas will be of various media, including soil, sediment, ground water, and surface water. Table 1 summarizes the sample locations, minimum frequencies, and analytes proposed for the site sampling activities. It is anticipated that the test trenches, monitoring wells, and soil borings will be located in the areas shown on Plate 1. The sampling locations are placed in areas with data gaps or areas where data collection will refine existing information on the extent of areas with elevated chemical concentrations. Table 2 is a sampling summary that outlines proposed sampling locations, identifications, types, and analyses.

A minimum of 10 percent of the environmental samples collected will be for QA/QC purposes. These samples will be in the form of duplicate samples, spiked samples, and field and trip blanks. Additional information on QA/QC procedures is contained in the QAPP.

Each sample collected for analysis at the Dover Electronics site will be assigned a specific identification number. The numbering system will be managed by the Site Manager so that each sample is correctly identified and no inadvertent duplications are assigned. The Site Manager will keep a Sample Identification and Tracking Log of all samples by matrix and sample location (Figure 3). Copies of all chain-of-custody forms will also be maintained in this log.

Sample identification numbers may consist of at least up to three separate elements:

- Sequential sample location number.
- Sample type and number.
- Sample depth, if applicable.

Sample locations will be designated by the following codes preceded by a sequential location number or predesignated identification number:

T - Test Trench
MW - Monitoring Well
SB - Soil Boring
CB - Catch Basin
CBO - Catch Basin Outfall

The sample types are designated with the following codes:

SS - Subsurface soil sample
SD - Sediment Sample
GW - Ground Water Sample
SW - Surface Water Sample

4.0 SITE MANAGEMENT PLAN

This section provides general operating guidelines for work to be conducted at the Dover Electronics site including site access, traffic control and organization of the field team. Responsibilities of each of the field team members are also indicated in this narrative.

4.1 Site Control

4.1.1 Site Access

The Universal Plastics facility, located on the subject site, is an active facility; therefore, site access will not be restricted. However, work zones such as trenching areas and drilling sites will be properly barricaded to prevent access by unauthorized personnel.

4.1.2 Traffic Control

Traffic will be restricted from active work zones using traffic cones or barricades as needed.

4.2 Project Organization and Personnel Responsibilities

Shield's project team at the site will work under the direction of the Project Director and Project Manager. Project personnel responsibilities are listed below.

- Project Director: Daniel V. Terrell III, will serve as the Project Director. Mr. Terrell will be responsible for assessing and monitoring the overall project progress, approving project plans and reports, making conclusions/recommendations, and leading major briefings/meeting negotiations.

- Project Manager: Kevin Durham, P.G., will serve as the Project Manager. Mr. Durham's responsibilities will include project team management, being the focal point for day-to-day client interactions and conducting briefings and client regulatory meetings. Mr. Durham will also be responsible for project scheduling, budget monitoring, technical task integration and communications and coordination of team leaders and field efforts. He will also monitor the project for adherence to the QAPP.

- Quality Assurance Officer: Barbara Jones will serve as the Quality Assurance Officer. Ms. Jones has the primary responsibility for overseeing and implementing the quality assurance (QA) program. She reports directly to the Project Director. In her role as Quality Assurance Officer, Ms. Jones will provide independent oversight so that overall QA procedures are in place for the project.

- Site Supervisor: Kreg Mills will be designated as the Site Supervisor. Mr. Mills will be responsible for overseeing all on-site activities. He will also interact with other field personnel so that field efforts are successfully completed. The Site Supervisor will communicate regularly with the Project Manager concerning the project status, additional material and/or labor needs, etc., and keep a daily summary of all on-site activities.

- Site Health and Safety Officer: The Health and Safety Officer is responsible for proper operation of all safety equipment, monitoring activities during site work, selecting the necessary level of personal protection, and enforcing the HASP. Nilda Goxhaj will act as the Health and Safety Officer for this project. The Health and Safety Officer will have the authority to stop work if conditions exceed allowable limits. The Health and Safety Officer will assist other members of the field team as needed to maintain the safe operation of the field program.

- Sample Custody Officer: Kreg Mills will be the Sample Custody Officer. Mr. Mills will be responsible for the proper completion of sample custody forms as well as packing and shipping samples. He will also be responsible for notifying the analytical laboratory of sample shipments including the number and types of samples that are being shipped.

- Sampling Personnel: Sampling personnel are responsible for helping the Site Manager during sample collection. Specific responsibilities include proper sample collection, packaging, documentation, and chain-of-custody documentation until samples are released to another party for storage or transport to the analytical laboratory. Sampling personnel will also be responsible for the correct and complete decontamination of sampling equipment.

- Drilling/Excavation/Surveying Subcontractors: The drilling/excavation/surveying subcontractors are responsible for supplying all services (including labor), equipment and materials required to perform the excavation/drilling/surveying activities. The excavation subcontractors are further responsible for conducting necessary maintenance and QC of required equipment and for following decontamination procedures specified in the Field Sampling Plan (FSP), HASP, and QAPP. Upon completing the work, the subcontractors will be responsible for demobilizing all equipment, cleaning up any materials deposited on-site, and properly filling excavated/drilled areas as directed.

- Analytical Subcontractor: The analytical subcontractor for this portion of the project will be Quanterra Environmental Services, a full-service analytical laboratory. Quanterra will be responsible for the analysis of all waste, soil, sediment, and liquid samples collected from the site. The laboratory will also be responsible for the QA/QC implementation and documentation of all analyses performed on the samples.

5.0 SAMPLING/MONITORING EQUIPMENT AND PROCEDURES

5.1 Introduction

This section of the FSP outlines the step-by-step procedures necessary to perform sampling and other field activities at the site. Site personnel should be trained and familiar with these procedures prior to sampling activities. Any questions on methodology or procedures should be addressed to the Project Director or Site Manager.

All of the site samples will be collected, preserved and stored according to laboratory and USEPA procedures. The laboratory will supply all sampling glassware or other containers necessary for sample collection. A list of equipment and decontamination procedures for sampling activities is contained in Table 3. Persons performing sampling should also be familiar with the HASP and QAPP prepared for this site. Personal Protective Equipment (PPE) levels appropriate for each site activity are contained in Table 4.

A decontamination area will be constructed prior to the start of the RI activities. The decontamination area will be south of the northeast parking lot east of the building. The decontamination pad will be a prefabricated plastic container or a plastic-lined box constructed of 2x4s and cinder blocks. Hollow stem augers, sampling equipment , and the excavator bucket will be placed in the container and pressure washed between borings/trenches/sampling locations.

The water generated during the decontamination process will be pumped out of the decontamination area into 55-gallon drums and transferred to the on-site water treatment system. The sludge/mud produced from the decontamination process will be shoveled into drums and characterized for disposal.

As appropriate, sampling activities will conform to the USEPA document entitled *Compendium of ERT Waste Sampling Procedures* dated January 1991 and the Region II *CERCLA Quality Assurance Manual* dated October 1989.

5.2 Air Monitoring

The purpose of the air monitoring program at the Dover Electronics site is to establish the presence and concentrations of airborne chemicals of concern and to establish the level of worker protection needed. The following equipment may be used for air monitoring at the site: an oxygen/combustible gas indicator; a particulate monitor (Miniram); Dräger tubes; a photoionization detector (PID); and/or a flame ionization detector (FID). All of these field air monitoring instruments will be available for use at any time, especially at the beginning of work or when conditions change.

5.2.1 Air Quality Monitoring

5.2.1.1 Pre-excavation Monitoring

An air quality survey will initially be conducted at the site. This survey will take place in and around the perimeter of the site to establish air quality conditions as well as conditions encountered during the sampling activities. Readings will be collected at the perimeter of the site using a calibrated oxygen/combustible gas indicator, a particulate monitor, and FID or PID at the locations around the building and property perimeter. Readings will be collected 6 to 12 inches above the ground surface and at the breathing zone (approximately 5 feet above the ground surface). Readings will be recorded in a field logbook or on an air monitoring log (Figure 4) and identified so that field locations can be readily found. Table 5 provides an air monitoring equipment list.

5.2.1.2 Excavation/Drilling Monitoring

Readings will also be collected using an FID or PID, a particulate monitor, and a oxygen/combustible gas indicator throughout excavation and drilling activities. These readings will be collected continuously in the active work zone both upwind and downwind to assess air conditions. Readings should be collected in the vicinity of the breathing zone and entered/recorded in the field logbook or air monitoring log. If readings exceed those levels specified in the HASP, PPE levels will be upgraded as appropriate.

5.3 Subsurface Soil and Sediment Sampling

At the Dover Electronics site, subsurface soil and sediment sampling will be conducted as part of the activities described in the RI/FS Work Plan. Subsurface sampling will occur during drilling and test trench excavations. Sediment sampling will be conducted from the catch basins and catch basin outfalls on-site.

Subsurface soil samples will be collected using one or more of the following methods or a combination of sampling techniques:

Method 1 Split spoon sampling through a hollow stem auger conducted during soil boring and monitoring well installation.

Method 2 Backhoe bucket or stainless steel hand auger in test trench excavations that exceed a depth of 4 feet.

Method 3 Stainless steel trowels for stockpiled soils and test trench excavations that do not exceed a depth of 4 feet.

It is anticipated that subsurface soil and sediment sampling activities will be carried out using Level D, C, or B PPE, depending on site conditions and air monitoring results. Field equipment and personnel will set up in an upwind direction from trenching/sampling areas unless field conditions dictate otherwise.

Sediment samples will be collected using one or more of the following methods or a combination of sampling techniques:

Method 1 Stainless steel trowels or shovels for sampling surface sediments in unconfined areas.

Method 2 Stainless steel hand augers for sampling confined space catch basins.

The following equipment is available for field use for soil and sediment sampling: stainless steel spoons and trowels; stainless steel shovels; stainless steel hand augers; disposable equipment; drill rigs with associated equipment (e.g., split-spoon samplers, shelby tubes); and backhoes or track-mounted excavation equipment. Table 6 provides a soil sampling equipment list.

Soil and sediment samples collected for volatile organic compound (VOC) analyses will be containerized immediately. The samples should be placed in precleaned sampling containers, supplied by the laboratory, so that no headspace is left in the container after it is closed. Samples for VOC analyses must be stored at 4°C until they are received by the laboratory.

Headspace analysis will be performed using a calibrated PID/FID in the field on a separate representative portion of each sample. Headspace analysis will be performed on approximately equal sample volumes. The samples will be placed in resealable storage bags and allowed to volatilize at ambient temperatures for approximately 15 minutes.

Some compounds can be detected in the parts per billion and/or parts per trillion range. Extreme care must be taken to prevent cross-contamination of these samples. The following precautions should be taken when trace levels are of concern:

- Sample containers for source samples or samples suspected of containing high concentrations of chemicals will be placed in separate plastic bags immediately after collecting, preserving, tagging, etc.

- Highly contaminated samples will never be placed in the same ice chest with confirmatory samples. Highly contaminated samples should be enclosed in plastic bags before placing them in ice chests. Ice chests or shipping containers for source samples or samples suspected to contain high concentrations of chemicals should be lined with clean plastic bags.

- One member of the field team will take all the notes, fill out labels, etc., while the other member performs the sampling.

- Personnel should use equipment constructed of Teflon®, stainless steel or glass that has been properly precleaned when collecting samples for trace metals or organic compound analyses. Teflon® or glass is preferred for collecting samples where trace metals are of concern. Equipment constructed of plastic or PVC will <u>not</u> be used to collect samples for trace organic compound analyses.

The step-by-step sampling procedures for soil sampling activities at the Dover Electronics site are as follows:

- Review FSP, HASP, and QAPP.

- Assemble equipment.

- Calibrate FID or PID and oxygen/combustible gas indicator.

- Decontaminate equipment (see Table 3).

- Don PPE as appropriate.

- Collect soil sample using stainless steel spoon or shovel, hand auger, split-spoons, shelby tubes, excavator bucket, etc., as appropriate.
- Immediately cap, seal and label a representative portion of the sample for VOC analysis; place in a cooler at 4°C.
- Place a representative portion of the sample into a container for headspace analysis.
- Place sample in appropriate containers for volatiles, semivolatiles, metals, and/or pH analyses; cap the samples, seal and label.
- Collect air readings according to the HASP.
- Record information in field logbook.
- Decontaminate equipment (see Table 3) and move to next sampling location.
- Backfill sample locations as appropriate.
- At the end of each day, ship or transport samples to the laboratory under chain of custody.

To prevent cross contamination, disposable gloves must be worn by sampling personnel and changed between sampling points. Table 6 contains a list of equipment necessary for soil sampling activities.

All equipment used to collect soil samples will be cleaned and repaired, if necessary, before being stored at the conclusion of field studies. Any cleaning conducted in the field or field repairs should be thoroughly documented in field records.

All contaminated samples will be clearly labeled as such when they are submitted for laboratory analyses. Any observations (odor, appearance, container labeling, etc.) made by the field team that might alert the laboratory to potential dangers or provide laboratory personnel with information on possible constituents in the samples (high concentrations) will be explained on the sample label. These observations will be explained verbally to the sample custodian or other laboratory personnel, as necessary.

The collection of auxiliary information and data is particularly important when collecting samples. Any field analyses, including those conducted with safety equipment such as FIDs, particulate monitor, oxygen/combustible gas indicators, or approximate analyses such as those obtained with pH indicator paper, will be recorded in field logbooks. Photographs will be used extensively during sampling operations for recording this information. Documentation of field activities will be conducted by the following:

- Detailed notation in field logbooks.
- Photographs, as appropriate.

- Completion of field forms (e.g., air monitoring log, sample tracking log, etc.).
- Collection of QA samples.

Notations in field logbooks will include at a minimum:

- Time and date of field activities.
- Names of all site personnel including regulators, subcontractors, and others.
- Weather conditions.
- Clear, concise summary of field activities.
- Notation of photographs taken during field activities.
- Documentation and summary of decontamination procedures.
- Problems encountered or unusual occurrences.
- Health and safety information, as appropriate.
- Deviation from any aspects of the RI/FS Work Plan, FSP, HASP or QAPP.

5.4 Ground Water and Surface Water Monitoring/Sampling

5.4.1 Shallow Ground Water and Surface Water Sampling

If encountered, water or liquid samples will be collected from the test trenches. These samples will be collected and handled in a manner similar to surface water samples by dipping or scooping a sample into the laboratory container. Appropriate safety precautions will also be taken if it appears that the sample is leachate or free organic liquid.

A step-by-step checklist for sampling surface water and ground water encountered in catch basins and test trenches is as follows:

- Review the FSP, HASP, and QAPP.
- Assemble supplies and equipment.
- Calibrate temperature, pH, and conductivity meters, if appropriate.
- Decontaminate sampling equipment (see Table 3).
- Don PPE, as appropriate.

- Collect a sample by placing the sample container into material to be sampled or use a dipper, Kemmerer or other sampler, as needed. Sampling equipment will be constructed of stainless steel, glass or Teflon®. For volatile samples, completely fill the vials to eliminate air bubbles.

- Seal and label sample, complete chain of custody, place sample in cooler and keep at 4°C.

- Decontaminate equipment (see Table 3) and move to next sample location.

- Ship or transport samples to the laboratory under chain-of-custody documentation at the end of each day.

In addition to the sampling equipment previously mentioned, a dipper, Kemmerer or other sampler and appropriate sample jars should be at the site for liquid sampling if needed. An equipment list for surface water sampling is contained in Table 7.

5.4.2 Ground Water Sampling (Monitoring Wells)

Monitoring wells will be purged and sampled using a low-flow (minimal drawdown) ground water sampling procedure as outlined in the USEPA Ground Water Issue publication (EPA/540/S-95/504). A copy of this EPA publication is contained in Attachment 1. The wells will be purged with a variable speed water pump at a rate that equals the natural recharge rate of the well.

Measurements of pH, specific conductance, dissolved oxygen, redox potential, turbidity, ferrous iron, and temperature will be made at a minimum of once per the calculated well volume using a flow-through cell as the well is purged until all parameters have stabilized. Stabilization is achieved when three successive readings are within plus or minus 0.1 for pH, plus or minus 3 percent for conductivity, plus or minus 10 mv for redox potential and plus or minus 10 percent for turbidity and DO.

An electronic data logger will collect and store the data. If the natural recharge rate of a well is insufficient to keep up with the minimum purge rate, the well will be purged dry and allowed to recharge a minimum of 4 hours but no more than 24 hours before sampling. After the indicator parameters have stabilized, the water samples will be collected from the end of the discharge tube at a pumping rate of 0.1 to 0.2 L/min or less.

This method allows for the collection of a representative ground water sample by drawing water into a well at its natural recharge rate, therefore minimizing volatilization due to the cascading effect produced by drawdown. Additionally, since the submersible pump is placed within the screened interval of each well, stagnant water trapped within the riser will not mix with the ground water being sampled. For these and other reasons, the above-mentioned USEPA Ground Water Issue publication (p. 6) states that "Bailers are inappropriate devices for low-flow sampling.".

The step-by-step sampling procedures for ground water sampling activities at the site are as follows:

- Review FSP, HASP, and QAPP.

- Assemble equipment.

- Calibrate flow-through cell (i.e., temperature, conductivity, redox, pH, dissolved oxygen, turbidity meter).

- Decontaminate all sampling and monitoring equipment.

- Gauge each well with a ground water level indicator accurate to 0.01 feet.

- Purge each well at a rate that is equal to or less than the natural recharge rate of the aquifer until temperature, conductivity, redox, pH, dissolved oxygen, ferrous iron, and turbidity parameters stabilize, and the ground water does not exceed 50 nephelometric turbidity units (NT). Readings will be collected once per well volume purged.

- Reduce pumping rate to no more than 0.2 L/min.

- Collect ground water samples into the appropriate containers for analyses, with the proper preservative if necessary, label, and place in an iced cooler at 4°C.

- Record all information including the initial ground water level, purge rate, chemical and physical parameters, duration of purging event, etc.

- Decontaminate equipment (see Table 3) and move to the next sampling location.

- At the end of each day, ship or transport samples to the laboratory under chain of custody.

To prevent cross contamination, disposable gloves must be worn by sampling personnel and changed between sampling points. Table 7 contains a list of equipment necessary for surface and ground water sampling activities.

All equipment used to collect water samples will be cleaned and repaired, if necessary, before being stored at the conclusion of field studies. Any cleaning conducted in the field or field repairs should be thoroughly documented in field records.

All contaminated samples will be clearly labeled as such when they are submitted for laboratory analyses. Any observations (odor, appearance, container labeling, etc.) made by the field team that might alert the laboratory to potential dangers or provide laboratory personnel with information on possible constituents in the samples (high concentrations) will be explained on the sample label.

Notations in field logbooks will include at a minimum:

- Time and date of field activities.

- Names of all site personnel including regulators, subcontractors, and others.

- Clear, concise summary of field activities.

- Notation of photographs taken during field activities.
- Weather conditions.
- Documentation and summary of decontamination procedures.
- Problems encountered or unusual occurrences.
- Health and safety information, as appropriate.
- Deviation from any aspects of the RI/FS Work Plan, FSP, HASP or QAPP.

