Remedial Investigation Work Plan

402 & 430 Buffalo Avenue Site
Niagara Falls, New York

November 2014 0294-013-001

Prepared For:

Merani Hospitality, Inc.

Prepared By:

TurnKey Environmental Restoration, LLC

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BCP SITE NO. C932164
NIAGARA FALLS, NEW YORK

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1.0 INTRODUCTION

This document presents the proposed scope of work and implementation procedures for completion of a Remedial Investigation (RI) and preparation of the RI and Alternatives Analysis (AA) Report for the 402 and 430 Buffalo Avenue Site, located in the City of Niagara Falls, Niagara County, New York (see Figures 1 and 2).

The Volunteer, Merani Hospitality, Inc. (Merani) has elected to pursue the investigation, cleanup and redevelopment of the Site under the New York State Brownfield Cleanup Program (BCP), and has executed a Brownfield Cleanup Agreement (BCA) with the New York State Department of Environmental Conservation (NYSDEC).

The RI/AA will be completed by TurnKey Environmental Restoration, LLC (TurnKey), in association with Benchmark Environmental Engineering & Science, PLLC (Benchmark; referred to jointly herein as TurnKey), on behalf of Merani. The work will be completed in general accordance with 6NYCRR Part 375 and NYSDEC DER-10 guidelines.

1.1 Site Background

The subject property (hereinafter, the "Project Site" or the "Site") subject to the Brownfield Cleanup Agreement (BCA) is comprised of three (3) adjoining parcels totaling 6.2 acres, located in a highly developed mixed use commercial and residential area of the City of Niagara Falls, Niagara County, New York (see Figures 1 and 2). The parcels include:

- **401 Buffalo Avenue, S.B.L. # 159.13-2-9, 3.8 acres**
- **402 Buffalo Avenue, S.B.L. # 159.54-1-46, 0.35 acres**
- **430 Buffalo Avenue, S.B.L. # 159.54-1-45, 2.05 acres**

The Site is bound by 4th Street to the west, 6th Street and Holly Place to the east, a public alleyway from 4th Street the 6th Street to the north, and the Robert Moses State Parkway with the Niagara River beyond to the south. Buffalo Avenue intersects the property from east to west. Land use surrounding the Site includes commercial and residential properties to the north, Robert Moses Parkway to the south with the Niagara beyond, residential properties to the east, and vacant and residential properties to the west.

The southern portion of the Site, 401 Buffalo Avenue parcel, is currently improved with a vacant municipally-condemned former hotel and conference center (Fallside), parking areas and vegetated/landscaped areas. Historically, Union Carbide and Carbon Corporation

(Union Carbide Corp.) owned and operated the parcel from at least 1917 to the 1960's. The existing hotel was developed in the early 1980's. The NYSDEC Spill No. 1312160 was opened for the 401 Buffalo Avenue parcel related to the vandalism/destruction of three transformers and the spilling of transformer oil/contents. The spill has been administratively closed upon the Site being accepted into the BCP, and further investigation and remediation is being addressed as an Interim Remedial Measure (IRM) directed under the guidance of NYSDEC through the BCP.

The northern portion of the Site, 402 and 430 Buffalo Avenue parcels, are currently vacant, though historically were part of the manufacturing facility owned and operated by National Biscuit Co / Shredded Wheat Company. Manufacturing began on Site in at least 1914, and operations included use of underground storage tanks (USTs) noted as fuel oil. Baking ovens, likely utilizing the noted fuel oil, were located across the manufacturing facility (including both 402 and 430 Buffalo Avenue parcels) for drying raw materials, heating the various buildings and operations, and baking final products. Additional operations included paper box manufacturing and printing, material handling and shipping equipment, maintenance of manufacturing equipment and vehicles, and use and storage of paint, solvents, thinners, grease and lubricants common among former manufacturing operations. It is also likely that demolition debris from the former factory is located on the vacant Site.

Previous environmental investigations completed at the Site have revealed evidence of environmental contamination related to the former uses of the Site. Elevated levels of semi-volatile organic compounds (SVOCs) and metals have been detected on-Site at concentrations exceeding regulatory guidelines. Details of the previous investigations are presented in Section 2.8 below.

1.2 Project Objectives

For sites entering the BCP at the point of investigation, NYSDEC requires completion of a RI/AA. The primary objectives of the RI/AA are to:

- Collect additional soil/fill and groundwater samples, under appropriate quality assurance/quality control criteria, to better delineate the nature and extent of contamination;
- Collect sufficient data to evaluate the actual and potential threats to the public health and the environment; and,

- Collect the data necessary to evaluate the remedial action alternatives.

As part of the RI/AA process, sampling data will be used to evaluate whether the remedial alternatives can meet the objectives. The intended uses of these data dictate the confidence levels. Two data confidence levels will be employed in the RI: screening level data and definitive level data. In general, screening level confidence will apply to field measurements, including PID measurements, groundwater elevation measurements, and field analyses (i.e., pH, temperature, specific conductivity, and turbidity). Definitive level confidence will apply to samples for chemical analysis. The applicability of these levels of data will be further specified in the Quality Assurance Project Plan (QAPP) in Section 5.0. Sampling and analytical acceptance and performance criteria such as precision, accuracy, representativeness, comparability, completeness, and sensitivity, are defined in the QAPP.

1.3 Project Organization and Responsibilities

Merani Hospitality, Inc. has been accepted into the NYS BCP as a Volunteer per ECL§27-1405. TurnKey, in association with Benchmark, will manage the brownfield cleanup on behalf of Merani. The NYSDEC Division of Environmental Remediation (Region 9), in consultation with the New York State Department of Health (NYSDOH), will monitor the investigation and remedial actions to verify that the work is performed in accordance with the BCA, the approved work plans, and NYSDEC DER-10 guidance (May 2010).

TurnKey personnel and key subcontractors for this project have not been determined at this time. Once subcontract agreements are in place, and a field schedule determined, resumes for the selected project team will be provided to the Department, if requested. TurnKey's Project Manager's résumé, has been included in Appendix A. The table below presents the planned project team.