5.4.3 Aquifer Flow Parameters Analysis (Limited Pump Tests)

Aquifer testing will be performed using a step drawdown and limited pump tests on at least four on-site wells. The purpose of the step drawdown test is to establish the maximum drawdown and pumping rate of the wells. The limited pump tests will establish the approximate hydraulic conductivity, transmissivity, and permeability of the aquifer. In addition, the pump tests will establish whether the glacial till aquifer and the sorted sediment aquifer are hydraulically connected. Additional information on the pump tests is contained in the RI/FS Work Plan.

The step-by-step procedures for performing the step drawdown and limited pump tests at the subject site are as follows:

- Review FSP, HASP, and QAPP.
- Decontaminate the water level indicator, submersible pump and pressure transducers/data loggers (See Table 3).
- Place a pressure transducer/data logger and the submersible pump into the pumping well.
- Place a pressure transducer/data logger into the adjacent observation well.
- Set the data loggers to collect water depths in each well at 10 second intervals.
- Adjust the pumping rate of the submersible pump to maintain the maximum drawdown in the well without pumping the well dry.
- Upon determining the pumping rate required to maintain a constant flow rate and the maximum drawdown in the pumping well, discontinue pumping and allow the well to recover to the initial water level.
- When the water level in the pumping well reaches equilibrium, begin the pump test at the predetermined pumping rate.
- Each pump test will run for approximately 5 hours.

- Upon completion of the test, down load the data from the pressure transducers/data loggers onto a computer disk and remove the equipment from the pumping and observation wells.

- Decontaminate equipment (see Table 3) and move to next sample location.

5.5 Field Analytical Procedures

QA procedures for field instruments (FID, PID, particulate monitor, oxygen/combustible gas indicator) are an essential part of these standard operating procedures. To satisfy QA/QC procedures, all field analyses will be conducted in duplicate at least 10 percent of the time. A record of these duplicate analyses will be kept in field logbooks. A significant difference in the replicate analyses will result in recalibration of the instruments used, reexamination of the analytical methodology being used, or re-examination of the sampling procedures and locations.

All field analyses must be traceable to the specific individual performing the analyses and to the specific equipment used. This information will be entered into the field logbooks for all field analyses. Time records will be kept in local time and will be recorded to the nearest 5 minutes. Additional details on the QA/QC procedures are contained in the QAPP.

6.0 SAMPLE HANDLING AND ANALYSES

An NYSDOH ELAP CLP certified laboratory (Quanterra Environmental Services, North Canton, Ohio - Pittsburgh, Pennsylvania) will be used for conducting analyses. When samples arrive at the laboratory, they are logged in, the chain-of-custody forms signed, and the condition of the samples recorded (e.g., any visible signs of tampering or damage).

Laboratory QA/QC procedures typically include using an extracted standard or spike as a quantitative check of the samples. Laboratory verification of any apparent discrepancies will be required prior to data submittal. More detail on these procedures is contained in the QAPP.

6.1 Sample Analysis Methods

Most of the subsurface soil and all of the sediment, surface water and ground water samples will be analyzed for site-specific parameters using USEPA SW-846 Method 8260A. The site-specific parameter list (SSPL) is as follows:

Tetrachloroethene (PCE)
Trichloroethene (TCE)
1,1 - Dichloroethene (1,1-DCE)
1,2 - Dichloroethene ~~Total~~ (1,2-DCE ~~Total~~) Cis & Trans
1,1 - Dichloroethane (1,1-DCA)
1,2 - Dichloroethane (1,2-DCA)

Selected soil samples included in Table 1 will be analyzed for the full Target Analyte List/Target Compound List (TAL/TCL). The samples selected for the TAL/TCL are from areas close to the source area. The TAL/TCL consists of total VOCs (Method 8260A), semivolatile organic compounds (Method 8270B), pesticides/PCBs (8080A), TAL metals (Method 6010) total cyanides (Method 9012) and mercury (Method 7471A). Samples from stockpiled soils requiring disposal will also be submitted for TCLP volatiles analysis (Table 8).

6.2 Sample Preservation Methods

Some samples require preservation immediately upon collection in the field to maintain sample integrity. All samples preserved with chemicals are to be identified with sample tags indicating they have been preserved. All chemical preservatives will be supplied by the laboratory. Preservatives required for routine sample analyses are given in 40 CFR Part 136, Table II (Table 8).

Samples that should <u>not</u> be preserved in the field include the following:

- Samples collected within a hazardous waste site that are known or thought to be highly contaminated with toxic materials. Barrel, closed container, spillage, or other source samples from hazardous waste sites are not to be preserved with any chemical. These samples may be preserved by placing the sample container on ice, if necessary.
- Samples that have extremely low or high pH or that may generate potentially dangerous gases if they were preserved using the procedures given in Table II (40 CFR Part 136).

- Samples for metals analyses that are shipped by air will not be preserved with nitric acid in excess of the amount specified in Table II (40 CFR Part 136).

- Samples for purgeable organic compound analyses that are shipped by air will not be preserved with hydrochloric acid in excess of the amount specified in Table II (40 CFR Part 136).

VOC samples will be containerized immediately and stored at 4°C until they are received by the laboratory. Water samples that will be analyzed for VOCs will be placed in 40-ml vials that contain the appropriate amount of hydrochloric acid (HCL). The HCL will be placed in the sample containers by the laboratory prior to shipment. The HCL will help preserve the sample by lowering the pH of the sample to <2.

If sample acidification causes effervescence, the sample must be submitted without preservation except for cooling to 4°C. This sample property must be appropriately noted when present.

6.3 Sample Containers

The sample container selection is established by the type of analyses required. Table II, 40 CFR Part 136 (Table 8) lists standard sample containers used.

6.4 Shipping Requirements

Samples may be shipped to the laboratory either by vehicles or by common carrier for overnight delivery. Samples must be shipped to the laboratory within 24 hours of collection. Samples collected at the Dover Electronics site will be classified as either environmental or hazardous material samples. Examples of environmental samples include drinking water, ground water, surface water, soil, sediment, or effluent not known to contain high concentrations of hazardous materials. Samples known to contain hazardous materials may require shipment as dangerous goods. The Project Manager will make this designation at the site.

6.5 Holding Times

The elapsed time between sample collection and the initiation of laboratory analyses must be within a specific time frame, which is dependent upon the type of analysis. Holding times for routine samples are shown in Table II, 40 CFR Part 136 (Table 8).

6.6 Sample Documentation

All sample identification, field records, and chain-of-custody records will be recorded with waterproof, nonerasable ink. If errors are made in any of these documents, field personnel will make corrections by simply crossing a single line through the error and entering the correct information. All corrections will be initialed and dated by the sampler. If possible, all corrections should be made by the individual making the error.

If stick-on labels are used to enter information onto sample tags, logbooks, or sample containers, these labels should not be able to be removed later without leaving obvious indications of the attempt. Labels should never be placed over previously recorded information. Corrections to information recorded on stick-on labels should be made as stated in the previous paragraph.

6.6.1 Sample Identification

The method of sample identification used depends on the type of sample collected. Sample identification procedures for soil, air, or water samples have been previously discussed in Section 3. Samples for in situ field analyses are those collected for specific field analyses or measurements where the data are recorded directly in bound field logbooks or recorded directly on the chain-of-custody record. Examples of such in situ field measurements and analyses include DRI readings, pH, temperature, turbidity and conductivity. Also included in this category are those field measurements or analyses such as surveying measurements that are made with field instruments or analyzers where no sample is actually collected. As much as possible, the identification procedures for in-situ field analyses will conform with the labeling described in Section 3.

6.6.1.1 Sample Labels

Samples, other than those collected for in situ field measurements or analyses, are identified by using a standard sample label (Figure 5) that is attached to the sample container. The sample labels are sequentially numbered. The following information will be included on the sample label:

- Client's name.
- Job number.
- Sample identification number.
- Date and time of sample collection.
- Signature(s) of the sampler(s) or the designated sampling team leader.
- Whether the sample is preserved or unpreserved.
- General types of analyses to be conducted (parameter).
- If a sample is split with a regulatory agency or other party, sample labels with identical information should be attached to each sample container by the party receiving the split sample. Blind, duplicate, spiked or blank samples will not be identified as such, but will be given fictitious identification numbers. Complete documentation on the submission of blind samples will be recorded in bound field logbooks for future reference.

6.6.1.2 Custody Seals

Sample coolers will be sealed prior to shipment using a custody seal (Figure 6). At a minimum, the sampler will provide the following information on the custody seal:

- Site at which the sample was collected.
- Sample identification number.

- Date collected.
- Sampler's signature and organization.

6.6.2 Chain-of-Custody Procedures

The possession of samples or other physical materials will be traceable from the time they are obtained until they are received by the laboratory. A sample is in custody if:

- It is in the field investigator's or the transferee's actual possession; or
- It is in the field investigator's or the transferee's view, after being in his/her physical possession; or
- It was in the field investigator's or the transferee's physical possession and then he/she secured it to prevent tampering; or
- It is placed in a designated secure area.

6.6.2.1 Chain-of-Custody Record

The field chain-of-custody record (Figure 7) is used to record the custody of all samples collected and maintained by field sampling personnel. The chain-of-custody record also serves as a sample logging mechanism for the receiving laboratory.

The following minimum information must be supplied to complete the field chain-of-custody record:

- Project job number.
- Project name.
- All samplers and/or the sampling team leader must sign the designated signature block.
- Sample identification number, date and time of sample collection, grab or composite sample designation, the sample matrix, and a brief description of the sample location.
- The total number of sample containers and the method of preservation.
- The field sampler(s) and subsequent transferee(s) must document the transfer of the samples listed on the record in the spaces provided at the bottom of the record. One of the samplers documented under the sampler(s) section must be the person that originally relinquished the samples/evidence or a designated field sample custodian who receives and maintains samples from sampling teams under secure conditions. Both the person relinquishing the samples and the person receiving them must sign the form; the date and time that this occurred must be documented in the proper space on the record. Usually, the last person receiving the samples or evidence should be a laboratory sample custodian or other evidence clerk.

- The remarks section at the bottom of the record is used to record airbill numbers or registered or certified mail serial numbers.

The chain-of-custody record is a legal document. Once the record is completed, it becomes an accountable document and must be maintained in the project file.

6.6.2.2 Field Custody Procedures

- To simplify the chain-of-custody record and eliminate potential litigation problems, as few people as possible should handle the sample or physical evidence during the investigation or inspection.

- The field sampler is responsible for the proper handling and custody of the samples collected until they are properly and formally transferred to another person or facility.

- Sample labels (Figure 5) will be completed for each sample using waterproof, nonerasable ink.

- All coolers will be sealed prior to shipment using a custody seal such as that shown on Figure 6.

- All samples must be documented in bound field logbooks.

- A chain-of-custody record will be completed for all samples. A separate chain-of-custody record will be used for each final destination or laboratory used for sample analysis.

6.6.2.3 Transfer of Custody and Shipment

- All samples will be accompanied by a chain-of-custody record. When transferring the possession of samples, the individual receiving the samples will sign, date, and note the time that he/she received the samples on the chain-of-custody record. This chain-of-custody record documents transfer of custody of samples from the field sampler to other persons, laboratories, or other entities.

- Samples will be properly packaged for shipment and delivered or shipped to the designated laboratory for analyses. Shipping containers will be secured by using strapping tape and custody seals. The custody seals will be placed on the containers so that they cannot be opened without breaking the seals. The seals will be signed and dated by the field sampler/team leader.

- When samples are split with any party, that party should sign the chain-of-custody record.

The original and one copy of the chain-of-custody record will be placed in a plastic bag inside the secured shipping container when samples are shipped. One copy of the record will be retained by the field sampler or team leader. The original record will be transmitted to the field sampler or team leader after samples are accepted by the laboratory. This copy will become a part of the project file.

6.6.3 Field Records

Field sampling personnel will use only bound field logbooks for the maintenance of field records. Other bound logbooks such as bound surveyors logbooks are acceptable as long as pages cannot be removed without tearing them out.

Preferably, logbooks should be dedicated specifically to the project. The sampler's name, project name, and project code should be entered on the inside of the front cover of the logbook. All entries should be dated and the time of entry recorded. At the end of each day's activity or entry of a particular event, if appropriate, the sampler should draw a diagonal line at the conclusion of the entry and initial it indicating the conclusion of the entry or the day's activity.

All aspects of sample collection and handling as well as visual observations will be documented in the field logbooks. All sample collection equipment (where appropriate), field analytical equipment, and equipment used to make physical measurements should also be identified in field logbooks. All calculations, results, and calibration data for field sampling, field analytical, and field physical measurement equipment will also be recorded in the field logbooks. All field analyses and measurements must be traceable to the specific piece of field equipment used and to the field sampler collecting the sample, or making the measurement or analyses.

All entries in field logbooks will be dated, will be legible, and will contain accurate and conclusive documentation of an individual's project activities. Since field records are the basis for later written reports, language should be objective, factual, and free of personal notes or other terminology that might prove inappropriate. Once completed, these field logbooks become accountable documents and must be maintained as part of the project files.

6.6.4 Photographs

All photographs taken by sampling personnel will be identified on the back of the print with the following information:

- An accurate description of what the photograph shows, including the name of the facility or site and its location.

- Orientation of the photograph (e.g., looking northeast, etc.).

- Signature of the photographer.

If the photograph was taken with a Polaroid camera, the information will be entered on the back of each photograph as soon as it is taken, including the date and time of the photograph. If a 35mm camera is used, it should be equipped with an automatic date stamp. A serial-type record of each frame exposed will be kept in the bound field logbook along with the information required for each photograph. The film will be developed, and the field sampler will then enter the required information on the prints, using the serialized photographic record from the bound field logbook to identify each photograph.

7.0 REFERENCES

NIOSH/OSHA/USCG/USEPA. 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*.

U.S. Environmental Protection Agency. January 1991. *Compendium of ERT Waste Sampling Procedures*. EPA/540/P-91/008.

U.S. Environmental Protection Agency. June 1986. *Superfund Remedial Design and Remedial Action Guidance*. PB88-107529.

U.S. Environmental Protection Agency. 1986. 1992. 1993. 1994. 1995. *Test Methods for Evaluating Solid Waste*. Updates I, IIA, II, IIB. SW-846. (3rd Edition).

U.S. Environmental Protection Agency. October 1989. *Region II CERCLA Quality Assurance Manual*.

Figures

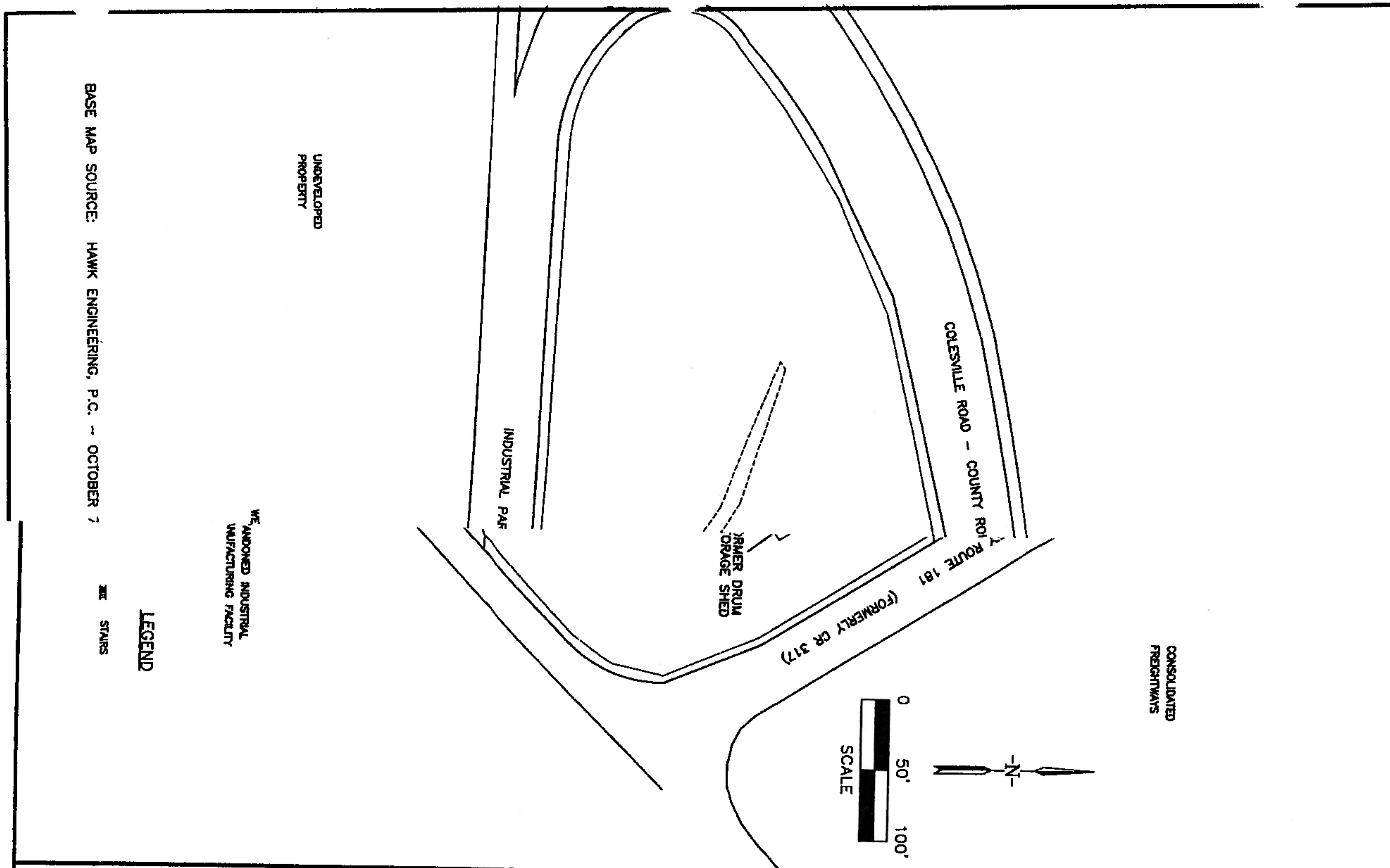
-N-

0 1,000' 2,000'

SCALE

SOURCE: USGS Topographic Quadrangle Map
Binghamton East, New York – 1968

DATE: 7/27/98	FIGURE 1	**SHIELD**
DRAWN BY: P.D.H.	SITE LOCATION MAP	ENVIRONMENTAL ASSOCIATES, INC.
APPROVED BY: K.D.	DOVER ELECTRONICS SITE	
CLIENT NO.: 395-0430	KIRKWOOD, NEW YORK	LEXINGTON, KENTUCKY



DATE: 7/27/98
DRAWN BY: P.D.H.
APPROVED BY: K.D.
CLIENT NO.: 395–0430

FIGURE 2
SURROUNDING PROPERTIES, BUILDING ADDITIONS, AND HISTORICAL SITE FEATURES
DOVER ELECTRONICS SITE
KIRKWOOD, NEW YORK

SHIELD
ENVIRONMENTAL ASSOCIATES, INC.
LEXINGTON, KENTUCKY

50430-48

DOVER ELECTRONICS SITE

Sample Identification and Tracking Log

Sample Matrix of Location: ____________

SAMPLE IDENTIFICATION NUMBER	DATE SAMPLE COLLECTED	ANALYTES	C of C No.	DATE SHIPPED TO LAB	DATE ANALYSES RECEIVED	COMMENTS

DATE: 8/14/98

DRAWN BY: JAG

APPROVED BY: KMD

CLIENT NO.: 395-0430

FIGURE 3

SAMPLE IDENTIFICATION AND TRACKING LOG

DOVER ELECTRONICS SITE

KIRKWOOD, NEW YORK

SHIELD

ENVIRONMENTAL ASSOCIATES, INC.