Company	Role	Name	Contact Information
TurnKey	Project Manager	Nathan Munley	(716) 856-0635
TurnKey	Field Personnel	TBD	(716) 856-0635
Merani Hospitality	Facility Contact	TBD	TBD
TBD	Analytical Testing	TBD	TBD

TBD	Drilling Services	TBD	TBD
TBD	Excavation Services	TBD	TBD
TBD	Data Usability Summary Report	TBD	TBD

2.0 SITE DESCRIPTION

2.1 General

The 6.2 acre Site includes the former Fallside Hotel building, asphalt and concrete parking areas and sidewalks, landscaped areas (401 Buffalo Avenue), and vacant areas (402 and 430 Buffalo Avenue). The Site is bound by 4th Street to the west, 6th Street and Holly Place to the east, a public alleyway from 4th Street the 6th Street to the north, and the Robert Moses State Parkway with the Niagara River beyond to the south. Buffalo Avenue intersects the property from east to west (see Figure 2).

2.2 Site Topography and Drainage

The northern portion of the Site is generally flat lying with limited topographic features. The southern portion of the Site is generally flat with topographic relief to the south toward the Niagara River. The southern portion of the Site is currently improved with the former hotel structure and associated parking and landscaped areas.

Precipitation (i.e., rain or melting snow) moves to the storm drains in the parking lots and roadways via overland flow. Surface and shallow groundwater flow are likely impacted by various cycles of development and filling, as well as utility lines and foundations.

2.3 Geology and Hydrogeology

2.3.1 Overburden

The U.S. Department of Agriculture (USDA) Soil Conservation Service soil survey map of Niagara County shows the Site is located within an un-surveyed area. The geology of the Site will be investigated as part of the RI activities.

2.3.2 Bedrock

Based on the bedrock geologic map of Niagara County New York, the Niagara Falls region is underlain by Silurian and Devonian age stratified limestone, dolomite, and shale of marine origin. The bedrock is virtually flat lying, with a gentle dip to the south of only about 30 to 40 feet per mile and exhibits only very gentle folding.

The primary bedrock type that forms the bedrock surface in the northern part of the Lake Erie-Niagara River Basin is the fine- to coarse-grained Lockport Dolomite; a white or grey, magnesium-rich sedimentary rock resembling limestone, but harder and more resistant. The Lockport is the lowermost carbonate-rock unit in the region, which overlies the Rochester Shale, a black to gray carbonaceous shale with minor calcareous beds and limestone layers. The maximum thickness of the Lockport is approximately 150 feet.

Depth to and type of bedrock below the Site has not been determined by drilling.

2.3.3 Hydrogeology

The Site is located in the Erie-Niagara River Basin. In the Erie-Niagara Basin, the major areas of groundwater are within coarser overburden deposits and limestone and shale bedrock. Regional groundwater appears to flow south south-west towards the Niagara River and Niagara Falls; however, this region has had extensive modification of the hydrogeology due to the development of hydroelectric production facilities.

Localized on-Site groundwater flow will be investigated during the RI.

2.4 Climate

Western New York has a cold continental climate, with moisture from Lake Erie causing increased precipitation. Average annual precipitation is reportedly 40.5 inches and snowfall is 93.6 inches (Ref. 4) to the northern part of the watershed with over 150 inches per year falling on the southern portion of the watershed. Average monthly temperatures range from 24.5 degrees Fahrenheit in January to 70.8 degrees Fahrenheit in July (Ref. 4). The ground and lakes typically remain frozen from December to March. Winds are generally from the southwest (240 degrees) with a mean velocity of 10 miles per hour (Buffalo Airport, 1999).

2.5 Population and Land Use

The City of Niagara Falls, encompassing 14 square miles, has a population of 55,593 persons (2000 U.S. Census Bureau), a decrease of 10.3% from the 1990 U.S. Census. The population density in the City is 3,955.7 people per square mile. The Site is located in Census Tract 211, in a highly developed area of the with commercial/vacant/residential and recreational land use surrounding the Site.

The Site is surrounded by commercial and residential properties to the north, Robert Moses Parkway to the south with the Niagara River beyond, residential properties to the east, and vacant and residential properties to the west. Residential properties are located along eastern boundary along Holly Place.

2.6 Utilities and Groundwater Use

The subject property has access to major public and private utilities, including water (City of Niagara Falls Division of Water), sanitary and storm sewers (City of Niagara Falls), electric (National Grid), and natural gas (National Fuel Gas).

Groundwater at the Site is assigned Class "GA" by 6NYCRR Part 701.15. Currently, there are no known deed restrictions on the use of groundwater at the Site; however, there are no groundwater supply wells on the property. Regionally, groundwater in the area has not been developed for industrial, commercial, agriculture, or public supply purposes. Municipal potable water service is provided on-site and off-site. Currently, there are no known permanent groundwater wells on the Site.

2.7 Wetlands and Floodplains

There are no State or Federal wetlands or floodplains located on-Site. Per the Niagara County GIS System, floodplains are located approximately 250-ft to the south along the Niagara River (see Figure 3).

2.8 Previous Investigations

A summary of the investigations that have occurred at the Site are presented below. These reports are included electronically in Appendix B.

2.8.1 November 2013 Limited Phase II Environmental Investigation Report and December 2013 Supplemental Phase II Site Assessment

TurnKey Environmental Restoration (TurnKey) completed a Limited Phase II Subsurface Environmental Investigation on the 401, 402, & 430 Buffalo Avenue Site, and the findings are summarized below:

- NYSDEC Spill No. 1312160 was assigned to the Site related to the vandalism/destruction of three transformers and spilling of approximately 120-gallons of potential PCB-containing transformer oil;
- Visual evidence of similar historic subsurface fill materials across the Site on both the north and south sides of Buffalo Avenue;

- Elevated PID readings for volatile organic compounds (VOCs) was detected in historic soil/fill on the south side of Buffalo Avenue;
- Elevated polycyclic aromatic hydrocarbons (PAHs) above Part 375 Unrestricted, Restricted Residential and Commercial Use SCOs across the Site;
- Elevated metals, including barium and lead, above the Part 375 Unrestricted, Restricted Residential and Commercial Use SCOs across the Site;
- Oil-leaking former hotel operation equipment in the basement, including compressors, elevator equipment, and transformers;
- Wide-spread floor staining in the basement associated with former mechanical system equipment (as noted above);
- Improper storage and handling of hazardous chemicals, including corrosive boiler chemicals, solvents, lubricants, degreasers, paints, thinners, hydraulic oils and maintenance equipment fuels, pesticides and herbicides, pool and water treatment chemicals;
- Former transformer vessels with staining noted;
- Sumps, floor drains and vent stacks noted in basement. Staining was noted proximate to several floor drains;
- Numerous ASTs of unknown contents in the basement; and,
- Universal and e-waste throughout the building.