LEXINGTON, KENTUCKY

C:\SHIELD\395-0430

DOVER ELECTRONICS SITE

Air Monitoring Log

Location	Date	Time	Taken By	OVA (ppm)	Hnu (ppm)	Oxygen (ppm)	Carbon Monoxide (%)	Combustible Gas (% LEL)	Instrument ID No.	Notes/Other

Note : Always collect background readings upwind from the work area prior to the start of activities and record in the log book.

C:\SHIELD\395-0430

DATE: 8/14/98	FIGURE 4	SHIELD ENVIRONMENTAL ASSOCIATES, INC.
DRAWN BY: JAG	AIR MONITORING LOG	LEXINGTON, KENTUCKY
APPROVED BY: KMD	DOVER ELECTRONICS SITE	
CLIENT NO.: 395-0430	KIRKWOOD, NEW YORK	

SHIELD ENVIRONMENTAL ASSOCIATES, INC.
3150 Custer Drive, Suite 301, Lexington, KY 40517

Site:__________ Project:__________

Sample ID:__________

Date:__________ Time:__________

Sampler:__________ Analysis:__________

DATE: 8/14/98	FIGURE 5	SHIELD ENVIRONMENTAL ASSOCIATES, INC. LEXINGTON, KENTUCKY
DRAWN BY: JAG	STANDARD SAMPLE LABEL	
APPROVED BY: KMD	DOVER ELECTRONICS	
CLIENT NO.: 395-0430	KIRKWOOD, NEW YORK	

Nº 069466

Quanterra Environmental Services

Custody Seal

DATE ______________________

SIGNATURE ______________________

Quanterra Environmental Services

Nº 069466

DATE: 8/14/98	FIGURE 6	SHIELD ENVIRONMENTAL ASSOCIATES, INC. LEXINGTON, KENTUCKY
DRAWN BY: JAG	CUSTODY SEAL	
APPROVED BY: KMD	DOVER ELECTRONICS SITE	
CLIENT NO.: 395-0430	KIRKWOOD, NEW YORK	

C:\SHIELD\395-0430

SHIELD ENVIRONMENTAL ASSOCIATES, INC.

3150 CUSTER DRIVE, SUITE 301
LEXINGTON, KY 40517
PHONE (606) 271-0269
FAX (606)271-1204

PROJECT NAME ______________ CONTACT NAME ______________ TELEPHONE NO. ______________

Samplers: Print Name		Signature									ANALYSIS									
Project No.						Sample Type														
SAMPLE ID	SAMPLE LOCATION	Composite	Grab	Date	Time	Water	Liquid	Oil	Solid	No. of Containers										REMARKS

COMMENTS: ____

Relinquished by: (Signature)			Received by: (Signature)	Date	Time
Relinquished by: (Signature)			Received by: (Signature)	Date	Time
Dispatched by: (Signature)	Date	Time	Received for Laboratory by:	Date	Time
Method of Shipment				Date	Time

DATE: 8/14/98	FIGURE 7	SHIELD ENVIRONMENTAL ASSOCIATES, INC.
DRAWN BY: JAG	CHAIN-OF-CUSTODY RECORD	LEXINGTON, KENTUCKY
APPROVED BY: KMD	DOVER ELECTRONICS SITE	
CLIENT NO.: 395-0430	KIRKWOOD, NEW YORK	

C:\SHIELD\395-0430

Tables

TABLE 1
SAMPLE LOCATION AND FREQUENCY SUMMARY

Sample Location	Sample Type	Number of Samples	Analyses/Extraction
Test Trenches 1-10	Soil	1-2 grab per trench[1]	Site-Specific Parameter List
	Water/liquid	1 grab[2]	Site-Specific Parameter List
Test Trenches 11-13	Soil	1-2 grab per trench[1]	TCL/TAL
	Water/liquid	1 grab[2]	TCL/TAL
Soil Borings	Soil	1-2 sample per boring	Site-Specific Parameter List or TCL/TAL
Monitoring Wells	Soil	3-6 samples per well	Site-Specific Parameter List
	Water/liquid	1 grab per well	Site-Specific Parameter List
Sediment Samples	Soil	1 grab per sampling point*	Site-Specific Parameter List
Surface Water Samples	Water	1 grab per sampling point	Site-Specific Parameter List

[1] One grab sample of affected material if contamination is observed.
[2] A water sample will be collected, if present.
Site Specific Parameter List: PCE, TCE, 1,1-DCE, 1,2-DCE, 1,1-DCA, 1,2-DCA(chlorides, sulfates, nitrates ground water only)
TCL/TAL - Target Compound List/Target Analyte List

TABLE 2
SAMPLING SUMMARY

Location	Sample ID	Estimated Trench/Sample Depth	Samples	Analysis	Comments
Test Trench 1	T1-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T1-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T1-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 2	T2-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T2-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T2-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 3	T3-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T3-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T3-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 4	T4-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T4-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T4-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 5	T5-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T5-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T5-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 6	T6-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T6-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T6-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 7	T7-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T7-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T7-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 8	T8-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T8-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T8-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 9	T9-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T9-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T9-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 10	T10-SS1	4-6'	grab sample	SSPL	Sample collected from native soil
	T10-SS2	2-4'	grab sample	SSPL	Sample collected only if contamination is observed.
	T10-GW		grab sample	SSPL	Ground water sampled if present.
Test Trench 11	T11-SS1	4-6'	grab sample	TAL/TCL	Sample collected from native soil
	T11-SS2	2-4'	grab sample	TAL/TCL	Sample collected only if contamination is observed.
	T11-GW		grab sample	TAL/TCL	Ground water sampled if present.
Test Trench 12	T12-SS1	4-6'	grab sample	TAL/TCL	Sample collected from native soil
	T12-SS2	2-4'	grab sample	TAL/TCL	Sample collected only if contamination is observed.
	T12-GW		grab sample	TAL/TCL	Ground water sampled if present.
Test Trench 13	T13-SS1	4-6'	grab sample	TAL/TCL	Sample collected from native soil
	T13-SS2	2-4'	grab sample	TAL/TCL	Sample collected only if contamination is observed.
	T13-GW		grab sample	TAL/TCL	Ground water sampled if present.

Table 2 (continued)

Location	Sample ID	Estimated Sample Depth	Samples	Analysis	Comments
Monitoring Well 1	MW1-GW		grab sample	TAL/TCL	
Monitoring Well 2	MW2-GW		grab sample	SSPL	
Monitoring Well 3	MW2-GW		grab sample	SSPL	
Monitoring Well 5	MW2-GW		grab sample	SSPL	
Monitoring Well 6	MW2-GW		grab sample	SSPL	
Monitoring Well 7	MW2-GW		grab sample	SSPL	
Monitoring Well 8	MW2-GW		grab sample	SSPL	
Monitoring Well 9	MW2-GW		grab sample	SSPL	
Monitoring Well 11	MW2-GW		grab sample	SSPL	
Monitoring Well 12	MW2-GW		grab sample	SSPL	
Monitoring Well 13	MW2-GW		grab sample	SSPL	
Monitoring Well 14	MW2-GW		grab sample	SSPL	
Monitoring Well 15	MW15 (SS8-10') MW15 (SS18-20') MW15 (SS28-30') MW15-GW	8-10' 18-20' 28-30'	grab sample grab sample grab sample grab sample	SSPL SSPL SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 16	MW16 (SS8-10') MW16 (SS18-20') MW16 (SS28-30') MW16-GW	8-10' 18-20' 28-30'	grab sample grab sample grab sample grab sample	SSPL SSPL SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 17	MW17(SS8-10') MW17-GW	8-10'	grab sample grab sample	SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 18	MW18(SS8-10') MW18-GW	8-10'	grab sample grab sample	SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 19	MW19(SS8-10') MW19-GW	8-10'	grab sample grab sample	SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 20	MW20(SS8-10') MW20 (SS18-20') MW20-GW	8-10' 18-20'	grab sample grab sample grab sample	SSPL SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.

Table 2 (Continued)

Monitoring Well 21	MW21(SS8-10') MW21-GW	8-10'	composite sample grab sample	SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 22	MW22(SS8-10') MW22(SS18-20') MW22-GW	8-10' 18-20'	grab sample grab sample grab sample	SSPL SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 23	MW23(SS8-10') MW23 (SS18-20') MW23 (SS28-30') MW23(SS38-40') MW23(SS48-50') MW23-GW	8-10' 18-20' 28-30' 38-40' 48-50'	grab sample grab sample grab sample grab sample grab sample grab sample	TAL/TCL SSPL SSPL SSPL SSPL TAL/TCL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 24	MW24(SS8-10') MW24(SS18-20') MW24 (SS28-30') MW24(SS38-40') MW24-GW	8-10' 18-20' 28-30' 38-40'	grab sample grab sample grab sample grab sample grab sample	SSPL SSPL SSPL SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Monitoring Well 25	MW25(SS8-10') MW25(SS18-20') MW25(SS28-30') MW25(SS38-40') MW25-GW	8-10' 18-20' 28-30' 38-40'	grab sample grab sample grab sample grab sample grab sample	SSPL SSPL SSPL SSPL SSPL	Depth of sample analyzed may be altered based on field screening results.
Soil Boring 1	SB1(SS8-10')	8-10'	grab sample	TCL/TAL	Depth and number of samples may be altered based on field screening results.
Soil Boring 2	SB2(SS8-10')	8-10'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 3	SB3(SS8-10')	8-10'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 4	SB4(SS8-10')	8-10'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 5	SB5(SS8-10')	8-10'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 6	SB6(SS5-7')	5-7'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 7	SB7(SS5-7')	5-7'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 8	SB8(SS5-7')	5-7'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 9	SB9(SS5-7')	5-7'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 10	SB10(SS5-7')	5-7'	grab sample	SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 11	SB11(SS1-3') SB11(SS8-10')	1-3' 8-10'	grab sample grab sample	TAL/TCL TAL/TCL	Depth and number of samples may be altered based on field screening results.
Soil Boring 12	SB12(SS1-3') SB12(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.

Table 2 (Continued)

Soil Boring 13	SB13(SS1-3') SB13(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 14	SB14(SS1-3') SB14(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 15	SB15(SS1-3') SB15(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 16	SB16(SS1-3') SB16(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 17	SB17(SS1-3') SB17(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 18	SB18(SS1-3') SB18(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 19	SB19(SS1-3') SB19(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 20	SB20(SS1-3') SB20(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 21	SB21(SS1-3') SB21(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 22	SB22(SS1-3') SB22(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 23	SB23(SS1-3') SB23(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 24	SB24(SS1-3') SB24(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 25	SB25(SS1-3') SB25(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 26	SB26(SS1-3') SB26(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 27	SB27(SS1-3') SB27(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Soil Boring 28	SB28(SS1-3') SB28(SS8-10')	1-3' 8-10'	grab sample grab sample	SSPL SSPL	Depth and number of samples may be altered based on field screening results.
Catch Basin 1846	CB1846-SD CB1846-SW	NA NA	grab sample grab sample	SSPL SSPL	
Catch Basin 1846 Outfall	CBO1846-SD CBO1846-SW	NA NA	grab sample grab sample	SSPL SSPL	
Catch Basin 2044	CB2044-SD CB2044-SW	NA NA	grab sample grab sample	SSPL SSPL	
Catch Basin 2077	CB2077-SD CB2077-SW	NA NA	grab sample grab sample	SSPL SSPL	
Catch Basin 1547	CB1547-SD CB1547-SW	NA NA	grab sample grab sample	SSPL SSPL	
Catch Basin 1547 Outfall	CBO1547-SD CBO1547-SW	NA NA	grab sample grab sample	SSPL SSPL	

Table 2 (Continued)

West Property Line Outfall	WPLO-SD WPLO-SW	NA NA	grab sample grab sample	SSPL SSPL	
South Property Lime Outfall	SPLO-SD SPLO-SW	NA NA	grab sample grab sample	SSPL SSPL	

SSPL - Site Specific Parameter List: PCE, TCE, 1,1-DCE, 1,2-DCE, 1,1-DCA, 1,2-DCA (sulfates, nitrates, chlorides for ground water only)
NA - Not Applicable

TABLE 3
EQUIPMENT AND DECONTAMINATION PROCEDURES FOR SAMPLING EQUIPMENT

Equipment

- Containers for contaminated soil or water and equipment
- Brush for removing soil accumulations
- Tap water
- Distilled or purified water
- Alconox or other biodegradable detergent
- Brush for washing equipment
- Containers or buckets for handling wash and rinse waters
- Steam cleaner, if required
- 10% nitric acid (HNO_3)
- Acetone, methanol or hexane
- Aluminum foil

Decontamination Procedures

- Remove/brush accumulations of dirt and containerize or stockpile for disposal.
- Place sampling equipment in container with soapy water using a brush to remove any particulate matter or surface film.
- Rinse equipment thoroughly with tap water (hot water if available). Tap water may be used from any municipal water treatment system.
- Rinse with 10% nitric acid if sampling for metals. Carbon steel split spoons should be rinsed with 1% nitric acid to reduce the possibility of leaching metals.
- Tap water rinse (hot water if available).
- Acetone only rinse or methanol followed by hexane rinse when sampling for organics.
- Perform final rinse with analyte-free water. Analyte-free water must comply with requirements outlined in Section 4.6 of the QAPP.
- Air dry and wrap in aluminum foil.
- If equipment will not be used immediately, store in a clean, dry, tamperproof area.
- If equipment is grossly contaminated, additional washes and rinses may be required.
- Containerize wash waters and soils; seal and label for disposal.

Notes: Steam cleaning may be substituted for wash and rinse steps.

TABLE 3 (Continued)

Decontamination Procedures (Low-Flow Sampling Equipment)

- Pre-rinse: Operate pump in a deep basin containing 8-10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

- Wash: Operate pump in a deep basin containing 8-10 gallons of nonphosphate detergent solution, such as Alconox, for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes.

- Rinse: Operate pump in a deep basin containing 8-10 gallons of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

- Final Rinse: Operate pump in a deep basin containing deionized/distilled water to pump out 1 to 2 gallons of this final rinse water.

- Containerize wash waters and soils; seal and label for disposal.

Monitoring instruments or other equipment that cannot be washed should be covered with plastic bags or other suitable material to prevent contamination. Sampling equipment that requires plastic tubing should be disassembled and the tubing replaced with clean tubing between samples.

TABLE 4
SUMMARY OF SITE ACTIVITIES AND PPE LEVELS

Site Activity	PPE Level*
• Subsurface soil sampling (Excavation/Drilling)	D+
• Ground water sampling	D
• Surface sediment and surface water sampling	D
• Air monitoring during excavation and/or drilling	D+
• Pilot studies	D

* PPE levels may be upgraded depending upon air monitoring results.

\+ Level D will be used for all sampling activities unless air readings indicate Level C or B is warranted.

TABLE 5
AIR MONITORING EQUIPMENT LIST

Sampling Equipment/Materials:

- Field Sampling and Analysis Plan, Health and Safety Plan, and Quality Assurance Project Plan
- Site map
- Particulate Monitor (Miniram PDM-3)
- FID or PID
- Oxygen/combustible gas indicator
- Calibration logs and gases
- Field logbook
- Personal protective equipment (PPE)

TABLE 6
SOIL AND SEDIMENT SAMPLING EQUIPMENT LIST

Sampling Equipment:

- Field Sampling and Analysis Plan, Health and Safety Plan, and Quality Assurance Project Plan
- Personal protective equipment, as appropriate
- Decontamination equipment
- Excavator
- Drill Rig
- Plastic for stockpiling
- Stainless steel spoons, scoops, and shovels
- Hand augering equipment
- Bentonite powder for sealing borings
- Disposable latex gloves/nitrile gloves. Disposabel latex gloves will be used during soil sampling activities. If free product is encountered, the sampling gloves will be changed to nitrile gloves.
- Sample jars, seals, labels, chain-of-custody forms, and aluminum foil
- Cooler and ice
- FID or PID
- Oxygen/combustible gas indicator
- Particulate monitor (Miniram PDM-3)
- Field logbook
- Stake or marker to locate trench/boring
- Measuring tape
- Site map
- Camera

TABLE 7
GROUND WATER AND SURFACE WATER SAMPLING EQUIPMENT LIST

Sampling Equipment:

- Field Sampling and Analysis Plan, Health and Safety Plan, and Quality Assurance Project Plan
- Personal protective equipment, as appropriate
- Decontamination equipment
- Water level indicator
- Variable-rate submersible pump with Teflon® tubing
- In-line pH, redox, turbidity, dissolved oxygen, temperature meter
- Sample jars, seals, labels, chain-of-custody forms
- Cooler and ice
- Disposable latex sampling gloves
- Field log book
- Site Map
- Camera

TABLE 8
SUMMARY OF ANALYTICAL METHODS, CHEMICAL CONTAINERS, PRESERVATION METHODS AND SAMPLE VOLUMES

Compound	SW846 Method	Matrix	Container	Preservation	Amount Required	Holding Time
Total Volatile Organic Compounds and SSPL	8260A 8260A	solid aqueous	G, TFE G, TFE	cool 4°C 1:1 HCl, cool 4°C	4 oz 3 x 40 ml	10 days
Semivolatile Organic Compounds	8270B 8270B	solid aqueous	G, TFE G, TFE	cool 4°C cool 4°C	8 oz 1 L	**
Pesticides/PCBs	8080A 8080A	solid aqueous	G, TFE G, TFE	cool 4°C cool 4°C	8 oz 1 L	**
TAL Metals	6010A 6010A	solid aqueous	G,TFE P	cool 4°C HNO_3 to pH<2	4 oz 1 L	6 months
Mercury	7471A	solid aqueous	G,TFE P	cool 4°C HNO_3 to pH<2	4 oz 1L	6 months
Total Cyanide	9012 9012	solid aqueous	P P	cool 4°C HNO_3 to pH<2	4 oz 250 ml	6 months
pH		solid aqueous	P P	none required none required	4 oz 250 ml	analyze immediately
TCLP - volatiles	8260A	waste	G, TFE	cool 4°C	2x1 L	*
Sulfates	300	aqueous	P	cool 4°C	500 ml	28 days
Nitrates	300	aqueous	P	cool 4°C	500 ml	48hours
Chlorides	300	aqueous	P	cool 4°C	500 ml	28 days

* TCLP - volatiles -- 14 days until extraction, 14 days extraction to analysis
** 7 days until extraction, 14 days to analysis
SSPL - Site-Specific Parameter List
G - Glass
P - Plastic
TFE - Teflon coated Lid

Don't use in future 10/10/98 KP

ATTACHMENT 1

USEPA LOW-FLOW SAMPLING GUIDANCE

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-95/504 April 1996

EPA Ground Water Issue

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

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

Background

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

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I. Introduction

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

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Technology Support Project

Superfund Technology Support Center for Ground Water

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

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

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

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

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

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

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

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

II. Monitoring Objectives and Design Considerations

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

A. Data Quality Objectives (DQOs)

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

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

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

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

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

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

B. Sample Representativeness

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

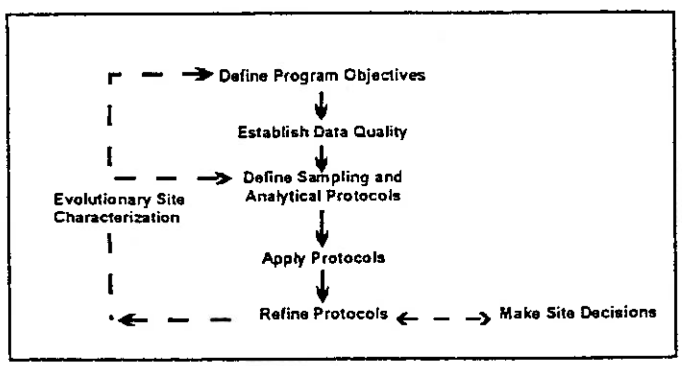

Figure 1. Evolutionary Site Characterization Model

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

1) Questions of Scale

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

2) Target Parameters

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

C. Sampling Point Design and Construction

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

1) Compatibility with Monitoring Program and Data Quality Objectives

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

2) Flexibility of Sampling Point Design

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

3) Equilibration of Sampling Point

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

III. Definition of Low-Flow Purging and Sampling

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

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

A. Low-Flow Purging and Sampling

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

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

B. Water Quality Indicator Parameters

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

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

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

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

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

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

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

Some disadvantages of low-flow purging are:

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

IV. Low-Flow (Minimal Drawdown) Sampling Protocols

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

A. Sampling Recommendations

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

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

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

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

B. Equipment Calibration

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

C. Water Level Measurement and Monitoring

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

D. Pump Type

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

1) General Considerations

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

2) Advantages and Disadvantages of Sampling Devices

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

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

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

E. Pump Installation

Dedicated sampling devices (left in the well) capable of pumping and sampling are preferred over <u>any</u> other type of device. Any portable sampling device should be slowly and carefully lowered to the middle of the screened interval or slightly above the middle (e.g., 1-1.5 m below the top of a 3 m screen). This is to minimize excessive mixing of the stagnant water in the casing above the screen with the screened interval zone water, and to minimize resuspension of solids which will have collected at the bottom of the well. These two disturbance effects have been shown to directly affect the time required for purging. There also appears to be a direct correlation between size of portable sampling devices relative to the well bore and resulting purge volumes and times. The y is to minimize disturbance of water and solids in the well ₄sing.

F. Filtration

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

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

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

G. Monitoring of Water Level and Water Quality Indicator Parameters

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

H. Sampling, Sample Containers, Preservation and Decontamination

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

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

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

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

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

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

I. Blanks

The following blanks should be collected:

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

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

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

V. Low-Permeability Formations and Fractured Rock

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

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

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

1. Low-Flow Purging and Sampling with Pumps

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

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

2. Passive Sample Collection

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

B. Fractured Rock

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

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

VI. Documentation

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

VII. Notice

The U.S. Environmental Protection Agency through its Office of Research and Development funded and managed the research described herein as part of its in-house research program and under Contract No. 68-C4-0031 to Dynamac Corporation. It has been subjected to the Agency's peer and administrative review and has been approved for publication as an EPA document. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

VIII. References

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Figure 2. **Ground Water Sampling Log**

Project ______________ **Site** ______________ **Well No.** ______________ **Date** ______________

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

Sampling Device ______________ **Tubing type** ______________ **Water Level** ______________

Measuring Point ______________ **Other Infor** ______________

____

Sampling Personnel ____

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

Type of Samples Collected

____

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

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

Project ______________ **Site** ______________ **Well No.** ______________ **Date** ______________

Well Depth ______________ **Screen Length** ______________ **Well Diameter** ______________ **Casing Type** ______________

Sampling Device ______________ **Tubing type** ______________ **Water Level** ______________

Measuring Point ______________ **Other Infor** ______________

Sampling Personnel ______________

Time	Pump Rate	Turbidity	Alkalinity	[ ] Conc	Notes

Type of Samples Collected

____

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

APPENDIX B
HEALTH AND SAFETY PLAN

Dover/Universal Instruments

Former Dover Electronics
Kirkwood, New York

June 2003

BBL
BLASLAND, BOUCK & LEE, INC.
engineers & scientists

consultants with focus

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1. Introduction

1.1 Objective

The objective of site activities is to conduct ongoing site monitoring duties at the Universal Instruments facility in Kirkwood, New York.

Field activities will include:

- Mobilization;
- Soil Excavation and restoration;
- Active Slab Depressurization System installation;
- Post-excavation soil sampling;
- Roof drain leader abandonment and replacement;
- Stormwater outfall extension; and
- Demobilization.

The objective of this Health and Safety Plan (HASP) is to provide a mechanism for establishing safe working conditions at the site. The safety organization, procedures, and protective equipment have been established based on an analysis of potential physical, chemical, and biological hazards. Specific hazard control methodologies have been evaluated and selected to minimize the potential of injury, illness, or other hazardous incident.

1.2 Site and Facility Description

Dover Electronics site is located at 29 Industrial Park Road, Broome County, Kirkwood, New York. The site is in an industrial area. Previous site activities impacted soil and groundwater at the site.

1.3 Policy Statement

The policy of Blasland, Bouck & Lee, Inc. (BBL) is to provide a safe and healthful work environment. No aspect of operations is of greater importance than injury and illness prevention. A fundamental principle of safety management is that all injuries, illnesses, and incidents are preventable. BBL will take every reasonable step to eliminate or control hazards in order to minimize the possibility of injury, illness, or incident.

This HASP prescribes the procedures that must be followed during activities at the site. Operational changes that could affect the health and safety of personnel, the community, or the environment will not be made without the prior approval of the Project Manager (PM) and the Health and Safety Officer (HSO). This document will be reviewed periodically to ensure that it is current and technically correct. Any changes in site conditions and/or the scope of work will require a review and modification to this HASP. Such changes will be completed in the form of an addendum or a revision to the plan.

The provisions of this plan are mandatory for all BBL personnel and BBL subcontractors assigned to the project. Subcontractors may prepare their own site-specific HASPs that must meet the basic requirements of this HASP. All visitors to BBL work areas at the site must abide by the requirements of this plan.

1.4 References

This HASP complies with applicable Occupational Safety and Health Administration (OSHA) regulations, United States Environmental Protection Agency (USEPA) regulations, and BBL health and safety policies and procedures. This plan follows the guidelines established in the following:

- *Standard Operating Safety Guides*, USEPA (Publication 9285.1-03, June 1992).
- *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, NIOSH, OSHA, USCG, USEPA (86116, October 1985).
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1910.
- *Title 29 of the Code of Federal Regulations* (CFR), Part 1926.
- *Pocket Guide to Chemical Hazards*, DHHS, PHS, CDC, NIOSH (1997).
- *Threshold Limit Values*, ACGIH (2001).
- *Guide to Occupational Exposure Values*, ACGIH (2001).
- *Quick Selection Guide to Chemical Protective Clothing*, Forsberg, K. and S.Z. Mansdorf, 2nd Ed. (1993).
- *Health and Safety Policies and Procedures Manual*, BBL.

1.5 Definitions

The following definitions (listed alphabetically) are applicable to this HASP:

- *Contamination Reduction Zone (CRZ)* - Area between the exclusion zone and support zone that provides a transition between contaminated and clean areas. Decontamination stations are located in this zone.
- *Exclusion Zone (EZ)* - Any portions of the site where hazardous substances are, or are reasonably suspected to be present, and pose an exposure hazard to on-site personnel.
- *Incident* - All losses, including first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions.
- *Near Miss* - An incident in which no injury, illness, motor vehicle accident, equipment or property damage, etc., occurred, but under slightly different circumstances, could have occurred.
- *On-Site Personnel* - All BBL and subcontractor personnel involved with the project.
- *Project* - All on-site work performed under the scope of work.

- *Site* - The area described in Section 1.2, Site and Facility Description, where the work is to be performed by BBL personnel and subcontractors.

- *Support Zone (SZ)* - All areas of the site, except the EZ and CRZ. The SZ surrounds the CRZ and EZ. Support equipment and break areas are located in this zone.

- *Subcontractor* - Includes contractor personnel hired by BBL.

- *Visitor* - All other personnel, except the on-site personnel.

- *Work Area* - The portion of the site where work activities are actively being performed. This area may change daily as work progresses and includes the SZ, CRZ, and EZ. If the work area is located in an area on the site that is not contaminated, or suspected of being contaminated, the entire work area may be a SZ.

1.6 Acronyms

The following acronyms (listed alphabetically) are applicable to this HASP:

- *ACGIH* - American Conference of Governmental Industrial Hygienists
- *BBL* - Blasland, Bouck & Lee, Inc.
- *COC* - Constituent(s) of Concern
- *CRZ* - Contamination Reduction Zone
- *EZ* - Exclusion Zone
- *GFCI* - Ground Fault Circuit Interrupter
- *HASP* - Health and Safety Plan
- *HSO* - Health and Safety Officer
- *HSS* - Health and Safety Supervisor
- *II* - Incident Investigation
- *IPO* - Incident Prevention Observation
- *JSA* - Job Safety Analysis
- *LEL* - Lower Explosive Limit
- *MSDS* - Material Safety Data Sheet
- *OSHA* - Occupational Safety and Health Administration

- *PEL* - Permissible Exposure Limit
- *PFD* - Personal Floatation Device
- *PID* - Photoionization Detector
- *PM* - Project Manager
- *PO* - Project Officer
- *PPE* - Personal Protective Equipment
- *SPSA* - Safe Performance Self-Assessment
- *SS* - Site Supervisor
- *SZ* - Support Zone
- *TLV* - Threshold Limit Value
- *USCG* - United States Coast Guard
- *USEPA* - United States Environmental Protection Agency
- *VOC* - Volatile Organic Compound

2. Roles and Responsibilities

2.1 All Personnel

All BBL and subcontractor personnel must adhere to the procedures outlined in this HASP during the performance of their work. Each person is responsible for completing tasks safely, and reporting any unsafe acts or conditions to their supervisor. No person may work in a manner that conflicts with these procedures. After due warnings, the PM will dismiss from the site any person or subcontractor who violates safety procedures.

All BBL and subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all personnel will attend an initial hazard briefing prior to beginning work at the site.

The roles of BBL personnel and subcontractors are outlined in the following sections. Key project personnel and contacts are summarized in Table 2-1.

2.2 BBL Personnel

2.2.1 Project Officer (PO)

The PO is responsible for providing resources to assure project activities are completed in accordance with this HASP, and for meeting all regulatory and contractual requirements.

2.2.2 Health and Safety Officer (HSO)

The HSO has overall responsibility for the technical health and safety aspects of the project, including review and approval of this HASP. Inquiries regarding BBL health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSO must approve changes or addenda to this HASP.

2.2.3 Project Manager (PM)

The PM is responsible for verifying that project activities are completed in accordance with the requirements of this HASP. The PM is responsible for confirming that the Site Supervisor (SS) has the equipment, materials, and qualified personnel to fully implement the safety requirements of this HASP, and/or that subcontractors assigned to this project meet the requirements established by BBL. It is also the responsibility of the PM to:

- Consult with the HSO on site health and safety issues;
- Verify that subcontractors meet health and safety requirements prior to commencing work;
- Review Incident Prevention Observation (IPO) forms;
- Verify that all incidents are thoroughly investigated;
- Approve, in writing, addenda or modifications of this HASP; and
- Suspend work or modify work practices, as necessary, for personal safety, protection of property, and regulatory compliance.

2.2.4 Health and Safety Supervisor (HSS)

The HSS is responsible for field health and safety issues, including the execution of this HASP. Questions in the field regarding health and safety procedures, project procedures, and other technical or regulatory issues should be addressed to this individual. The HSS will advise the PM on health and safety issues, and will establish and coordinate the project air monitoring program if one is deemed necessary (see Section 6.1, Air Monitoring). The HSS is the primary site contact on health and safety matters. It is the responsibility of the HSS to:

- Provide on-site technical assistance, if necessary;
- Participate in all incident investigations (IIs) and ensure that they are reported to the HSO and PM within 24 hours;
- Coordinate site and personal air monitoring as required, including equipment maintenance and calibration;
- Conduct site safety orientation training and safety meetings;
- Verify that BBL personnel and subcontractors have received the required physical examinations and medical certifications;
- Review site activities with respect to compliance with this HASP;
- Maintain required health and safety documents and records;
- Assist the SS in instructing field personnel on project hazards and protective procedures; and
- Review IPO forms.

2.2.5 Site Supervisor

The SS is responsible for implementing this HASP, including communicating requirements to on-site personnel and subcontractors. The SS will be responsible for informing the PM of changes in the work plan, procedures, or site conditions so that those changes may be addressed in this HASP. Other responsibilities are to:

- Consult with the HSS on site health and safety issues;
- Conduct IPOs at the site, and complete the IPO forms;
- Stop work, as necessary, for personal safety, protection of property, and regulatory compliance;
- Obtain a site map and determine and post routes to medical facilities and emergency telephone numbers;
- Notify local public emergency representatives (as appropriate) of the nature of the site operations, and post their telephone numbers (i.e., local fire department personnel who would respond for a confined space rescue);
- Observe on-site project personnel for signs of ill health effects;
- Investigate and report any incidents to the HSS;
- Verify that all on-site personnel have had applicable training;
- Verify that on-site personnel are informed of the physical, chemical, and biological hazards associated with the site activities, and the procedures and protective equipment necessary to control the hazards; and
- Issue/obtain any required work permits (hot work, confined space, etc.).

2.3 Subcontractors

Subcontractors and their personnel must understand and comply with applicable regulations and site requirements established in this HASP. Subcontractors may prepare their own site-specific HASP that must be consistent with the requirements of this HASP.

All subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. All subcontractor personnel will attend an initial hazard briefing prior to beginning work at the site. Additionally, on-site subcontractor personnel must attend and participate in the daily site safety meetings.

Subcontractors must designate individuals to function as the PM, HSO, HSS, and SS. In some firms, it is not uncommon for the duties of the HSO to be carried out by the PM. This is acceptable provided the PM has the required knowledge, training, and experience to properly address all hazards associated with the work, and to prepare, approve, and oversee the execution of the site-specific HASP. A subcontractor may designate the same person to perform the duties of both the HSS and the SS. However, depending on the level of complexity of a contractor's scope of work, it may be infeasible for one person to perform both functions satisfactorily.

2.4 All On-Site Personnel

All on-site personnel (including subcontractors) must read and acknowledge their understanding of this HASP before commencing work, and abide by the requirements of the plan. All on-site personnel shall sign the HASP Acknowledgement Form following their review of this HASP.

All BBL and subcontractor personnel will receive training in accordance with applicable regulations, and be familiar with the requirements and procedures contained in this HASP prior to initiating site activities. In addition, all on-site personnel will attend an initial hazard briefing prior to beginning work at the site and the daily safety meetings.

All on-site personnel must perform a Safe Performance Self-Assessment (SPSA) prior to beginning each work activity. The SPSA process is presented in Section 4.1.1. This process must be performed prior to beginning each activity, and must be performed after any near miss or other incident in order to determine if it is safe to proceed. On-site personnel will immediately report the following to the SS or HSS:

- Personal injuries and illnesses no matter how minor;
- Unexpected or uncontrolled release of chemical substances;
- Symptoms of chemical exposure;
- Unsafe or hazardous situations;
- Unsafe or malfunctioning equipment;
- Changes in site conditions that may affect the health and safety of project personnel;
- Damage to equipment or property;
- Situations or activities for which they are not properly trained; and
- Near misses.

2.5 Visitors

All visitors to BBL work areas must check in with the SS. Visitors will be cautioned to avoid skin contact with surfaces, soils, groundwater, or other materials that may impacted or be suspected to be impacted by constituents of concern (COC).

Visitors requesting to observe work at the site must don appropriate personal protective equipment (PPE) prior to entry to the work area and must have the appropriate training and medical clearances to do so. If respiratory protective devices are necessary, visitors who wish to enter the work area must have been respirator-trained and fit tested for a respirator within the past 12 months.

TABLE 2-1
KEY PERSONNEL

BBL Personnel		
Role	**Name**	**Address/Telephone No.**
Site Supervisor	David Gwozdz	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Health and Safety Supervisor	David Gwozdz	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Health and Safety Officer	Jay D. Keough, CIH	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Project Officer	D. Robert Gan, Phd.	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Project Manager	Gregory Albright	8 South River Road Cranbury, NJ 08512 (609) 860-0590
Key Agency Personnel		
Role	**Name**	**Address/Telephone No.**
NYDEC Project Manager	James Moras - Engineering Dave Chiusano - Construction	624 Broadway Albany, New York (518) 402-9671
Subcontractors		
Role	**Name**	**Address/Telephone No.**
ASD System Installation		
Madison Construction	Kevin Madison	57 Franklin Avenue Binghamton, NY (607) 771-7511
Client		
Role	**Name**	**Address/Telephone No.**
On-Site Representative	Mark Gialanella Universal Instruments, Inc.	(607) 779-7820

3. Project Hazards and Control Measures

3.1 Scope of Work

- Mobilization;
- Groundwater sampling;
- Soil vapor extraction system installation;
- Monitoring and injection well installation;
- Hydrogen Released Compound (HRC®) injection; and
- Demobilization.

3.2 Field Activities, Hazards, and Control Procedures

The following job safety analyses (JSAs) identify potential health, safety, and environmental hazards associated with each type of field activity. Because of the complex and changing nature of field projects, supervisors must continually inspect the site to identify hazards that may affect on-site personnel, the community, or the environment. The SS must be aware of these changing conditions and discuss them with the PM whenever these changes impact employee health, safety, the environment, or performance of the project. The SS will keep on-site personnel informed of the changing conditions, and the PM will write and/or approve addenda or revisions to this HASP as necessary. Attachment H contains the JSAs for monitoring well installation, groundwater sampling and soil vapor extraction system operation and installation.

3.2.1 Mobilization/Area Reconnaissance

Site mobilization and area reconnaissance will include establishing excavation locations, determining the location of utilities and other installations, and establishing work areas. Mobilization may also include setting up equipment and establishing a temporary site office. A break area will be set up outside of regulated work areas. Mobilization may involve clearing areas for the SZ and CRZ. During this initial phase, project personnel will walk the site to confirm the existence of anticipated hazards, and identify safety and health issues that may have arisen since the writing of this plan.