Additional observations included potential asbestos containing materials (ACMs), mold, chipping paint, vandalism, illegal dumping, theft of copper piping, and compromised structural components including roof and walls.

2.8.2 September 2014 – 401 Buffalo Avenue Supplemental Investigation

TurnKey completed a pre-demolition supplemental investigation at the 401 Buffalo Avenue parcel and the findings are summarized below:

- Elevated PAHs above Part 375 Unrestricted, Restricted-Residential and/or Commercial Use SCOs were detected on-Site, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, benzo(k)flouranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene;

- Elevated metals above Part 375 Unrestricted, Restricted Residential, and/or Commercial Use SCOs were detected on-Site, including arsenic, cadmium, chromium, lead, and mercury; and,
- Based on the radiological screening results, elevated levels of NORM/TENORM are present across the Site. Additional radiological assessment was recommended.

2.9 Primary Constituents of Potential Concern (COPCs)

Based on findings to date, the Constituents of Potential Concern (COPCs) are presented by media below:

- ***Soil:*** SVOCs and metals. Specific areas of the property may also be impacted by polychlorinated biphenyls (PCBs) in the electrical equipment room, and elevated radiologic slag material.
- ***Groundwater:*** SVOCs and metals

3.0 INVESTIGATION SCOPE OF WORK

The Remedial Investigation scope of work is focused on defining the nature and extent of contamination on-Site, identifying the source of contamination, defining chemical constituent migration pathways, qualitatively assessing human health and ecological risks (if necessary), and obtaining data of sufficient quantity and quality to perform the alternatives analysis report.

Field team personnel will collect environmental samples in accordance with the rationale and protocols described in the QAPP in Section 5. USEPA and NYSDEC-approved sample collection and handling techniques will be used. Samples for chemical analysis will be analyzed in accordance with USEPA SW-846 methodology with an equivalent Category B deliverable package to meet the definitive-level data requirements. Analytical results will be evaluated by a third-party data validation expert in accordance with provisions described in the QAPP.

During intrusive RI activities, a Community Air Monitoring Plan (CAMP) will be followed. The CAMP is consistent with the requirements for community air monitoring at remediation sites as established by the New York State Department of Health (NYSDOH) and NYSDEC. Accordingly, it follows procedures and practices outlined within the NYSDEC's DER-10 (May 2010) Appendix 1A (NYSDOH's Generic Community Air Monitoring Plan) and Appendix 1B (Fugitive Dust and Particulate Monitoring). The CAMP is included in the Health and Safety Plan (HASP) included in Appendix C.

3.1 Investigation Preparation Activities

3.1.1 Radiological Screening

Based on the location of the Site within an area of Niagara Falls New York that is recently known to contain historic slag material which exhibits elevated levels of naturally-occurring radioactive material (NORM) and technologically-enhanced, naturally-occurring radioactive material (TENORM), a radiological survey of the Site will be completed across accessible areas. The radiological survey will be completed by a NYSDOH licensed-radiologic subcontractor. Any areas that are identified to be elevated above the approved background levels will be handled in accordance with the approved Radiological Work Plan and Support Documents (see Appendix D).

3.1.2 Utility Clearance

Prior to any intrusive activities, Dig Safely New York (Call 811) will be contacted by the site contractor a minimum of three business days in advance of the work and informed of the intent to perform excavation work at the Site. If underground utilities are present on the property and are anticipated to interfere with intrusive activities, the Applicant and the NYSDEC will be contacted to discuss mitigating measures.

3.1.3 Demolition Activities

As described in the Interim Remedial Measures (IRM) Work Plan dated November 2014, the three-story portion of the existing hotel structure, located on the 401 Buffalo Avenue parcel, is slated for demolition. The US Environmental Protection Agency (EPA) and NYS Department of Labor 10-day notification will be filed by the demolition subcontractor. Details of the pre-demolition activities, including abatement, air monitoring, and waste management are provided in the IRM Work Plan.

3.2 Field Investigation Activities

3.2.1 Soil/Fill Investigation

A soil/fill investigation will be completed across the BCP Site to assess potential impacts related to the historic use of the Site. The soil/fill investigation will include the collection of surface (0.0-0.5 feet below ground surface (fbgs), near surface (0.0-2.0 fbgs), and subsurface soil/fill samples (>2.0 fbgs). The soil/fill investigation will include the excavation of exploratory test pits (TPs) across the accessible portions of the Site, and the advancement boreholes to allow for inspection and characterization of subsurface soil/fill and sample collection. The proposed RI sample locations are presented on Figure 4 and a Sampling and Analytical Plan is presented on Table 1.

3.2.2 Surface Soil Investigation

Six (6) surface soil samples will be collected from the upper 6 inches in non-paved areas of the Site. All surface soil samples will be analyzed in accordance with Table 1. If visible evidence of impacts is observed (e.g., petroleum-type surface staining) additional samples for VOCs and PCBs will be collected from that sample location.

3.2.3 Subsurface Soil/Fill Investigation

An estimated twenty nine (29) subsurface soil/fill exploratory locations will be completed across the BCP Site to assess the subsurface soil/fill, including the excavation of twenty (20) test pits, identified as TP-10 through TP-29; and the advancement of nine (9) soil borings during groundwater monitoring well installation, identified as MW-1 through MW-9. Each TP will be approximately 3 feet in width, 8-10 feet in length, and will be advanced to an approximate depth of 12 to 15 fbgs, the extent of the excavator arm, or refusal. Soil borings and monitoring well locations will be advanced to approximately 12-16 fbgs, or refusal. All soil samples will be field screened for the presence of VOCs using a field photoionization detector (PID) equipped with a 10.6 eV lamp as a procedure for ensuring the health and safety of personnel at the Site, and to identify potentially impacted soil samples for laboratory analysis.

In an effort to characterize the Site lithology, if multiple or differentiable soil horizons are observed, TurnKey will discuss collecting additional samples with the Department.

3.2.4 Soil/Fill Sample Collection and Analysis

Tables 1 and 2 summarize the proposed RI analytical program and sampling requirements. During the subsurface investigation, the soil/fill interval identified as the most impacted within the target horizon (i.e., greatest PID scan result and/or evidence of visual/olfactory impact) will be selected for analysis. In the event that either the impacts are ubiquitous from grade to final depth or no impacts are identified, the soil/fill sample interval will be collected to delineate previously identified impacts and uniformly characterize the Site as detailed on Table 1. If additional differentiable impacts are noted within a target horizon, or if an additional soil horizon is identified, additional samples may be collected from the material for characterization.