Manual materials handling and manual site preparation may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Installation of temporary field office and support facilities may expose personnel to electrical hazards, underground and overhead utilities, and physical injury due to the manual lifting and moving of materials. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces, and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Environmental hazards include plants, such as poison ivy and poison oak; aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

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Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.2.2 Active Slab Depressurization System Installation

The active slab depressurization (ASD) system will be installed by a subcontractor. BBL will only be involved in oversite duties. The subcontractor health and safety plan will cover these activities.

3.2.3 Active Slab Depressurization System Operation

Operation of the ASD system will include operating the apparatus, collecting air samples, collecting readings from various gauges, and conducting routine maintenance operations. The hazards associated with this operation include but are not limited to chemical exposure due to broken piping and seals, and electrocution during maintenance.

To mitigate these hazards operations will be handled in accordance with Sections 4.10 Lockout/Tagout Procedures and 4.11 Electrical Safety. Broken or leaking pipes and seals will be replaced or repaired immediately, and contact with contaminated water or vapor will be avoided. Normally, operations will be in Level D, however when doing maintenance activities where exposure to hazardous materials is possible, upgrades to Modified Level D, or Level C may be necessary, and are left to the HSS's discretion based on air monitoring results and dermal hazards.

3.2.4 Excavation Hazards and Control Procedures

This task involves excavating at specified locations to remove impacted soils and debris. Excavation activities will be conducted in accordance with this section and all applicable OSHA regulations.

The physical hazards involved in the excavation of soils are related to the excavation itself and the operation of heavy equipment. The presence of overhead utilities such as power lines requires careful positioning of the excavating equipment in order to maintain a safe distance between the lines and the closest part of the equipment. The presence of underground utilities such as gas lines, power lines, water lines, and sewer pipes must be determined prior to beginning the excavation.

Excavations pose significant hazards to employees if they are not carefully controlled. There exists a chance for the excavation to collapse if it is not dug properly, sloped, benched, or shored as required by 29 CFR 1926 Subpart P. Protective systems, as required by 29 CFR 1926 Subpart P, must be utilized if the potential for hazardous cave-ins exist. The excavation also is a fall hazard, and employees must pay careful attention to what they are doing or they risk a fall into the excavation. Fall protection, as required by 29 CFR 1926 Subpart M, will be required.

Personnel are not permitted to enter excavations. All activities shall be done remotely, without entering the excavation. Access to open excavations will be restricted at all times by the use of high visibility fencing at a minimum.

Noise also may present a hazard. Heavy equipment operation frequently results in noise levels exceeding 85 dBA, requiring the use of hearing protection.

At the end of each workday, open test pit excavations will be backfilled or secured with high visibility fencing and equipment will be moved to a location away from high-voltage electrical equipment and away from routes necessary to access high-voltage electrical equipment.

Airborne concentrations of COC in the site soil and the dust from the excavation procedure pose the potential for inhalation exposure. PPE for this phase is described in Section 5, Personal Protective Equipment. Airborne particulate generation will be controlled during site excavations. Dry, dusty soil will be wetted with a water spray from a potable water source to control the generation of dust. Soil will not be wetted to a degree that will cause runoff or erosion.

Before excavation activities commence, the existence and location of underground pipe, electrical equipment, and gas lines shall be determined. This will be done, if possible, by contacting the appropriate client representative to mark the location of the lines. If the client's knowledge of the area is incomplete, an appropriate device, such as a magnetometer, will be used to locate the line. The Underground/Overhead Utility Checklist (see Attachment G) shall be used to document that nearby utilities have been marked on the ground, and that the excavation and drilling areas have been cleared. The completed checklist will be in the possession of the SS prior to commencement of any intrusive investigation.

All excavation activities shall be conducted in accordance with 29 CFR 1926 Subpart P. If excavation operations are located near underground installations, the exact location of the installations must be determined by safe and acceptable means. While the excavation is open, underground installations must be protected, supported, or removed as necessary to safeguard employees.

3.2.4.1 Inspections by a Competent Person

Daily inspections of excavations, the adjacent areas, and protective systems must be made by a competent person for evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. An inspection must be conducted by the competent person prior to the start of work and as needed throughout the shift (see attached Periodic Excavation Inspection Form in Attachment H).

Inspections also must be made after every rainstorm or other hazard-increasing occurrence. These inspections are only required when employee exposure can be reasonably anticipated. Where the competent person finds evidence of a situation that could result in a possible cave-in, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions, exposed employees must be removed from the hazardous area until the necessary precautions have been taken to ensure their safety.

Walkways must be provided where employees or equipment are required or permitted to cross over excavations. Guardrails which comply with 1926.502(b) must be provided. Adequate barrier protection must be provided at all remotely located excavations. All wells, pits, shafts, etc. must be barricaded or covered. Upon completion of exploration and other similar operations, temporary wells, pits, shafts, etc., must be backfilled.

3.2.4.2 Soil Classification

29 CFR 1926 Subpart P, Appendix A describes methods of classifying soil and rock deposits based on site and environmental conditions and on the structure and composition of the earth deposits. The appendix contains definitions, sets forth requirements, and describes acceptable visual and manual tests for use in classifying soils. This appendix applies when a sloping or benching system is designed in accordance with the requirements set forth in 1926.652(b)(2) as a method of protection for employees from cave-ins. This appendix also applies when timber shoring for excavations is designed as a method of protection from cave-ins in accordance with Appendix C to Subpart P of Part 1926, and when aluminum hydraulic shoring is designed in accordance with 29 CFR Subpart P Appendix D. This appendix also applies if other protective systems are designed and selected for use from data prepared in accordance with the requirements set forth in 1926.652(c), and the use of the data are predicated on the use of the soil classification system set forth in Appendix A of 29 CFR 1926.

Maximum allowable slope means the steepest incline of an excavation face that is acceptable for the most favorable site conditions as protection against cave-ins, and is expressed as the ratio of horizontal distance to vertical rise (H: V). Short-term exposure means a period of time less than or equal to 24 hours that an excavation is open. Soil and rock deposits must be classified in accordance with Appendix A to Subpart P of Part 1926. The maximum allowable slope for a soil or rock deposit must be determined from Table B-1. The actual slope must not be steeper than the maximum allowable slope. The actual slope must be less steep than the maximum allowable slope, when there are signs of distress. If that situation occurs, the slope must be cut back to an actual slope which is at least horizontal to one vertical (1/2H: 1V) less steep than the maximum allowable slope. When surcharge loads from stored material or equipment, operating equipment, or traffic are present, a competent person must determine the degree to which the actual slope must be reduced below the maximum allowable slope, and must assure that such reduction is achieved. Surcharge loads from adjacent structures must be evaluated in accordance with 1926.651(I). Configurations of sloping and benching systems must be in accordance with 29 CFR 1926 Subpart P Appendix B.

TABLE B-1
29 CFR 1926 SUBPART P APPENDIX B
MAXIMUM ALLOWABLE SLOPES

Soil or Rock Type	Maximum Allowable Slopes (H:V)[1] for Excavations Less Than 20 Feet Deep[2]
Stable Rock	Vertical (90 degrees)
Type A[3]	¾:1 (53 degrees)
Type B	1:1 (45 degrees)
Type C	1:½ (34 degrees)

1. Numbers shown in parentheses next to maximum allowable slopes are angles expressed in degrees from the horizontal. Angles have been rounded off.
2. Sloping or benching for excavations greater than 20 feet deep must be designed by a registered professional engineer.

A short-term maximum allowable slope of 1/2H:1V (63 degrees) is allowed in excavations in Type A soil that are 12 feet (3.67 m) or less in depth. Short-term maximum allowable slopes for excavations greater than 12 feet (3.67 m) in depth must be 3/4H:1V (53 degrees).

3.2.5 Overhead Electrical Clearances

If excavation activities are conducted in the vicinity of overhead power lines, the power to the lines must be de-energized, tested de-energized, marked up/guaranteed, and grounded or the equipment must be positioned such that no part, including excavation boom, can come within the minimum clearances as follows:

Nominal System Voltage	Minimum Required Clearance
0-50kV	10 feet
51-100kV	12 feet
101-200kV	15 feet
201-300kV	20 feet
301-500kV	25 feet
501-750kV	35 feet
751-1,000kV	45 feet

3.2.5.1 Excavation Entry Procedure

Persons entering an excavation must do so under controlled conditions. The excavation must be properly sloped, benched, or shored, and ladders or ramps must be available every 25 feet laterally in the excavation. Each entry shall have an attendant who observes the entrant(s) and is prepared to render assistance.

Duties of Workers Entering an Excavation

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants;
- Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space;
- Alert the attendant whenever:
  - the entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or
  - the entrant detects a prohibited condition;
- Exit from the excavation as quickly as possible whenever:
  - an order to evacuate is given by the attendant or the supervisor;
  - the entrant recognizes any warning sign or symptom of exposure to a dangers situation; or
  - the entrant detects a prohibited condition.

Duties of Attendants

- Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of exposure to site contaminants;
- Continuously maintains a count of entrants in the excavation;
- Remains outside the excavation during entry operations until relieved by another attendant;
- Communicates with authorized entrants as necessary to monitor entrant status to alert entrants of the need to evacuate the excavation under any of the following conditions:
  - if the attendant detects a prohibited condition;
  - if the attendant detects the behavioral effects of hazard exposure in an entrant;
  - if the attendant detects a situation outside the excavation that could endanger the entrants; or
  - if the attendant cannot effectively and safely perform his duties;

Summon rescue and other emergency services if the attendant determines that entrants may need assistance to evacuate the excavation.

3.2.6 Field Soil Sampling Activities

Field sampling operations consist of the collection of soil samples for subsequent analysis and evaluation of potential site impact. The physical hazards of these operations are primarily associated with the sample collection methods and procedures utilized.

Samples of soils will be obtained to evaluate the extent of potential site impacts. Inhalation and absorption (contact) of constituents are the primary routes of entry associated with soil sampling due to the manipulation of sample and equipment, manual transfer of media into sample containers, and proximity of operations to the breathing zone. To control dermal exposure during soil sampling activities, a minimum of Modified Level D protection (see Section 5, Personal Protective Equipment) will be worn. Air sampling may be conducted during soil sampling to assess the potential for exposure to airborne constituents. If the results of air monitoring indicate the presence of organic vapors in a concentration exceeding the site action level for Modified Level D, personnel will upgrade to Level C protection. Refer to Section 6, Air Monitoring, for a description of air monitoring requirements and action levels. A description of each level of protection is included in Section 5, Personal Protective Equipment.

The collection of soil samples involves advancing test pit excavations with excavation equipment. The equipment poses a hazard if it is not properly operated. The presence of overhead utilities and underground obstacles poses a hazard if the excavator contacts them. Safety hazards and procedures associated with activities conducted around excavations are presented in the following sections.

3.2.7 Clearing

Site clearing and subsequent construction activities involve a potential for exposure to numerous physical and health hazards. The hazards are primarily associated with the equipment used and the debris being removed.

Physical Hazards - The physical hazards involved with clearing and construction relate to work done with heavy equipment, hand tools, and the environment itself. There exists a potential for incidents involving personnel struck by or struck against powered equipment, timber, or materials, resulting in fractures, cuts, punctures, or abrasions. Walking and working surfaces during construction activities may involve slip, trip, and fall hazards. Working at elevations may create a fall hazard.

Environmental Hazards - Overgrown areas present hazards of uneven walking surfaces, soft terrain, and biological hazards such as insects and snakes.

Working Surfaces - Uneven terrain and slippery work surfaces can increase the likelihood of back injuries, overexertion injuries, and slips and falls. All personnel should frequently inspect the area in which they are working, and keep the area as clear as possible.

Powered Equipment Operations - Site workers are exposed to serious hazards during clearing when using powered equipment. Workers may be struck by blades or by material thrown by powered equipment.

Materials Handling - The most common type of accident that occurs in material handling operations is the "caught between" situation when a load is being handled and a finger or toe gets caught between two objects. Extreme care must be taken when loading and unloading material. Proper lifting technique must be employed, and mechanical means must be used to lift objects whenever possible.

Health Hazards - Due to the type of work involved in clearing and construction activities, the primary health hazards involve repetitive motion disorders, lifting, and other ergonomic stressors. Noise may also present a hazard. Operation of heavy equipment and power actuated and pneumatic hand tools frequently results in high noise levels.

Control - Prior to initiating clearing and construction activities, the operation will be explained to all employees. Hazards will be identified and protective measures will be explained. Equipment will be inspected and in proper working condition. Employees should receive training to address the equipment, its operations, and care. Personnel should be scheduled in a manner to reduce the likelihood of performing repetitive tasks for prolonged periods.

Technical assistance should be provided for large lifting tasks. Hearing protection is required for use when exposed to noise levels exceeding 85 dBA, or a level that commonly results in difficult conversation.

3.2.8 Equipment Decontamination

All equipment will be decontaminated before leaving the site. Personnel involved in decontamination activities may be exposed to skin contact with contaminated materials and chemicals brought to the site as part of the project work. Personnel involved in decontamination activities must wear PPE that is one level below the level wordn by personnel working in the EZ.

3.2.9 Demobilization

Demobilization involves the removal of all tools, equipment, supplies, and vehicles brought to the site. The hazards of this phase of activity are associated with heavy equipment operation and manual materials handling.

Manual materials handling may cause blisters, sore muscles, and joint and skeletal injuries; and may present eye, contusion, and laceration hazards. Heavy equipment operation presents noise and vibration hazards, and hot surfaces, to operators. Personnel in the vicinity of heavy equipment operation may be exposed to physical hazards resulting in fractures, contusions, and lacerations and may be exposed to high noise levels. The work area presents slip, trip, and fall hazards from scattered debris and irregular walking surfaces. Rainy weather may cause wet, muddy, slick walking surfaces, and unstable soil. Freezing weather hazards include frozen, slick, and irregular walking surfaces.

Environmental hazards include plants, such as poison ivy and poison oak; aggressive fauna, such as ticks, fleas, mosquitoes, wasps, spiders, and snakes; weather, such as sunburn, lightning, rain, and heat- or cold-related illnesses; and pathogens, such as rabies, Lyme disease, and blood-borne pathogens.

Control procedures for these hazards are discussed in Section 4, General Safety Practices.

3.3 Chemical Hazards

The chemical hazards associated with site operations are related to inhalation, ingestion, and skin exposure to site COCs. Concentrations of airborne COCs during site tasks may be measurable, and will require air monitoring during certain operations. Air monitoring requirements for site tasks are outlined in Section 6.1.

Site COCs may include benzene, 1,2-dichloroethene, 1,1-dichloroethane, tetrachloroethylene (perchloroethylene), trichloroethene, and 1,1,1-trichloroethane.

The potential for inhalation of site COCs is low. The potential for dermal contact with soils and groundwater containing site COCs during drilling, and sampling operations is moderate. Table 3-1 lists the chemical, physical, and toxicological properties of site COCs. Material Safety Data Sheets (MSDS) for the COCs is included in Attachment A.

4. General Safety Practices

4.1 General Safety Rules

General safety rules for site activities include, but are not limited to, the following:

- At least one copy of this HASP must be in a location at the site that is readily available to personnel, and all project personnel shall review the plan prior to starting work.
- Consume or use food, beverages, chewing gum, and tobacco products only in the SZ or other designated area outside the EZ and CRZ. Cosmetics shall not be applied in the EZ or CRZ.
- Wash hands before eating, drinking, smoking, or using toilet facilities.
- Wear all PPE as required, and stop work and replace damaged PPE immediately.
- Secure disposable coveralls, boots, and gloves at the wrists and legs and ensure closure of the suit around the neck.
- Upon skin contact with materials that may be impacted by COC, remove contaminated clothing and wash the affected area immediately. Contaminated clothing must be changed. Any skin contact with materials potentially impacted by COC must be reported to the SS or HSS immediately. If needed, medical attention should be sought.
- Practice contamination avoidance. Avoid contact with surfaces either suspected or known to be impacted by COC, such as standing water, mud, or discolored soil. Equipment must be stored on elevated or protected surfaces to reduce the potential for incidental contamination.
- Remove PPE as required in the CRZ to limit the spread of COC-containing materials.
- At the end of each shift or as required, dispose of all single-use coveralls, soiled gloves, and respirator cartridges in designated receptacles designated for this purpose.
- Removing soil containing site COC from protective clothing or equipment with compressed air, shaking, or any other means that disperses contaminants into the air is prohibited.
- Inspect all non-disposable PPE for contamination in the CRZ. Any PPE found to be contaminated must be decontaminated or disposed of appropriately.
- Recognize emergency signals used for evacuation, injury, fire, etc.
- Report all injuries, illnesses, near misses, and unsafe conditions or work practices to the SS or HSS.
- Use the "buddy system" during all operations requiring Level C PPE, and when appropriate, during Modified Level D operations.
- Obey all warning signs, tags, and barriers. Do not remove any warnings unless authorized to do so.

- Use, adjust, alter, and repair equipment only if trained and authorized to do so, and in accordance with the manufacturer's directions.

- Personnel are to perform only tasks for which they have been properly trained and will advise their supervisor if they have been assigned a task for which they are not trained.

- The presence or consumption of alcoholic beverages or illicit drugs during the workday is strictly prohibited. Do not take prescription or over-the-counter drugs when assigned to tasks with the potential for absorption, inhalation, or ingestion of hazardous substances, unless given written approval by an appropriate health care professional.

- Remain upwind during site activities whenever possible.

4.1.1 Safe Performance Self-Assessment (SPSA)

All on-site personnel are required to perform a SPSA prior to beginning any activity. This three-step process requires each individual to:

- *Assess* the risk of the task to be performed. Ask the following questions:
  - What could go wrong?
  - What is the worst thing that could happen if something does go wrong?

- *Analyze* the ways the risk can be reduced. Ask the following questions:
  - Do I have all the necessary training and knowledge to do this task safely?
  - Do I have all the proper tools and PPE?

- *Act* to control the risk and perform the task safely.
  - Take the necessary action to perform the job safely.
  - Follow written procedures, and ask for assistance if necessary.

This process must be performed prior to beginning any activity, and must be performed after any near miss or other incident in order to determine if it is safe to proceed.

4.1.2 Incident Investigation

An incident is any of the following events: first aid cases, injuries, illnesses, near misses, spills/leaks, equipment and property damage, motor vehicle accidents, regulatory violations, fires, and business interruptions. All incidents shall be investigated within 24 hours and reported to the PM and the HSO.

The purpose of an II is to prevent the recurrence of a similar hazardous event. II investigates all incidents in the same manner. Using the information gathered during an II, appropriate measures will be taken to protect personnel from the hazard in question. The II form is included in Attachment B.

4.1.3 Incident Prevention Observation

The SS or the HSS will perform the IPO (see Attachment C for the IPO form). The purpose of the IPO is to identify and correct potential hazards, and to positively reinforce behaviors and practices that are correct. The SS or HSS must identify potential deviations from safe work practices that could possibly result in an incident, and take prompt corrective action. The IPO process steps are:

- Identify tasks that have the greatest potential for hazardous incidents;
- Review the standard procedure for completing the task;
- Discuss with the observed employee the task and the SS/HSS role in observing the task;
- Observe the employee completing the task;
- Reference the IPO form for criteria. Complete the form, documenting positive, as well as areas in need of improvement;
- Discuss the results of the IPO with the employee. Discuss corrective action necessary;
- Implement corrective action; and
- Communicate the results of the IPO and corrective action to the PM and the HSO.

4.1.4 Job Safety Analysis

A JSA is a tool used of identifying potential hazards and developing corrective or protective systems to eliminate the hazard. A JSA lists all the potential hazards associated with an activity. Hazards may be physical, such as lifting hazards or eye hazards, or environmental, such as weather or biological (stinging insects, snakes, etc.). Following the identification of the hazards associated with an activity, control measures are evaluated and protective measures or procedures are then instituted. JSAs are reviewed periodically to ensure that the procedures and protective equipment specified for each activity are current and technically correct. Any changes in site conditions and/or the scope of work may require a review and modification to the JSA in question. During this review process, comments on the JSA and its procedures should be obtained from personnel associated with the activity being analyzed.

4.2 Buddy System

On-site personnel must use the buddy system as required by operations. Use of the "buddy system" is required during all operations requiring Level C to Level A PPE, and when appropriate, during Level D operations. Crewmembers must observe each other for signs of chemical exposure, and heat or cold stress. Indications of adverse effects include, but are not limited to:

- Changes in complexion and skin coloration;
- Changes in coordination;
- Changes in demeanor;
- Excessive salivation and pupillary response; and
- Changes in speech pattern.

Crewmembers must also be aware of the potential exposure to possible safety hazards, unsafe acts, or non-compliance with safety procedures.

Field personnel must inform their partners or fellow crewmembers of non-visible effects of exposure to toxic materials that they may be experiencing. The symptoms of such exposure may include, but are not limited to:

- Headaches;
- Dizziness;
- Nausea;
- Blurred vision;
- Cramps; and
- Irritation of eyes, skin, or respiratory tract.

If protective equipment or noise levels impair communications, prearranged hand signals must be used for communication. Personnel must stay within line of sight of another team member.

4.3 Heat Stress

Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, etc., as well as the physical and conditioning characteristics of the individual. Since heat stress is one of the most common illnesses associated with heavy outdoor work conducted with direct solar load and, in particular, because wearing PPE can increase the risk of developing heat stress, workers must be capable of recognizing the signs and symptoms of heat-related illnesses. Personnel must be aware of the types and causes of heat-related illnesses and be able to recognize the signs and symptoms of these illnesses in both themselves and their co-workers.

Heat rashes are one of the most common problems in hot work environments. Commonly known as prickly heat, a heat rash is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickling sensation. Prickly heat occurs in skin that is persistently wetted by unevaporated sweat, and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

Heat cramps are usually caused by performing hard physical labor in a hot environment. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused both by too much or too little salt.

Cramps appear to be caused by the lack of water replenishment. Because sweat is a hypotonic solution (plus or minus 0.3% NaCl), excess salt can build up in the body if the water lost through sweating is not replaced. Thirst cannot be relied on as a guide to the need for water; instead, water must be taken every 15 to 20 minutes in hot environments.

Under extreme conditions, such as working for 6 to 8 hours in heavy protective gear, a loss of sodium may occur. Drinking commercially available carbohydrate electrolyte replacement liquids is effective in minimizing physiological disturbances during recovery.

Heat exhaustion occurs from increased stress on various body organs due to inadequate blood circulation, cardiovascular insufficiency, or dehydration. Signs and symptoms include pale, cool, moist skin; heavy sweating; dizziness; nausea; headache, vertigo, weakness, thirst, and giddiness. Fortunately, this condition responds readily to prompt treatment.

Heat exhaustion should not be dismissed lightly, however, for several reasons. One is that the fainting associated with heat exhaustion can be dangerous because the victim may be operating machinery or controlling an operation that should not be left unattended; moreover, the victim may be injured when he or she faints. Also, the signs and symptoms seen in heat exhaustion are similar to those of heat stroke, which is a medical emergency.

Workers suffering from heat exhaustion should be removed from the hot environment, be given fluid replacement, and be encouraged to get adequate rest.

Heat stroke is the most serious form of heat stress. Heat stroke occurs when the body's system of temperature regulation fails and the body's temperature rises to critical levels. This condition is caused by a combination of highly variable factors, and its occurrence is difficult to predict.

Heat stroke is a medical emergency. The primary signs and symptoms of heat stroke are confusion; irrational behavior; loss of consciousness; convulsions; a lack of sweating (usually); hot, dry skin; and an abnormally high body temperature, e.g., a rectal temperature of 41°C (105.8°F). If body temperature is too high, it causes death. The elevated metabolic temperatures caused by a combination of workload and environmental heat load, both of which contribute to heat stroke, are also highly variable and difficult to predict.

If a worker shows signs of possible heat stroke, professional medical treatment should be obtained immediately. The worker should be placed in a shady area and the outer clothing should be removed. The worker's skin should be wetted and air movement around the worker should be increased to improve evaporative cooling until professional methods of cooling are initiated and the seriousness of the condition can be assessed. Fluids should be replaced as soon as possible. The medical outcome of an episode of heat stroke depends on the victim's physical fitness and the timing and effectiveness of first aid treatment.

Regardless of the worker's protestations, no employee suspected of being ill from heat stroke should be sent home or left unattended unless a physician has specifically approved such an order.

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or exhaustion, that person may be predisposed to additional heat injuries.

Heat Stress Safety Precautions

Heat stress monitoring and work rest cycle implementation should commence when the ambient adjusted temperature exceeds 72°F. A minimum work rest regimen and procedures for calculating ambient adjusted temperature are described in Table 4-1.

TABLE 4-1
WORK/REST SCHEDULE

Adjusted Temperature[b]	Work/Rest Regimen Normal Work Ensemble[c]	Work/Rest Regimen Impermeable Ensemble
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° - 90°F (30.8°-32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° - 87.5°F (28.1° - 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° - 82.5°F (25.3° - 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° - 77.5°F (30.8° - 32.2°C)	After each 150 minutes of work	After each 120 minutes of work

a. For work levels of 250 kilocalories/hour (Light-Moderate Type of Work)

b. Calculate the adjusted air temperature (ta adj) by using this equation: ta adj ºF = ta ºF + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)

c. A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.
d. The information presented above was generated using the information provided in the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV) Handbook.

In order to determine if the work rest cycles are adequate for the personnel and specific site conditions, additional monitoring of individual heart rates will be conducted during the rest cycle. To check the heart rate, count the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work period by one third and maintain the same rest period.

Additionally, one or more of the following control measures can be used to help control heat stress and are mandatory if any site worker has a heart rate (measure immediately prior to rest period) exceeding 115 beats per minute:

- Site workers will be encouraged to drink plenty of water and electrolyte replacement fluids throughout the day.
- On-site drinking water will be kept cool (50 to 60°F).
- A work regimen that will provide adequate rest periods for cooling down will be established, as required.
- All personnel will be advised of the dangers and symptoms of heat stroke, heat exhaustion, and heat cramps.
- Cooling devices, such as vortex tubes or cooling vests, should be used when personnel must wear impermeable clothing in conditions of extreme heat.
- Employees should be instructed to monitor themselves and co-workers for signs of heat stress and to take additional breaks as necessary.
- A shaded rest area must be provided. All breaks should take place in the shaded rest area.
- Employees must not be assigned to other tasks during breaks.
- Employees must remove impermeable garments during rest periods. This includes white Tyvek-type garments.

All employees must be informed of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress disorders.

4.4 Cold Stress

Cold stress normally occurs in temperatures at or below freezing, or under certain circumstances, in temperatures of 40°F. Extreme cold for a short time may cause severe injury to exposed body surfaces or result in profound generalized cooling, causing death.

Areas of the body that have high surface area-to-volume ratio, such as fingers, toes, and ears, are the most susceptible. Two factors influence the development of a cold weather injury: ambient temperature and the velocity of the wind. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at 18°F. An equivalent chill temperature chart relating the actual dry bulb temperature and wind velocity is presented in Table 4-2.

TABLE 4-2
CHILL TEMPERATURE CHART

Estimated Wind Speed (in mph)	Actual Temperature Reading (°F)											
	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
	Equivalent Chill Temperature (°F)											
Calm	50	40	30	20	10	0	-10	-20	-30	-40	-50	-60
5	48	37	27	16	6	-5	-15	-26	-36	-47	-57	-68
10	40	28	16	4	-9	-24	-33	-46	-58	-70	-83	-95
15	36	22	9	-5	-18	-32	-45	-58	-72	-85	-99	-112
20	32	18	4	-10	-25	-39	-53	-67	-82	-96	-110	-121
25	30	16	0	-15	-29	-44	-59	-74	-88	-104	-118	-133
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109	-125	-140
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113	-129	-145
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116	-132	-148
(Wind speeds greater than 40 mph have little additional effect.)	LITTLE DANGER Maximum danger of false sense of security.				INCREASING DANGER Danger from freezing of exposed flesh within one minute.			GREAT DANGER Flesh may freeze within 30 seconds.				
	Trench foot and immersion foot may occur at any point on this chart.											

[This chart was developed by the U.S. Army Research Institute of Environmental Medicine, Natick, MA (Source: ACGIH Threshold Limit Values for Chemical Substances and Physical Agents)].

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of tissue damage associated with frostbite. Frostbite of the extremities can be categorized into:

- *Frost Nip or Incipient Frostbite* - characterized by sudden blanching or whitening of skin.
- *Superficial Frostbite* - skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- *Deep Frostbite* - tissues are cold, pale, and solid; extremely serious injury.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. It can be fatal. Its symptoms are usually exhibited in five stages: 1) shivering; 2) apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F; 3) unconsciousness, glassy stare, slow pulse, and slow respiratory rate; 4) freezing of the extremities; and 5) death. Trauma sustained in freezing or sub-zero conditions requires special attention because an injured worker is predisposed to secondary cold injury. Special provisions must be made to prevent hypothermia and secondary freezing of damaged tissues in addition to providing for first aid treatment. To avoid cold stress, site personnel must wear protective clothing appropriate for the level of cold and physical activity. In addition to protective clothing, preventive safe work practices, additional training, and warming regimens may be utilized to prevent cold stress.

Safety Precautions for Cold Stress Prevention

For air temperature of 0°F or less, mittens should be used to protect the hands. For exposed skin, continuous exposure should not be permitted when air speed and temperature results in a wind chill temperature of -25°F.

At air temperatures of 36°F or less, field personnel who become immersed in water or whose clothing becomes wet must be immediately provided with a change of clothing and be treated for hypothermia.

If work is done at normal temperature or in a hot environment before entering the cold, the field personnel must ensure that their clothing is not wet as a consequence of sweating. If wet, field personnel must change into dry clothes prior to entering the cold area.

If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work must be modified or suspended until adequate clothing is made available or until weather conditions improve.

Field personnel handling evaporative liquid (e.g., gasoline, alcohol, or cleaning fluids) at air temperatures below 40°F must take special precaution to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling.

Safe Work Practices

Direct contact between bare skin and cold surfaces (< 20°F) should be avoided. Metal tool handles and/or equipment controls should be covered by thermal insulating material.

For work performed in a wind chill temperature at or below 10°F, workers should be under constant protective observation (buddy system). The work rate should be established to prevent heavy sweating that will result in wet clothing. For heavy work, rest periods must be taken in heated shelters and workers should be provided with an opportunity to change into dry clothing if needed.

Field personnel should be provided the opportunity to become accustomed to cold-weather working conditions and required protective clothing.

Work should be arranged in such a way that sitting or standing still for long periods is minimized.

During the warming regimen (rest period), field personnel should be encouraged to remove outer clothing to permit sweat evaporation or to change into dry work clothing. Dehydration, or loss of body fluids, occurs insidiously in the cold environment and may increase susceptibility to cold injury due to a significant change in blood flow to the extremities. Fluid replacement with warm, sweet drinks and soups is recommended. The intake of coffee should be limited because of diuretic and circulatory effects.

4.5 Biological Hazards

Biological hazards may include poison ivy, snakes, thorny bushes and trees, ticks, mosquitoes, scorpions, and other pests.

4.5.1 Tick Borne Diseases

Lyme Disease: The disease commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, New Jersey, Pennsylvania, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

Erlichiosis: The disease also commonly occurs in summer and is transmitted by the bite of infected ticks. "Hot spots" in the United States include New York, Massachusetts, Connecticut, Rhode Island, Minnesota, and Wisconsin.

These diseases are transmitted primarily by the deer tick, which is smaller and redder than the common wood tick. The disease may be transmitted by immature ticks, which are small and hard to see. The tick may be as small as a period on this page.

Symptoms of Lyme disease include a rash or a peculiar red spot, like a bull's eye, which expands outward in a circular manner. The victim may have headache, weakness, fever, a stiff neck, and swelling and pain in the joints, and eventually, arthritis. Symptoms of erlichiosis include muscle and joint aches, flu-like symptoms, but there is typically no skin rash.

Rocky Mountain Spotted Fever (RMSF): This disease is transmitted via the bite of an infected tick. The tick must be attached 4 to 6 hours before the disease-causing organism (Rickettsia rickettsii) becomes reactivated and can infect humans. The primary symptom of RMSF is the sudden appearance of a moderate-to-high fever. The fever may persist for two to three weeks. The victim may also have a headache, deep muscle pain, and chills. A rash appears on the hands and feet on about the third day and eventually spreads to all parts of the body. For this reason, RMSF may be confused with measles or meningitis. The disease may cause death, if untreated, but if identified and treated promptly, death is uncommon.

Control: Tick repellant containing diethyltoluamide (DEET) should be used when working in tick-infested areas, and pant legs should be tucked into boots. In addition, workers should search the entire body every three or four hours for attached ticks. Ticks should be removed promptly and carefully without crushing, since crushing can squeeze the disease-causing organism into the skin. A gentle and steady pulling action should be used to avoid leaving the head or mouth parts in the skin. Hands should be protected with surgical gloves when removing ticks.

4.5.2 Poisonous Plants

Poisonous plants may be present in the work area. Personnel should be alerted to its presence, and instructed on methods to prevent exposure.

Control: The main control is to avoid contact with the plant, cover arms and hands, and frequently wash potentially exposed skin. Particular attention must be given to avoiding skin contact with objects or protective clothing that have touched the plants. Treat every surface that may have touched the plant as contaminated, and practice contamination avoidance. If skin contact is made, the area should be washed immediately with soap and water, and observed for signs of reddening.

4.5.3 Snakes

The possibility of encountering snakes exists, specifically for personnel working in wooded/vegetated areas. Snake venoms are complex and include proteins, some of which have enzymatic activity. The effects produced by venoms include neurotoxic effects with sensory, motor, cardiac, and respiratory difficulties; cytotoxic effects on red blood cells, blood vessels, heart muscle, kidneys, and lungs; defects in coagulation; and effects from local release of substances by enzymatic actions. Other noticeable effects of venomous snakebites include swelling, edema, and pain around the bite, and the development of ecchymosis (the escape of blood into tissues from ruptured blood vessels).

Control: To minimize the threat of snakebites, all personnel walking through vegetated areas must be aware of the potential for encountering snakes, and the need to avoid actions potentiating encounters, such as turning over logs, etc. If a snakebite occurs, an attempt should be made to safely kill the snake for identification. The victim must be transported to the nearest hospital within 30 minutes; first aid consists of applying a constriction band, and washing the area around the wound to remove any unabsorbed venom.

4.5.4 Spiders

Personnel may encounter spiders during work activities.

Two spiders are of concern, the black widow and the brown recluse. Both prefer dark sheltered areas such as basements, equipment sheds and enclosures, and around woodpiles or other scattered debris. The black widow is shiny black, approximately one inch long, and found throughout the United States. There is a distinctive red hourglass marking on the underside of the black widows body. The bite of a black widow is seldom fatal to healthy adults, but effects include respiratory distress, nausea, vomiting, and muscle spasms. The brown recluse is smaller than the black widow and gets its name from its brown coloring and behavior. The brown recluse is more prevalent in the southern United States. The brown recluse has a distinctive violin shape on the top of its body. The bite of the brown recluse is painful and the bite site ulcerates and takes many weeks to heal completely.

Control: To minimize the threat of spider bites, all personnel walking through vegetated areas must be aware of the potential for encountering these arachnids. Personnel need to avoid actions that may result in encounters, such as turning over logs, and placing hands in dark places such as behind equipment or in corners of equipment sheds or enclosures. If a spider bite occurs, the victim must be transported to the nearest hospital as soon as possible; first aid consists of applying ice packs and washing the area around the wound to remove any unabsorbed venom.

4.6 Noise

Exposure to noise over the OSHA action level can cause temporary impairment of hearing; prolonged and repeated exposure can cause permanent damage to hearing. The risk and severity of hearing loss increases with the intensity and duration of exposure to noise. In addition to damaging hearing, noise can impair voice communication, thereby increasing the risk of accidents on site.

Control: All personnel must wear hearing protection, with a Noise Reduction Rating (NRR) of at least 20, when noise levels exceed 85 dBA. When it is difficult to hear a co-worker at normal conversation distance, the noise level is approaching or exceeding 85 dBA, and hearing protection is necessary. All site personnel who may be exposed to noise must also receive baseline and annual audiograms and training as to the causes and prevention of hearing loss. Noise monitoring is discussed in Section 6.2, Noise Monitoring.
Whenever possible, equipment that does not generate excessive noise levels will be selected for this project. If the use of noisy equipment is unavoidable, barriers or increased distance will be used to minimize worker exposure to noise, if feasible.

4.7 Spill Control

All personnel must take every precaution to minimize the potential for spills during site operations. All on-site personnel shall immediately report any discharge, no matter how small, to the SS.

Spill control equipment and materials will be located on the site at locations that present the potential for discharge. All sorbent materials used for the cleanup of spills will be containerized and labeled appropriately. In the event of a spill, the SS will follow the provisions in Section 9, Emergency Procedures, to contain and control released materials and to prevent their spread to off-site areas.

4.8 Sanitation

Site sanitation will be maintained according to OSHA requirements.

4.8.1 Break Area

Breaks must be taken in the SZ, away from the active work area after site personnel go through decontamination procedures. There will be no smoking, eating, drinking, or chewing gum or tobacco in any area other than the SZ.

4.8.2 Potable Water

The following rules apply to all field operations:

- An adequate supply of potable water will be provided at each project site. Potable water must be kept away from hazardous materials or media, and contaminated clothing or equipment.

- Portable containers used to dispense drinking water must be capable of being tightly closed, and must be equipped with a tap dispenser. Water must not be consumed directly from the container (drinking from the tap is prohibited) nor may it be removed from the container by dipping.