Soil/fill samples will be collected and analyzed for Target Compound List (TCL) plus NYSDEC CP-51 List volatile organic compounds (VOCs), TCL list semi-volatile organic compounds (SVOCs) and Part 375 Metals list. Approximately 25% of soil/fill samples collected will be analyzed for a comprehensive list of parameters including PCBs, pesticides, and herbicides. Laboratory provided core samplers will be used to collect VOC soil/fill samples. All remaining samples will be collected using dedicated stainless steel sampling tools. Representative soil samples will be placed in pre-cleaned laboratory provided sample bottles, cooled to 4ºC in the field, and transported under chain-of-custody command to a NYSDOH Environmental Laboratory Approval Program (ELAP)-certified analytical laboratory, in accordance with USEPA SW-846 methodology with equivalent NYSDEC Category B deliverables to allow for independent third-party data usability assessment.

3.2.5 Groundwater Investigation

Nine (9) groundwater monitoring wells will be advanced across the Site to assess groundwater flow direction and groundwater quality data. Proposed groundwater monitoring well locations are identified on Figure 4. Monitoring well installation, well development, and groundwater sample collection details are discussed in the following sections.

3.2.5.1 Monitoring Well Installation

A direct-push drill rig capable of advancing hollow-stem augers will be employed to install 2-inch inside diameter (ID) monitoring wells. Each well location will be advanced to approximately 14-16 fbgs, or refusal, with a target minimum of 5 feet below the first encountered groundwater. All non-dedicated drilling tools and equipment will be decontaminated between boring locations using potable tap water and a phosphate-free detergent (e.g., Alconox).

Each monitoring well will be installed using a 2-inch ID diameter flush-joint Schedule 40 PVC casing with a minimum 5-foot flush-joint Schedule 40 PVC, 0.010-inch machine slotted well screen. Each well screen and attached riser will be placed at the bottom of each borehole and a silica sand filter pack (size #0) will be installed from the base of the well to a maximum of 2 feet above the top of the screen. A bentonite chip seal will then be installed and allowed to hydrate sufficiently to mitigate the potential for downhole grout contamination. The newly installed monitoring wells will be completed with keyed-alike locks, a lockable J-plug, and a steel flush mounted road box.

3.2.5.2 Well Development

After installation, but not within 24 hours, newly installed monitoring wells will be developed in accordance with TurnKey and NYSDEC protocols. Development of the monitoring wells will be accomplished with dedicated disposable polyethylene bailers via surge and purge methodology. Field parameters including pH, temperature, turbidity, dissolved oxygen (DO), oxidation-reduction potential (ORP) and specific conductance will be measured periodically (i.e., every well volume or as necessary) during development. Field measurements will continue until they became relatively stable. Stability will be defined as variation between measurements of approximately 10 percent or less with no overall upward or downward trend in the measurements. A minimum of three well volumes will be evacuated from each monitoring well. Development water from the monitoring wells will be discharged to the ground surface in the vicinity of the monitoring well being developed. If light non-aqueous phase liquid (LNAPL), dense non-aqueous phase liquid (DNAPL), odors, or sheen are encountered during well development, water will be containerized in NYSDOT-approved drums and labeled per monitoring well location. Based on the RI analytical results, containerized water may be discharged to the ground surface, passed through a granular activated carbon unit or other on-Site treatment system, prior to discharge to ground surface, or taken off-site for disposal.

3.2.5.3 Groundwater Sample Collection

Prior to sample collection, static water levels will be measured and recorded from all on-Site monitoring wells. Following water level measurement, TurnKey personnel will purge and sample monitoring wells using either a peristaltic pump with dedicated pump tubing following low-flow/minimal drawdown purge and sample collection procedures; or using a dedicated polyethylene bailer. Prior to sample collection, groundwater will be evacuated from each well at a low-flow rate (typically less than 0.1 L/min). Field measurements for pH, temperature, turbidity, dissolved oxygen (DO), oxidation-reduction potential (ORP), specific conductance and water level, as well as visual and olfactory field observations will be periodically recorded and monitored for stabilization. Purging will be considered complete when pH, specific conductivity, DO, ORP and temperature stabilize and when turbidity measurements fall below 50 Nephelometric Turbidity Units (NTU), or become stable above 50 NTU. Stability is defined as variation between field measurements of 10 percent or less and no overall upward or downward trend in the measurements. Upon stabilization of field parameters, groundwater samples will be collected and analyzed as discussed below.

Sample collection methods that may be implemented during the RI include:

- **Low-Flow` Submersible Pump with Dedicated Pump Tubing**

All monitoring wells will be purged and sampled using a non-dedicated submersible pump and dedicated pump tubing following low-flow (minimal drawdown) purge and sample collection procedures, as described above. Non-dedicated pumps will require decontamination prior to use at each well location and the collection of an equipment blank.

- **Polyethylene Disposable Bailer**

  Wells of any depth (up to 100 fbgs) may be purged and sampled using a polyethylene disposable bailer via direct grab. In general, a bottom filling dedicated polyethylene bailer is attached to a length of dedicated hollow-braid polypropylene rope and lowered into the well smoothly and slowly as not to agitate the groundwater or damage the well. Purging continues until a predetermined volume of water has been removed (typically three well volumes) or to dryness. Measurements for pH, temperature, specific conductance, dissolved oxygen and turbidity are recorded following removal of each well volume. The well is purged until the readings for indicator parameters stabilize or the well is purged to dryness.

Prior to, and immediately following collection of groundwater samples, field measurements for pH, specific conductance, temperature, DO, ORP, turbidity and water level, as well as visual and olfactory field observations will be recorded. All collected groundwater samples will be placed in pre-cleaned, pre-preserved laboratory provided sample bottles, cooled to 4°C in the field, and transported under chain-of-custody command to NYSDOH ELAP-certified analytical laboratory for analysis; in accordance with USEPA SW-846 methodology with equivalent NYSDEC Category B deliverables to allow for independent third-party data usability assessment.

3.2.5.4 Groundwater Sample Analyses

A total of nine (9) groundwater samples will be collected and analyzed for TCL plus CP-51 VOCs, TCL SVOCs, Part 375 List dissolved metals, PCBs, pesticides, and herbicides (see Table 1).

3.2.5.5 Groundwater Flow Evaluation

Groundwater elevation data will be collected during the RI. Two rounds of water level data from within the newly installed monitoring wells will be collected, and used to develop an on-Site groundwater isopotential map. A table that summarizes the well casing and groundwater elevations will be prepared. An isopotential map showing the general direction of groundwater flow will be prepared based on water elevation measurements relative to USGS vertical datum.

3.2.6 Soil Vapor Assessment

If initial RI subsurface soil and groundwater data indicates that VOCs may cause a soil vapor concern within the current or future buildings, TurnKey will discuss with NYSDEC and NYSDOH whether a soil vapor assessment is necessary.

3.2.7 Field Specific Quality Assurance/Quality Control Sampling

In addition to the surface soil, subsurface soil/fill and groundwater samples described above, field-specific quality assurance/quality control (QA/QC) samples will be collected and analyzed to ensure the reliability of the generated data as described in the QAPP (see Section 5.0) and to support the required third-party data usability assessment effort. Site-specific QA/QC samples will include matrix spikes, matrix spike duplicates, blind duplicates, and trip blanks.

3.3 Investigation-Derived Waste Management

Every attempt will be made to utilize dedicated sampling equipment during the RI, however if non-dedicated equipment is required and/or used, the equipment will be decontaminated, at a minimum, with a non-phosphate detergent (i.e., Alconox®) and potable water mixture and rinsed before each use. All decontaminated sampling equipment will be kept in a clean environment prior to sample collection.

RI generated spoils, groundwater, or decontamination rinse water not exhibiting contamination (i.e., visible product, odor, sheen, etc.) will be either returned to the hole from which it was removed (soil/fill) or discharged to the ground surface (groundwater and rinse water). Investigative-Derived Waste (IDW) or those materials exhibiting gross contamination will be placed in NYSDOT-approved drums and labeled for subsequent characterization and disposal. All generated IDW drums will be labeled alpha-numerically with regard to contents, origin, and date of generation using a paint stick marker on two sides and the top of each drum. Characterization analytical results of containerized IDW material will be used to determine if spoils can be returned to the ground surface, utilized on-Site, or require treatment and/or off-Site disposal. Drums will be securely staged on-site pending characterization analyses and remedial measures assessment. Field personnel will coordinate the on-site handling and temporary storage of IDW drums, including transportation, characterization sampling, and offsite disposal arrangements, as necessary.

Discarded personal protective equipment (PPE) (i.e., latex gloves, Tyvek, paper towels, etc.) and disposable sampling equipment (i.e., bailers or stainless steel spoons) will be placed in sealed plastic garbage bags and disposed of as municipal solid waste.

3.4 Site Mapping

A Site map will be developed during the field investigation. All sample points and relevant Site features will be located on the map. TurnKey will employ a handheld GPS unit to identify the locations of all surface soil, test pit and newly installed well locations relative to State planar grid coordinates. Additional geospatial data may be collected related to debris piles, structure locations, and/or subsurface structures. Monitoring well elevations will be measured by TurnKey's surveyor. Site maps will be provided with the RI report.

4.0 QUALITY ASSURANCE PROJECT PLAN

A QAPP has been prepared in support of the RI activities. The QAPP dictates implementation of the investigation tasks delineated in this Work Plan. A Sampling and Analysis Plan (SAP) identifying methods for sample collection, decontamination, handling, and shipping, is provided as below.

The QAPP will assure the accuracy and precision of data collection during the Site characterization and data interpretation periods. The QAPP identifies procedures for sample collection to mitigate the potential for cross-contamination, as well as analytical requirements necessary to allow for independent data validation. The QAPP has been prepared in accordance with USEPA's Requirements for Quality Assurance Project Plans for Environmental Data Operations; the EPA Region II CERCLA Quality Assurance Manual, and NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation (May 2010).

4.1 Scope of the QAPP

This QAPP was prepared to provide quality assurance (QA) guidelines to be implemented during the RI activities. This document may be modified for subsequent phases of investigative work, as necessary. The QAPP provides:

- A means to communicate to the persons executing the various activities exactly what is to be done, by whom, and when.
- A culmination to the planning process that ensures that the program includes provisions for obtaining quality data (e.g., suitable methods of field operations).
- A historical record that documents the investigation in terms of the methods used, calibration standards and frequencies planned, and auditing planned.
- A document that can be used by the Project Manager's and QA Officer to assess if the activities planned are being implemented and their importance for accomplishing the goal of quality data.
- A plan to document and track project data and results.

- Detailed descriptions of the data documentation materials and procedures, project files, and tabular and graphical reports.

The QAPP is primarily concerned with the quality assurance and quality control aspects of the procedures involved in the collection, preservation, packaging, and transportation of samples; field testing; record keeping; data management; chain-of-custody procedures; laboratory analyses; and other necessary matters to assure that the investigation activities, once completed, will yield data whose integrity can be defended.

QA refers to the conduct of all planned and systematic actions necessary to perform satisfactorily all task-specific activities and to provide information and data confidence as a result of such activities. The QA for task-specific activities includes the development of procedures, auditing, monitoring and surveillance of the performance.

QC refers to the activity performed to determine if the work activities conform to the requirements. This includes activities such as inspections of the work activities in the field (e.g., verification that the items and materials installed conform to applicable codes and design specifications). QA is an overview monitoring of the performance of QC activities through audits rather than first time inspections.

4.2 QAPP Organization and Responsibility

The principal organizations involved in verifying achievement of data collection goals for the 401, 402, and 430 Buffalo Avenue Site include: the NYSDEC, NYSDOH, Merani Hospitality, Inc. (Volunteer), TurnKey Environmental Restoration, LLC (Volunteer's Consultant), the drilling subcontractor(s), the independent environmental laboratory, and the independent third party data validator. Roles, responsibilities, and required qualifications of these organizations are discussed in the following subsections. Resumes are included in Appendix A.

4.2.1 NYSDEC and NYSDOH

It is the responsibility of the NYSDEC, in conjunction with NYSDOH, to review the RI/AAR Work Plan and supporting documents, for completeness and conformance with the site-specific cleanup objectives and to make a decision to accept or reject these documents based on this review. The NYSDEC also has the responsibility and authority to review and approve all QA documentation collected during brownfield cleanup construction and to confirm that the QA Plan was followed. The NYSDEC may split any waste, soil or groundwater sample during this investigation.