- Containers used for drinking water must be clearly marked and shall not be used for any other purpose.

- Disposable drinking cups must be provided. A sanitary container for dispensing cups and a receptacle for disposing of used cups is required.

4.8.3 Sanitary Facilities

Access to facilities for washing before eating, drinking, or smoking, or alternate methods such as waterless hand-cleaner and paper towels will be provided.

4.8.4 Lavatory

If permanent toilet facilities are not available, an appropriate number of portable chemical toilets will be provided. This requirement does not apply to mobile crews or to normally unattended site locations so long as employees at these locations have transportation immediately available to nearby toilet facilities.

4.9 Emergency Equipment

Adequate emergency equipment for the activities being conducted on site and as required by applicable sections of 29 CFR 1910 and 29 CFR 1926 will be on site prior to the commencement of project activities. Personnel will be provided with access to emergency equipment, including, but not limited to, the following:

- Fire extinguishers of adequate size, class, number, and location as required by applicable sections of 29 CFR 1910 and 1926;

- Industrial first aid kits of adequate size for the number of personnel on site; and

- Emergency eyewash and/or shower if required by operations being conducted on site.

4.10 Lockout/Tagout Procedures

Only fully qualified and trained personnel will perform maintenance procedures. Before maintenance begins, lockout/tagout procedures per OSHA 29 CFR 1910.147 will be followed.

Lockout is the placement of a device that uses a positive means, such as lock, to hold an energy or material-isolating device such that the equipment cannot be operated until the lockout device is removed. If a device cannot be locked out, a tagout system shall be used. Tagout is the placement of a warning tag on an energy or material isolating device indicating that the equipment controls may not be operated until the tag is removed by the personnel who attached the tag.

4.11 Electrical Safety

Electricity may pose a particular hazard to site workers due to the use of portable electrical equipment. If wiring or other electrical work is needed, a qualified electrician must perform it.

General electrical safety requirements include:

- All electrical wiring and equipment must be a type listed by Underwriters Laboratories (UL), Factory Mutual Engineering Corporation (FM), or other recognized testing or listing agency.
- All installations must comply with the National Electrical Safety Code (NESC), the National Electrical Code (NEC), or USCG regulations.
- Portable and semi-portable tools and equipment must be grounded by a multi-conductor cord having an identified grounding conductor and a multi-contact polarized plug-in receptacle.
- Tools protected by an approved system of double insulation, or its equivalent, need not be grounded. Double insulated tools must be distinctly marked and listed by UL or FM.
- Live parts of wiring or equipment must be guarded to prevent persons or objects from touching them.
- Electric wire or flexible cord passing through work areas must be covered or elevated to protect it from damage by foot traffic, vehicles, sharp corners, projections, or pinching.
- All circuits must be protected from overload.
- Temporary power lines, switchboxes, receptacle boxes, metal cabinets, and enclosures around equipment must be marked to indicate the maximum operating voltage.
- Plugs and receptacles must be kept out of water unless of an approved submersible construction.
- All extension cord outlets must be equipped with ground fault circuit interrupters (GFCI).
- Attachment plugs or other connectors must be equipped with a cord grip and be constructed to endure rough treatment.

- Extension cords or cables must be inspected prior to each use, and replaced if worn or damaged. Cords and cables must not be fastened with staples, hung from nails, or suspended by bare wire.
- Flexible cords must be used only in continuous lengths without splice, with the exception of molded or vulcanized splices made by a qualified electrician.

4.12 Lifting Safety

Using proper lifting techniques may prevent back strain or injury. The fundamentals of proper lifting include:

- Consider the size, shape, and weight of the object to be lifted. A mechanical lifting device or additional persons must be used to lift an object if it cannot be lifted safely alone.
- The hands and the object should be free of dirt or grease that could prevent a firm grip.
- Gloves must be used, and the object inspected for metal slivers, jagged edges, burrs, or rough or slippery surfaces.
- Fingers must be kept away from points that could crush or pinch them, especially when putting an object down.
- Feet must be placed far enough apart for balance. The footing should be solid and the intended pathway should be clear.
- The load should be kept as low as possible, close to the body with the knees bent.
- To lift the load, grip firmly and lift with the legs, keeping the back as straight as possible.
- A worker should not carry a load that he or she cannot see around or over.
- When putting an object down, the stance and position are identical to that for lifting; the legs are bent at the knees, and the back is straight as the object is lowered.

4.13 Ladder Safety

When portable ladders are used for access to an upper landing surface, the ladder side rails shall extend at least 3 feet (9 m) above the upper landing surface to which the ladder is used to gain access; or, when such an extension is not possible because of the ladder's length, then the ladder shall be secured at its top to a rigid support that will not deflect, and a grasping device, such as a grabrail, shall be provided to assist employees in mounting and dismounting the ladder. In no case shall the extension be such that ladder deflection under a load would, by itself, cause the ladder to slip off its support.

- Ladders shall be maintained free of oil, grease, and other slipping hazards.
- Ladders shall not be loaded beyond the maximum intended load for which they were built, nor beyond their manufacturer's rated capacity.
- Ladders shall be used only for the purpose for which they were designed.

- Non-self-supporting ladders shall be used at an angle such that the horizontal distance from the top support to the foot of the ladder is approximately one-quarter of the working length of the ladder (the distance along the ladder between the foot and the top support).

- Wood job-made ladders with spliced side rails shall be used at an angle such that the horizontal distance is one-eighth the working length of the ladder.

- Fixed ladders shall be used at a pitch no greater than 90 degrees from the horizontal, as measured to the back side of the ladder.

- Ladders shall be used only on stable and level surfaces unless secured to prevent accidental displacement.

- Ladders shall not be used on slippery surfaces unless secured or provided with slip-resistant feet to prevent accidental displacement. Slip-resistant feet shall not be used as a substitute for care in placing, lashing, or holding a ladder that is used upon slippery surfaces, including, but not limited to, flat metal or concrete surfaces that are constructed so they cannot be prevented from becoming slippery.

- Ladders placed in any location where they can be displaced by workplace activities or traffic, such as in passageways, doorways, or driveways, shall be secured to prevent accidental displacement, or a barricade shall be used to keep the activities or traffic away from the ladder.

- The area around the top and bottom of ladders shall be kept clear.

- The top of a non-self-supporting ladder shall be placed with the two rails supported equally unless it is equipped with a single support attachment.

- Ladders shall not be moved, shifted, or extended while occupied.

- Ladders shall have non-conductive siderails if they are used where the employee or the ladder could contact exposed energized electrical equipment.

- The top, top step, or the step labeled that it or any step above it should not be used as a step.
- Cross-bracing on the rear section of stepladders shall not be used for climbing unless the ladders are designed and provided with steps for climbing on both front and rear sections.

- Ladders shall be inspected by the HSO for visible defects on a daily basis and after any occurrence that could affect their safe use.

- Portable ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; corroded components; or other faulty or defective components shall either be immediately marked in a manner that readily identifies them as defective, or be tagged with "Do Not Use" or similar language, and shall be withdrawn from service.

- Fixed ladders with structural defects, such as, but not limited to, broken or missing rungs, cleats, or steps; broken or split rails; or corroded components; shall be withdrawn from service.

- Ladder repairs shall restore the ladder to a condition meeting its original design criteria, before the ladder is returned to use.

- Single-rail ladders shall not be used.

- When ascending or descending a ladder, the user shall face the ladder.

- Each employee shall use at least one hand to grasp the ladder when progressing up and/or down the ladder.

- An employee shall not carry any object or load that could cause the employee to lose balance and fall.

4.14 Traffic Safety

The project site may be located adjacent to a public roadway where exposure to vehicular traffic is likely. Traffic may also be encountered as vehicles enter and exit the area. To minimize the likelihood of project personnel and activities being affected by traffic, the following procedures will be implemented.

Cones must be placed along the shoulder of the roadway starting 100 feet from the work area to alert passing motorists to the presence of personnel and equipment. A "Slow" or "Men Working" sign must be placed at the first cone. Barricades with flashing lights should be placed between the roadway and the work area.

During activities along a roadway, equipment will be aligned parallel to the roadway to the extent feasible, facing into the oncoming traffic so as to place a barrier between the work crew and the oncoming traffic. All crewmembers must remain behind the equipment and the traffic barrier.

All site personnel who are potentially exposed to vehicular traffic must wear an outer layer of orange warning garments, such as vests, jackets, or shirts. If work is performed in hours of dusk or darkness, workers will be outfitted with reflective garments either orange, white (including silver-coated reflective coatings or elements that reflect white light), yellow, fluorescent red-orange, or fluorescent yellow-orange.

The flow of traffic into and out of the adjacent business must be assessed, and precautions taken to warn motorists of the presence of workers and equipment. Where possible, vehicles should be aligned to provide physical protection of people and equipment.

5. Personal Protective Equipment

5.1 Levels of Protection

PPE is required to safeguard site personnel from various hazards. Varying levels of protection may be required depending on the levels of COC and the degree of physical hazard. This section presents the various levels of protection and defines the conditions of use for each level. A summary of the levels is presented in Table 5-1 in this section.

5.1.1 Level D Protection

The minimum level of protection that will be required of BBL personnel and subcontractors at the site will be Level D, which will be worn when site conditions or air monitoring indicates no inhalation hazard exists. The following equipment will be used:

- Work clothing as prescribed by weather;
- Steel toe work boots, meeting ANSI Z41;
- Safety glasses or goggles, meeting ANSI Z87;
- Outer gloves chosen based on COC over nitrile surgical gloves (if handling soils or groundwater);
- Hard hat, meeting ANSI Z89, when falling object hazards are present; and
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used).

5.1.2 Modified Level D Protection

Modified Level D will be used when airborne contaminants are not present at levels of concern, but site activities present an increased potential for skin contact with contaminated materials. Modified Level D consists of:

- Tyvek® coveralls (polyethylene coated Tyvek® suits for handling liquids) when skin contact with COC-impacted media is anticipated;
- Latex/PVC overboots when contact with COC-impacted media is anticipated;
- Steel toe work boots, meeting ANSI Z41;
- Safety glasses or goggles, meeting ANSI Z87;
- Face shield in addition to safety glasses or goggles when projectiles or splash hazards exist;
- Outer gloves chosen based on COC over nitrile surgical gloves;

- Hard hat, meeting ANSI Z89 when falling object hazards are present;
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used); and
- PFD if working in or near the water.

5.1.3 Level C Protection

Level C protection will be required when the airborne concentration of COC reaches ½ of the OSHA Permissible Exposure Limit (PEL) or American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV). The following equipment will be used for Level C protection:

- Full-face, air-purifying respirator with appropriate cartridges for site COC;
- Polyethylene-coated Tyvek® suit, with ankles and cuffs taped to boots and gloves;
- Outer gloves chosen based on site COC over nitrile surgical gloves;
- Steel toe work boots, meeting ANSI Z41;
- Chemical resistant boots with steel toes or latex/PVC overboots over steel toe boots;
- Hard hat, meeting ANSI Z89;
- Hearing protection (if noise levels exceed 85 dBA, then hearing protection with a USEPA NRR of at least 20 dBA must be used); and
- PFD if working in or near the water.

5.2 Selection of PPE

Equipment for personal protection will be selected based on the potential for contact, site conditions, ambient air quality, and the judgment of supervising site personnel and health and safety professionals. The PPE used will be chosen to be effective against the COC present on the site.

5.3 Site Respiratory Protection Program

Respiratory protection is an integral part of employee health and safety at the site due to potentially hazardous concentrations of airborne COC. The site respiratory protection program will consist of the following (as a minimum):

- All on-site personnel who may use respiratory protection will have an assigned respirator.
- All on-site personnel who may use respiratory protection will have been fit tested and trained in the use of a full-face air-purifying respirator within the past 12 months.

- All on-site personnel who may use respiratory protection must within the past year have been medically certified as being capable of wearing a respirator. Documentation of the medical certification must be provided to the HSS, prior to commencement of site work.

- Only cleaned, maintained, NIOSH-approved respirators will be used.

- If respirators are used, the respirator cartridge is to be properly disposed of at the end of each work shift, or when load-up or breakthrough occurs.

- Contact lenses are not to be worn when a respirator is worn.

- All on-site personnel who may use respiratory protection must be clean-shaven. Mustaches and sideburns are permitted, but they must not touch the sealing surface of the respirator.

- Respirators will be inspected, and a negative pressure test performed prior to each use.

- After each use, the respirator will be wiped with a disinfectant, cleansing wipe. When used, the respirator will be thoroughly cleaned at the end of the work shift. The respirator will be stored in a clean plastic bag, away from direct sunlight in a clean, dry location, in a manner that will not distort the face piece.

5.4 Using PPE

Depending upon the level of protection selected, specific donning and doffing procedures may be required. The procedures presented in this section are mandatory if Modified Level D or Level C PPE is used. All personnel entering the EZ must put on the required PPE in accordance with the requirements of this HASP. When leaving the EZ, PPE will be removed in accordance with the procedures listed, to minimize the spread of COC.

5.4.1 Donning Procedures

These procedures are mandatory only if Modified Level D or Level C PPE is used on the site:

- Remove bulky outerwear. Remove street clothes and store in clean location;

- Put on work clothes or coveralls;

- Put on the required chemical protective coveralls;

- Put on the required chemical protective boots or boot covers;

- Tape the legs of the coveralls to the boots with duct tape;

- Put on the required chemical protective gloves;

- Tape the wrists of the protective coveralls to the gloves;

- Don the required respirator and perform appropriate fit check (Level C);

- Put hood or head covering over head and respirator straps and tape hood to facepiece (Level C); and

- Don remaining PPE, such as safety glasses or goggles and hard hat.

When these procedures are instituted, one person must remain outside the work area to ensure that each person entering has the proper protective equipment.

5.4.2 Doffing Procedures

The following procedures are only mandatory if Modified Level D or Level C PPE is required for the site. Whenever a person leaves the work area, the following decontamination sequence will be followed:

- Upon entering the CRZ, rinse contaminated materials from the boots or remove contaminated boot covers;
- Clean reusable protective equipment;
- Remove protective garments, equipment, and respirator (Level C). All disposable clothing should be placed in plastic bags, which are labeled with contaminated waste labels;
- Wash hands, face, and neck (or shower if necessary);
- Proceed to clean area and dress in clean clothing; and
- Clean and disinfect respirator for next use.

All disposable equipment, garments, and PPE must be bagged in plastic bags, labeled for disposal. See Section 7, Decontamination, for detailed information on decontamination stations.

5.5 Selection Matrix

The level of personal protection selected will be based on air monitoring of the work environment and an assessment by the SS and HSS of the potential for skin contact with COC. The PPE selection matrix is presented in Table 5-1. This matrix is based on information available at the time this plan was written. The Airborne Contaminant Action Levels in Table 8-1 should be used to verify that the PPE prescribed in these matrices is appropriate.

TABLE 5-1
PPE SELECTION MATRIX

Task	Level of Protection
Site Set-Up, SZ Work	Level D
Soil Excavation	Level D/Modified Level D
Active Slab Depressurization System Installation	Level D/Modified Level D
ASD System Operations	Modified Level D
Decontamination	Level D
Demobilization	Level D

6. Air Monitoring

6.1 Air Monitoring

Air monitoring will be conducted to determine employee exposure to airborne constituents. The monitoring results will dictate work procedures and the selection of PPE. The monitoring devices to be used are an MIE Data RAM particulate monitor (or equivalent) and a Rae Systems MultiRAE detector (PID with a 10.2 eV lamp/oxygen/LEL/Hydrogen Sulfide Sensors). The BBL HSS will be responsible for utilizing the air monitoring results to determine appropriate health and safety precautions for BBL personnel and subcontractors.

Air monitoring will be conducted continuously with the LEL/Oxygen meter during drilling in areas where flammable vapors or gases are suspect. All work activity must stop where tests indicate the concentration of flammable vapors exceeds 10% of the LEL at a location with a potential ignition source. Such an area must be ventilated to reduce the concentration to an acceptable level. In areas where tetrachloroethene (PCE) is suspected, PCE detector tube readings must be taken if PID readings exceed 1ppm, and are sustained for 15 minutes in the breathing zone.

Air monitoring for fugitive dust emissions will be performed in accordance with the protocols described in the Remedial Design Package (Section 2-3, page 2-2). The project site will be maintained so as to minimize the creation and dispersion of fugitive dust. The program for suppressing fugitive dust and monitoring particulate matter will follow NYSDEC's *Technical And Administrative Guidance Memorandum #4031: Fugitive Dust Suppression and Particulate Monitoring Program At Inactive Hazardous Waste Sites* (TAGM #4031). Dust control measures will be used throughout the course of the site work, as warranted. Dust emissions will be visually monitored throughout the period of work. Particulate monitoring for fugitive dust will be performed using real-time particulate monitors that will have automatic alarms and will detect particulate matter less than 10 microns in diameter. Fugitive dust controls will immediately be implemented if conditions warrant.

Community Air Monitoring Plan

Air monitoring will include real-time air monitoring for protection of the downwind community such as, residences and businesses. Community air monitoring will be performed for VOCs and particulates. Continuous air monitoring will be performed of all ground intrusive activities and during soil stockpiling and loading, and periodic air monitoring for non-intrusive activities such as the collection of soil samples.

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

If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

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

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

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

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m^3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m^3 above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m^3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m^3 of the upwind level and in preventing visible dust migration.

6.2 Noise Monitoring

Noise monitoring may be conducted as required. Hearing protection is mandatory for all employees in noise hazardous areas, such as around heavy equipment. As a general rule, sound levels that cause speech interference at normal conversation distance should require the use of hearing protection.

6.3 Monitoring Equipment Maintenance and Calibration

All direct-reading instrumentation calibrations should be conducted under the approximate environmental conditions the instrument will be used. Instruments must be calibrated before and after use, noting the reading(s) and any adjustments that are necessary. All air monitoring equipment calibrations, including the standard used for calibration, must be documented on a calibration log or in the field notebook. All completed HS documentation/forms must be reviewed by the HSS and maintained by the SS.

All air monitoring equipment will be maintained and calibrated in accordance with the specific manufacturer's procedures. Preventive maintenance and repairs will be conducted in accordance with the respective manufacturer's procedures. When applicable, only manufacturer-trained and/or authorized personnel will be allowed to perform instrument repairs or preventive maintenance.

If an instrument is found to be inoperative or suspected of giving erroneous readings, the HSS must be responsible for immediately removing the instrument from service and obtaining a replacement unit. If the instrument is essential for safe operation during a specific activity, that activity must cease until an appropriate replacement unit is obtained. The HSS will be responsible for ensuring a replacement unit is obtained and/or repairs are initiated on the defective equipment.

6.4 Action Levels

Table 6-1 presents airborne contaminant action levels that will be used to determine the procedures and protective equipment necessary based on conditions as measured at the site.