4.2.2 Volunteer

Merani Hospitality, Inc. ("Volunteer") will be responsible for complying with the QA requirements as specified herein and for monitoring and controlling the quality of the Brownfield cleanup construction either directly or through their designated environmental consultant and/or legal counsel. The Volunteer will also have the authority to select Remedial Action Contractor(s) to assist them in fulfilling these responsibilities. The designated Project Manager is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements.

4.2.3 TurnKey Environmental Restoration, LLC

TurnKey Environmental Restoration, LLC (TurnKey), in association with Benchmark Environmental Engineering and Science, PLLC (Benchmark), is the prime consultant on this project and is responsible for the performance of all services required to implement each phase of the RI Work Plan, including, but not limited to, field operations, laboratory testing, data management, data analysis and reporting. Any one member of TurnKey's staff may fill more than one of the identified project positions (e.g., field team leader and site safety and health officer). The various quality assurances, field, laboratory and management responsibilities of key project personnel are defined below.

- *TurnKey Project Manager (PM):* *Michael Lesakowski / Nathan Munley*

  The TurnKey PM has the responsibility for ensuring that the project meets the Work Plan objectives. The PM will report directly to the Merani's Project Coordinator and the NYSDEC/NYSDOH Project Coordinators and is responsible for technical and project oversight. The PM will:

  - Define project objectives and develop a detailed work plan schedule.
  - Establish project policy and procedures to address the specific needs of the project as a whole, as well as the objectives of each task.
  - Acquire and apply technical and corporate resources as needed to assure performance within budget and schedule constraints.

- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Review the work performed on each task to assure its quality, responsiveness, and timeliness.
- Review and analyze overall task performance with respect to planned requirements and authorizations.
- Review and approve all deliverables before their submission to NYSDEC.
- Develop and meet ongoing project and/or task staffing requirements, including mechanisms to review and evaluate each task product.
- Ultimately be responsible for the preparation and quality of interim and final reports.
- Represent the project team at meetings.

- *TurnKey FTL/SSHO:* *Nathan Munley*

The Field Team Leader (FTL) has the responsibility for implementation of specific project tasks identified at the Site, and is responsible for the supervision of project field personnel, subconsultants, and subcontractors. The FTL reports directly to the Project Manager. The FTL will:

- Define daily work activities.
- Orient field staff concerning the project's special considerations.
- Monitor and direct subcontractor personnel.
- Review the work performed on each task to ensure its quality, responsiveness, and timeliness.
- Assure that field activities, including sample collection and handling, are carried out in accordance with this QAPP.

For this project the FTL will also serve as the Site Safety and Health Officer (SSHO). As such, he is responsible for implementing the procedures and required components of the Site Health and Safety Plan (HASP), determining levels of protection needed during field tasks, controlling site entry/exit, briefing the field team and subcontractors on site-specific health and safety issues, and all other responsibilities as identified in the HASP.

4.3 Quality Assurance (QA) Responsibilities

The QA Officer will have direct access to corporate executive staff as necessary, to resolve any QA dispute, and is responsible for auditing the implementation of the QA program in conformance with the demands of specific investigations and TurnKey policies, and NYSDEC requirements. The QA Officer has sufficient authority to stop work on the investigation as deemed necessary in the event of serious QA issues.

- *Project QA Officer:* *Lori E. Riker*

  Specific function and duties include:
  - Performing QA audits on various phases of the field operations
  - Reviewing and approving QA plans and procedures
  - Providing QA technical assistance to project staff
  - Reporting on the adequacy, status, and effectiveness of the QA program on a regular basis to the Project Manager for technical operations
  - Responsible for assuring third party data review of all sample results from the analytical laboratory

4.4 Field Responsibilities

TurnKey field staff for this project is drawn from a pool of qualified resources. The Project Manager will use staff to gather and analyze data, and to prepare various task reports and support materials. All of the designated technical team members are experienced professionals who possess the degree of specialization and technical competence required to effectively and efficiently perform the required work.

4.5 Quality Assurance Objectives for Measurement Data

The overall objectives and criteria for assuring quality for this effort are discussed below. This QAPP addresses how the acquisition and handling of samples and the review and reporting of data will be documented. The objectives of this QAPP are to address the following:

- The procedures to be used to collect, preserve, package, and transport groundwater samples.

- Field data collection.

- Record keeping.

- Data management.

- Chain-of-custody procedures.

- Precision, accuracy, completeness, representativeness, decision rules, comparability and level of quality control effort conformance for sample analysis and data management by TestAmerica under EPA analytical methods.

4.6 Level of QC Effort for Sample Parameters

Field blank, method blank, trip blank, field duplicate, laboratory duplicate, laboratory control, standard reference materials (SRM) and matrix spike samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs. QC samples are discussed below.

- Field and trip blanks consisting of distilled water will be submitted to the analytical laboratories to provide the means to assess the quality of the data resulting from the field-sampling program. Field (equipment) blank samples are analyzed to check for procedural chemical constituents at the facility that may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage.

- Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures.

- Duplicate samples are analyzed to check for sampling and analytical reproducibility.

- MS/MSD and MS/Duplicate samples provide information about the effect of the sample matrix on the digestion and measurement methodology. Depending on site-specific circumstances, one MS/MSD or MS/Duplicate should be collected for every 20 or fewer investigative samples to be analyzed for organic and inorganic chemicals of a given matrix.

The general level of QC effort will be one field (blind) duplicate and one field blank (when non-dedicated equipment is used) for every 20 or fewer investigative samples of a given matrix. Additional sample volume will also be provided to the laboratory to allow one site-specific MS/MSD or MS/Duplicate for every 20 or fewer investigative samples of a given matrix. One trip blank consisting of distilled, deionized water will be included along with each sample delivery group of aqueous VOC samples.

4.7 Sampling and Analysis Plan

The selection and rationale for the RI sampling program is discussed in the RI/AAR Work Plan. Methods and protocol to be used to collect environmental samples (i.e., soil, and groundwater) for this investigation are described in the TurnKey Field Operating Procedures (FOPs) presented in Appendix F.

The number and types of environmental samples to be collected is summarized on Table 1. Sample parameter lists, holding times and sample container requirements are summarized on Table 2. The sampling program and related site activities are discussed below. To the extent allowed by existing physical conditions at the facility, sample collection efforts will adhere to the specific methods presented herein. If alternative sampling locations or procedures are implemented in response to facility specific constraints, each will be selected on the basis of meeting data objectives. Such alternatives will be approved by NYSDEC before implementation and subsequently documented for inclusion in the project file.

4.7.1 Custody Procedures

Sample custody is controlled and maintained through the chain-of-custody procedures. Chain of custody is the means by which the possession and handling of samples will be tracked from the source (field) to their final disposition, the laboratory. A sample is considered to be in a person’s custody if it is in the person’s possession or it is in the person's view after being in his or her possession or it was in that person's possession and that person has locked it in a vehicle or room. Sample containers will be cleaned and preserved at the laboratory before shipment to the Site. The following section and FOPs for

Sampling, Labeling, Storage, and Shipment, located in Appendix F, describe procedures for maintaining sample custody from the time samples are collected to the time they are received by the analytical laboratory.

4.7.2 Sample Storage

Samples are stored in secure limited-access areas. Walk-in coolers or refrigerators are maintained at 4°C, ± 2°C, or as required by the applicable regulatory program. The temperatures of all refrigerated storage areas are monitored and recorded a minimum of once per day. Deviations of temperature from the applicable range require corrective action, including moving samples to another storage location if necessary.

4.7.3 Sample Custody

Sample custody is defined by this document as when any of the following occur:

- It is in someone's actual possession.
- It is in someone's view after being in his or her physical possession.
- It was in someone's possession and then locked, sealed, or secured in a manner that prevents unsuspected tampering.
- It is placed in a designated and secured area.

Samples are removed from storage areas by the sample custodian or analysts and transported to secure laboratory areas for analysis. Access to the laboratory and sample storage areas is restricted to laboratory personnel and escorted visitors only; all areas of the laboratory are therefore considered secure. If required by the applicable regulatory program, internal chain-of-custody is documented in a log by the person moving the samples between laboratory and storage areas.

Laboratory documentation used to establish COC and sample identification may include the following:

- Field COC forms or other paperwork that arrives with the sample.
- The laboratory COC.
- Sample labels or tags are attached to each sample container.

- Sample custody seals.

- Sample preparation logs (i.e., extraction and digestion information) recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist.

- Sample analysis logs (e.g., metals, GC/MS, etc.) information recorded in hardbound laboratory books that are filled out in legible handwriting, and signed and dated by the chemist.

- Sample storage log (same as the laboratory COC).

- Sample disposition log, which documents sample disposal by a contracted waste disposal company.

4.7.4 Sample Tracking

All samples are maintained in the appropriate coolers prior to and after analysis. The analysts remove and return their samples as needed. Samples that require internal COC are relinquished to the analysts by the sample custodians. The analyst and sample custodian must sign the original COC relinquishing custody of the samples from the sample custodian to the analyst. When the samples are returned, the analyst will sign the original COC returning sample custody to the sample custodian. Sample extracts are relinquished to the instrumentation analysts by the preparatory analysts. Each preparation department tracks internal COC through their logbooks/spreadsheets.

Any change in the sample during the time of custody will be noted on the COC (e.g., sample breakage or depletion).

4.8 Calibration Procedures and Frequency

This section describes the calibration procedures and the frequency at which these procedures will be performed for both field and laboratory instruments.

4.8.1 Field Instrument Calibration

Quantitative field data to be obtained during groundwater sampling include pH, turbidity, specific conductance, temperature, dissolved oxygen and depth to groundwater. Quantitative water level measurements will be obtained with an electronic sounder or steel tape, which require no calibration. Quantitative field data to be obtained during soil sampling include screening for the presence of volatile organic constituents using a photoionization detector (PID).

FOPs located in Appendix F describe the field instruments used to monitor for these parameters and the calibration methods, standards, and frequency requirements for each instrument. Calibration results will be recorded on the appropriate field forms and in the Project Field Book.

4.9 Analytical Procedures

Samples collected during this investigation field sampling activities will be analyzed by a NYSDOH Environmental Laboratory Approval Program (ELAP)-certified analytical laboratory.

4.9.1 Field Analytical Procedures

Field procedures for collecting and preserving groundwater and soil samples are described in FOPs located in Appendix F. A summary of the FOPs is presented on Table 3.

4.10 Data Usability Evaluation

Data usability evaluation procedures shall be performed for both field and laboratory operations as described below.

4.10.1 Procedures Used to Evaluate Field Data Usability

Procedures to validate field data for this project will be facilitated by adherence to the FOPs identified in Appendix F. The performance of all field activities, calibration checks on all field instruments at the beginning of each day of use, manual checks of field calculations, checking for transcription errors and review of field log books is the responsibility of the Field Team Leader.

4.10.2 Procedures Used to Evaluate Laboratory Data Usability

Data evaluation will be performed by the third party data validator using the most current methods and quality control criteria from the USEPA's Contract Laboratory Program (CLP) *National Functional Guidelines for Organic Data Review*, and Contract Laboratory Program, *National Functional Guidelines for Inorganic Data Review*. The data review guidance will be used only to the extent that it is applicable to the SW-846 methods; SW-846 methodologies will be followed primarily and given preference over CLP when differences occur. Also, results of blanks, surrogate spikes, MS/MSDs, and laboratory control samples will be reviewed/evaluated by the data validator. All sample analytical data for each sample matrix shall be evaluated. The third party data validation expert will also evaluate the overall completeness of the data package. Completeness checks will be administered on all data to determine whether deliverables specified in this QAPP are present. The reviewer will determine whether all required items are present and request copies of missing deliverables.

5.0 INVESTIGATION SUPPORT DOCUMENTS

5.1 Health and Safety Protocols

TurnKey Environmental Restoration has prepared a Site-Specific Health and Safety Plan (HASP) for use by our employees in accordance with 40 CFR 300.150 of the NCP and 29 CFR 1910.120. The HASP, provided in Appendix C, includes the following site-specific information:

- A hazard assessment.
- Training requirements.
- Definition of exclusion, contaminant reduction, and other work zones.
- Monitoring procedures for site operations.
- Safety procedures.
- Personal protective clothing and equipment requirements for various field operations.
- Disposal and decontamination procedures.

The HASP also includes a contingency plan that addresses potential site-specific emergencies, and a Community Air Monitoring Plan that describes required particulate and vapor monitoring to protect the neighboring community during intrusive site investigation and remediation activities.