TABLE 6-1
AIRBORNE CONTAMINANT ACTION LEVELS

Parameter	Reading	Action
Total VOCs	0 ppm to ≤ 1 ppm	Normal operations; continue hourly breathing zone monitoring
	> 1 ppm to 5 ppm	Increase monitoring frequency to every 15 minutes and use benzene Drager tube to screen for the presence of benzene
	≥ 5 ppm to ≤ 50 ppm	Upgrade to Level C PPE; continue screening for benzene
	> 50 ppm	Stop work; investigate cause of reading
Tetrachloroethene	≥ 1 ppm to 10 ppm	Upgrade to Level C PPE
	> 10 ppm	Stop work; investigate cause of reading
Airborne Particulates	0 to < 7.5 mg/m^3	Normal operations; continue hourly breathing zone monitoring
	≥ 7.5 mg/m^3 to 15 mg/m^3	Initiate dust suppression measures; if suppression measures are insufficient to reduce particulates below 7.5 mg/m^3 to 15 mg/m^3, upgrade to Level C and increase monitoring frequency to every 15 minutes
Oxygen	≤ 19.5%	Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area
	> 19.5% to < 23.5%	Normal operations
	≥ 23.5%	Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area
Carbon Monoxide	0 ppm to ≤ 20 ppm	Normal operations
	> 20 ppm	Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area
Hydrogen Sulfide	0 ppm to ≤ 5 ppm	Normal operations
	> 5 ppm	Stop work, evacuate confined spaces/work area, investigate cause of reading, and ventilate area
Flammable Vapors (LEL)	< 10% LEL	Normal operations
	≥ 10% LEL	Stop work, ventilate area, investigate source of vapors

7. Work Zones and Decontamination

7.1 Work Zones

7.1.1 Authorization to Enter

Only personnel with the appropriate training and medical certifications (if respirators are required) will be allowed to work at the project site. The SS will maintain a list of authorized persons; only personnel on the authorized persons list will be allowed to enter the site work areas.

7.1.2 Site Orientation and Hazard Briefing

No person will be allowed in the work area during site operations without first being given a site orientation and hazard briefing. This orientation will be presented by the SS or HSS, and will consist of a review of this HASP. This review must cover the chemical, physical, and biological hazards, protective equipment, safe work procedures, and emergency procedures for the project. Following this initial meeting, daily safety meetings will be held each day before work begins.

All people entering the site work areas, including visitors, must document their attendance at this briefing, as well as the daily safety meetings on the forms included with this plan.

7.1.3 Certification Documents

A training and medical file may be established for the project and kept on site during all site operations. Specialty training, such as first aid/cardiopulmonary resuscitation (CPR) certificates, as well as current medical clearances for all project field personnel required to wear respirators, will be maintained within that file. All BBL and subcontractor personnel must provide their training and medical documentation to the HSS prior to starting work.

7.1.4 Entry Log

A log-in/log-out sheet will be maintained at the site by the SS. Personnel must sign in and out on a log sheet as they enter and leave the work area, and the SS may document entry and exit in the field notebook.

7.1.5 Entry Requirements

In addition to the authorization, hazard briefing, and certification requirements listed above, no person will be allowed in any BBL work area unless they are wearing the minimum PPE as described in Section 5, Personal Protective Equipment.

7.1.6 Emergency Entry and Exit

People who must enter the work area on an emergency basis will be briefed of the hazards by the SS. All activities will cease in the event of an emergency. People exiting the work area because of an emergency will gather in a safe area for a head count. The SS is responsible for ensuring that all people who entered the work area have exited in the event of an emergency.

7.1.7 Contamination Control Zones

Contamination control zones are maintained to prevent the spread of contamination and to prevent unauthorized people from entering hazardous areas.

7.1.7.1 Exclusion Zone

An EZ may consist of a specific work area, or may be the entire area of potential contamination. All employees entering an EZ must use the required PPE, and must have the appropriate training and medical clearance for hazardous waste work. The EZ is the defined area where there is a possible respiratory and/or contact health hazard. Cones, caution tape, or a site diagram will identify the location of each EZ.

7.1.7.2 Contamination Reduction Zone

The CRZ or transition area will be established, if necessary, to perform decontamination of personnel and equipment. All personnel entering or leaving the EZ will pass through this area to prevent any cross-contamination. Tools, equipment, and machinery will be decontaminated in a specific location. The decontamination of all personnel will be performed on site adjacent to the EZ. Personal protective outer garments and respiratory protection will be removed in the CRZ and prepared for cleaning or disposal. This zone is the only appropriate corridor between the EZ and the SZ.

7.1.7.3 Support Zone

The SZ is a clean area outside the CRZ located to prevent employee exposure to hazardous substances. Eating and drinking will be permitted in the support area only after proper decontamination. Smoking may be permitted in the SZ, subject to site requirements.

7.1.8 Posting

Work areas will be prominently marked and delineated using cones, caution tape, or a site diagram.

7.1.9 Site Inspections

The SS will conduct a daily inspection of site activities, equipment, and procedures to verify that the required elements are in place. The Safety Inspection Form in Attachment D may be used as a guide for daily inspections. A monthly IPO must also be completed and forwarded to the PM for review.

7.2 Decontamination

7.2.1 Personnel Decontamination

All personnel wearing Modified Level D or Level C protective equipment in the EZ must undergo personal decontamination prior to entering the SZ. The personnel decontamination area will consist of the following stations at a minimum:

- *Station 1*: Personnel leaving the contaminated zone will remove the gross contamination from their outer clothing and boots.
- *Station 2*: Personnel will remove their outer garment and gloves and dispose of it in properly labeled containers. Personnel will then decontaminate their hard hats, and boots with an aqueous solution of detergent or other appropriate cleaning solution. These items are then hand carried to the next station.

- *Station 3*: Personnel will thoroughly wash their hands and face before leaving the CRZ. Respirators will be sanitized and then placed in a clean plastic bag.

7.2.2 Equipment Decontamination

All vehicles that have entered the EZ will be decontaminated at the decontamination pad prior to leaving the zone. If the level of vehicle contamination is low, decontamination may be limited to rinsing of tires and wheel wells with water. If the vehicle is significantly contaminated, steam cleaning or pressure washing of vehicles and equipment may be required.

7.2.3 Personal Protective Equipment Decontamination

Where and whenever possible, single-use, external protective clothing must be used for work within the EZ or CRZ. This protective clothing must be disposed of in properly labeled containers. Reusable protective clothing will be rinsed at the site with detergent and water. The rinsate will be collected for disposal.

When removed from the CRZ, the respirator will be thoroughly cleaned with soap and water. The respirator face piece, straps, valves, and covers must be thoroughly cleaned at the end of each work shift, and ready for use prior to the next shift. Respirator parts may be disinfected with a solution of bleach and water, or by using a spray disinfectant.

8. Training and Medical Surveillance

8.1 Training

8.1.1 General

All on-site project personnel who work in areas where they may be exposed to site contaminants must be trained as required by OSHA Regulation 29 CFR 1910.120 (HAZWOPER). Field employees also must receive a minimum of three days of actual field experience under the direct supervision of a trained, experienced supervisor. Personnel who completed their initial training more than 12 months prior to the start of the project must have completed an eight-hour refresher course within the past 12 months. The SS must have completed an additional eight hours of supervisory training, and must have a current first-aid/CPR certificate.

8.1.2 Basic 40-Hour Course

The following is a list of the topics typically covered in a 40-hour HAZWOPER training course:

- General safety procedures;
- Physical hazards (fall protection, noise, heat stress, cold stress);
- Names and job descriptions of key personnel responsible for site health and safety;
- Safety, health, and other hazards typically present at hazardous waste sites;
- Use, application, and limitations of PPE;
- Work practices by which employees can minimize risks from hazards;
- Safe use of engineering controls and equipment on site;
- Medical surveillance requirements;
- Recognition of symptoms and signs which might indicate overexposure to hazards;
- Worker right-to-know (Hazard Communication OSHA 1910.1200);
- Routes of exposure to contaminants;
- Engineering controls and safe work practices;
- Components of a health and safety program and a site-specific HASP;
- Decontamination practices for personnel and equipment;
- Confined-space entry procedures; and
- General emergency response procedures.

8.1.3 Supervisor Course

Management and supervisors must receive an additional eight hours of training, which typically includes:

- General site safety and health procedures;

- PPE programs; and
- Air monitoring techniques.

8.1.4 Site-Specific Training

Site-specific training will be accomplished by on-site personnel reading this HASP, or through a thorough site briefing by the PM, SS, or HSS on the contents of this HASP before work begins. The review must include a discussion of the chemical, physical, and biological hazards; the protective equipment and safety procedures; and emergency procedures.

8.1.5 Daily Safety Meetings

Daily safety meetings will be held to cover the work to be accomplished, the hazards anticipated, the PPE and procedures required to minimize site hazards, and emergency procedures. The SS or HSS should present these meetings prior to beginning the day's fieldwork. No work will be performed in an EZ before the daily safety meeting has been held. The daily safety meeting must also be held prior to new tasks, and repeated if new hazards are encountered. The Daily Safety Meeting Log is included in Attachment E.

8.1.6 First Aid and CPR

At least one employee current in first aid/CPR will be assigned to the work crew and will be on the site during operations. Refresher training in first aid (triennially) and CPR (annually) is required to keep the certificate current. These individuals must also receive training regarding the precautions and protective equipment necessary to protect against exposure to blood-borne pathogens.

8.2 Medical Surveillance

8.2.1 Medical Examination

All personnel who are potentially exposed to site contaminants must participate in a medical surveillance program as defined by OSHA at 29 CFR 1910.120 (f).

8.2.2 Pre-placement Medical Examination

All potentially exposed personnel must have completed a comprehensive medical examination prior to assignment, and periodically thereafter as defined by applicable regulations. The pre-placement and periodic medical examinations typically include the following elements:

- Medical and occupational history questionnaire;
- Physical examination;
- Complete blood count, with differential;
- Liver enzyme profile;
- Chest X-ray, at a frequency determined by the physician;
- Pulmonary function test;
- Audiogram;

- Electrocardiogram for persons older than 45 years of age, or if indicated during the physical examination;
- Drug and alcohol screening, as required by job assignment;
- Visual acuity; and
- Follow-up examinations, at the discretion of the examining physician or the corporate medical director.

The examining physician provides the employee with a letter summarizing his findings and recommendations, confirming the worker's fitness for work and ability to wear a respirator. Documentation of medical clearance will be available for each employee during all project site work.

Subcontractors will certify that all their employees have successfully completed a physical examination by a qualified physician. The physical examinations must meet the requirements of 29 CFR 1910.120 and 29 CFR 1910.134. Subcontractors will supply copies of the medical examination certificate for each on-site employee.

8.2.3 Other Medical Examinations

In addition to pre-employment, annual, and exit physicals, personnel may be examined:

- At employee request after known or suspected exposure to toxic or hazardous materials; and
- At the discretion of the HSS, HSO, or occupational physician in anticipation of, or after known or suspected exposure to toxic or hazardous materials.

8.2.4 Periodic Exam

Following the placement examination, all employees must undergo a periodic examination, similar in scope to the placement examination. For employees potentially exposed over 30 days per year, the frequency of periodic examinations will be annual. For employees potentially exposed less than 30 days per year, the frequency for periodic examinations will be 18 months.

8.2.5 Medical Restriction

When the examining physician identifies a need to restrict work activity, the employee's supervisor must communicate the restriction to the employee and the HSS. The terms of the restriction will be discussed with the employee and the supervisor.

9. Emergency Procedures

9.1 General

Prior to the start of operations, the work area will be evaluated for the potential for fire, contaminant release, or other catastrophic event. Unusual conditions or events, activities, chemicals, and conditions will be reported to the SS/HSS immediately.

The SS/HSS will establish evacuation routes and assembly areas for the site. All personnel entering the site will be informed of this route and the assembly area.

9.2 Emergency Response

If an incident occurs, the following steps will be taken:

- The SS/HSS will evaluate the incident and assess the need for assistance and/or evacuation;
- The SS/HSS will call for outside assistance as needed;
- The SS/HSS will ensure the PM is notified promptly of the incident; and
- The SS/HSS will take appropriate measures to stabilize the incident scene.

9.2.1 Fire

In the case of a fire at the site, the SS/HSS will assess the situation and direct fire-fighting activities. The SS/HSS will ensure that the PM is immediately notified of any fires. Site personnel will attempt to extinguish the fire with available extinguishers, if safe to do so. In the event of a fire that site personnel are unable to safely extinguish with one fire extinguisher, the local fire department will be summoned.

9.2.2 Contaminant Release

In the event of a contaminant release, the following steps will be taken:

- Notify SS/HSS immediately;
- Evacuate immediate area of release;
- Conduct air monitoring to determine needed level of PPE; and
- Don required level of PPE and prepare to implement control procedures.

The SS/HSS has the authority to commit resources as needed to contain and control released material and to prevent its spread to off-site areas.

9.3 Medical Emergency

All employee injuries must be promptly reported to the HSS/SS, who will:

- Ensure that the injured employee receives prompt first aid and medical attention;

- In emergency situations, the worker is to be transported by appropriate means to the nearest urgent care facility (normally a hospital emergency room); and

- If the injured person is a BBL employee, notify Continuum Healthcare, BBL's medical surveillance consultant, as soon as possible after an injured worker has left the site. The caller should dial 1-800-229-3674 and follow the instructions for reaching the Injury Management Office. When the Case Manager answers, the caller should provide the information requested by the Case Manager.

9.3.1 Emergency Care Steps

Survey the scene. Determine if it is safe to proceed. Try to determine if the conditions that caused the incident are still a threat. Protect yourself from exposure before attempting to rescue the victim.

- Do a primary survey of the victim. Check for airway obstruction, breathing, and pulse. Assess likely routes of chemical exposure by examining the eyes, mouth, nose, and skin of the victim for symptoms.

- Phone Emergency Medical Services (EMS). Give the location, telephone number used, caller's name, what happened, number of victims, victim's condition, and help being given.

- Maintain airway and perform rescue breathing as necessary.

- Perform CPR as necessary.

- Do a secondary survey of the victim. Check vital signs and do a head-to-toe exam.

Treat other conditions as necessary. If the victim can be moved, take him/her to a location away from the work area where EMS can gain access.

9.4 First Aid - General

All persons must report any injury or illness to their immediate supervisor or the SS. Trained personnel will provide first aid. Injuries and illnesses requiring medical treatment must be documented. The SS and HSS must conduct an II as soon as emergency conditions no longer exist and first aid and/or medical treatment has been ensured. IIs must be completed and submitted to the PM within 24 hours after the incident.

If first-aid treatment is required, first aid kits are kept at the CRZ. If treatment beyond first aid is required, the injured person(s) should be transported to the medical facility. If the injured person is not ambulatory, or shows any sign of not being in a comfortable and stable condition for transport, then an ambulance/paramedics should be summoned. If there is any doubt as to the injured worker's condition, it is best to let the local paramedic or ambulance service examine and transport the worker.

9.4.1 First Aid - Inhalation

Any employee complaining of symptoms of chemical overexposure as described in Section 4, General Site Safety Procedures, will be removed from the work area and transported to the designated medical facility for examination and treatment.

9.4.2 First Aid - Ingestion

Call EMS and consult a poison control center for advice. If available, refer to the MSDS for treatment information. If the victim is unconscious, keep them on their side and clear the airway if vomiting occurs.

9.4.3 First Aid - Skin Contact

Project personnel who have had skin contact with contaminants will, unless the contact is severe, proceed through the CRZ, to the wash area. Personnel will remove any contaminated clothing, and then flush the affected area with water for at least 15 minutes. The worker should be transported to the medical facility if he/she shows any sign of skin reddening, irritation, or if he/she requests a medical examination.

9.4.4 First Aid - Eye Contact

Project personnel who have had contaminants splashed in their eyes or who have experienced eye irritation while in the EZ, must immediately proceed to the eyewash station in the CRZ. Do not decontaminate prior to using the eyewash. Remove whatever protective clothing is necessary to use the eyewash. Flush the eye with clean running water for at least 15 minutes. Arrange prompt transport to the designated medical facility.

9.5 Reporting Injuries, Illnesses, and Near Miss Incidents

Injuries and illnesses, however minor, will be reported to the SS immediately. The SS will complete an injury report and submit it to the HSO and the PM within 24 hours.

Near miss incidents are situations in which no injury or property damage occurred, but under slightly different circumstances an injury or property damage could have occurred. Near misses are caused by the same factors as injuries; therefore, they must be reported and investigated in the same manner. A SPSA must be done immediately after an injury, illness, near miss, or other incident to determine if it is safe to proceed with the work.

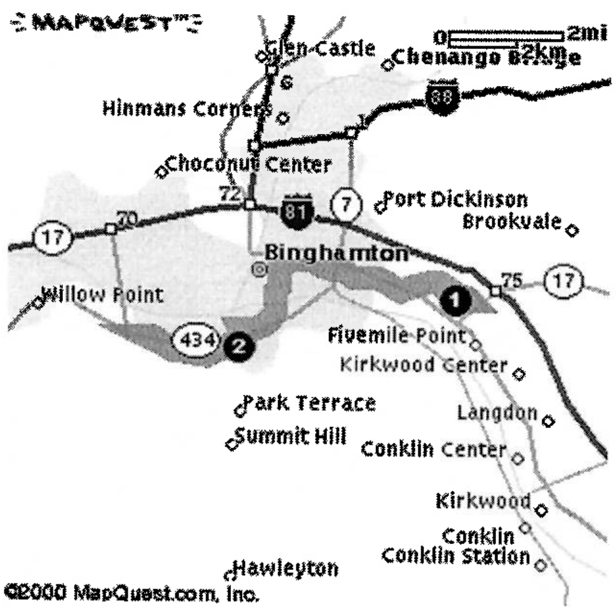
9.6 Emergency Information

The means to summon local public response agencies such as police, fire, and ambulance will be reviewed in the daily safety meeting. These agencies are identified in Table 9-1.

TABLE 9-1
EMERGENCY CONTACTS

Agency	Telephone No.
Fire	911
Police	911
Ambulance	911
Binghamton General Hospital 10 Mitchell Ave, Binghamton, NY 13903	(607) 762-2200

9.6.1 Directions to Hospital



1. Start out going Northwest on INDUSTRIAL PARK RD towards W COLESVILLE RD by turning left. 0.1 miles
2. Turn RIGHT onto W COLESVILLE RD. 0.2 miles
3. Turn RIGHT onto CORPORATE DR. 0.2 miles
4. Take the I-81 NORTH/RT-17 WEST ramp. 0.1 miles
5. Merge onto I-81 N/NY-17 W. 3.7 miles
6. Take the RT-17 NORTH exit, exit number 4, towards BINGHAMTON. 0.0 miles
7. Keep LEFT at the fork in the ramp. 0.2 miles
8. Keep RIGHT at the fork in the ramp. 0.2 miles
9. Merge onto NY-7 S/NY-363 W. 0.4 miles
10. Stay straight to go onto NY-363 W. 1.6 miles
11. Take the N Y 434 WEST ramp towards VESTAL. 0.2 miles
12. Merge onto NY-434 W. 2.3 miles
13. Turn LEFT. 0.0 miles
14. Turn LEFT onto NY-434 E. 1.9 mile