Health and safety activities will be monitored throughout the field investigation. A member of the field team will be designated to serve as the on-site Health and Safety Officer throughout the field program. This person will report directly to the Project Manager and the Corporate Health and Safety Coordinator. The HASP will be subject to revision as necessary, based on new information that is discovered during the field investigation and/or remedial activities.

5.1.1 Community Air Monitoring

Real-time community air monitoring will be performed during all ground intrusive activities at the Site. A CAMP is included with TurnKey's HASP. Particulate and VOC monitoring will be performed along the downwind perimeter of the work area during subgrade excavation, grading and soil/fill handling activities in accordance with this plan. The CAMP is consistent with the requirements for community air monitoring at remediation sites as established by the New York State Department of Health (NYSDOH) and NYSDEC. Accordingly, it follows procedures and practices outlined under NYSDEC's DER-10 (May 2010) Appendix 1A (NYSDOH's Generic Community Air Monitoring Plan) and Appendix 1B (Fugitive Dust and Particulate Monitoring).

5.2 Citizen Participation Activities

NYSDEC will coordinate and lead community relations throughout the course of the project. TurnKey will support NYSDEC's community relations activities, as necessary. A Citizen Participation Plan was prepared by TurnKey and submitted to NYSDEC under separate cover. The Citizen Participation Plan will follow NYSDEC's Citizen Participation Plans template for Brownfield Cleanup Program sites entering the BCP at the point of site investigation.

5.3 Radiological Work Plan

Greater Radiological Dimensions, Inc. (GRD), a licensed NYSDOH Radioactive Material contractor has prepared the Radiological Work Plan, Technical Approach and Radiological Safety Plan, on behalf of Merani, and submitted to NYSDEC for review and approval.

The documents detail the required radiological oversight, monitoring, QA/QC, segregation, disposal, training and health and safety procedures for the project. Copies of the radiological work plan and associated documents are provided electronically in Appendix D.

6.0 REPORTING AND SCHEDULE

Upon completion of the IRM and RI fieldwork, a comprehensive RI/IRM/AA report will be completed summarizing the RI/IRM tasks completed as described below.

6.1 Remedial Investigation Reporting

The RI/AAR Report will include the following information and documentation, consistent with the NYSDEC's DER-10 Technical Guidance for Site Investigation and Remediation (May 2010).

- Introduction and background;
- A description of the site and the investigation areas;
- A description of the field procedures and methods used during the RI;
- A discussion of the nature and rationale for any significant variances from the scope of work described in this RI Work Plan;
- The data obtained during the RI and historical data considered by TurnKey to be of useable quality. This will include geochemical data, field measurements, etc;
- A discussion of contaminant fate and transport. This will provide a description of the hydrologic parameters of the Site, and an evaluation of the lateral and vertical movement of groundwater;
- Conclusions regarding the extent and character of environmental impact in the media being investigated;
- The conclusions of the qualitative human health and environmental risk assessments, including any recommendations for more detailed assessments, if applicable; and,
- Supporting materials for RI data. These will include test pit and boring logs, monitoring well construction diagrams, laboratory analytical reports, and similar information.

In addition, TurnKey will require third-party data review by a qualified, independent data validation expert. Specifically, a Data Usability Summary Report (DUSR) will be prepared, with appropriate data qualifiers added to the results. The DUSR will follow

NYSDEC format per the NYSDEC's September 1997 DUSR guidelines and May 2010 DER-10 guidance. The DUSR and any necessary qualifications to the data will be appended to the RI/AAR Report.

6.2 IRM Reporting

A TurnKey environmental professional will be on-site to document IRM activities. Such documentation will include, at minimum, daily reports of IRM activities, community air monitoring results, photographs and corrective measures report, if necessary.

A summary of the IRM activities will be included in the RI/IRM/AA report submitted to the NYSDEC, with full details of the IRM activities included in the Final Engineering Report. At a minimum, the IRM section of the report will include:

- A Site or area planimetric map showing the parcel(s) remediated;
- A map showing the lateral limits of excavation(s);
- Summaries of unit quantities, including: volume of soil/fill excavated; disposition of excavated soil/fill and collected ground/surface water; volume/type/source of backfill; volume of ground/surface water pumped and treated; and, volumes/quantities of wastes removed;
- Planimetric map showing location of all verification and other sampling locations with sample identification labels/codes;
- Tabular comparison of verification and other sample analytical results to SCOs. An explanation shall be provided for all results exceeding acceptance criteria; and
- Text describing that the IRM activities were performed in accordance with this Work Plan.

6.3 Alternatives Analysis Report

An alternatives analysis report (AAR) will be completed to provide a forum for evaluating and selecting a recommended remedial approach. Based on the findings of the RI, a list of remedial action objectives will be developed with the requirement for the selected remedial measures to be protective of human health and the environment under the proposed future use scenario. Proposed soil cleanup objectives (SCOs) for the property will also be presented based on the proposed future use of the Site. SCOs will be based on published standards, criteria, and guidance (SCGs) and other NYSDEC and NYSDOH-accepted values.

Based on the remedial action objectives and SCOs, volumes and areas of media potentially requiring additional remediation will be calculated. General response actions will then be delineated to address each of the site problem areas. These response actions will form the foundation for the development and screening of applicable remedial alternatives against the following criteria as described in 6NYCRR 375-1.10:

- Overall Protection of Human Health and the Environment
- Compliance with Standards, Criteria, & Guidance (SCGs)
- Long-term Effectiveness & Permanence
- Reduction of Toxicity, Mobility, or Volume
- Short-term Effectiveness
- Implementability
- Cost
- Future Land Use?

In addition, the criteria of community acceptance will be considered based on public comments on the AAR and proposed remedial action. Following the screening of alternatives, a comparative analysis will be performed against the above criteria. The comparative analysis will allow for better understanding of the relative advantages and disadvantages of each of the alternatives, and will facilitate identification of a recommended remedial approach.

6.4 Project Schedule

A tentative project schedule for the major tasks to be performed from submittal of the RI Work Plan through approval of the Certificate of Completion is presented on Figure 5.

7.0 REFERENCES

1. TurnKey Environmental Restoration, LLC. *401Buffalo Avenue – Supplemental Investigation, Niagara Falls, New York*. September 2014.
2. TurnKey Environmental Restoration, LLC. *401Buffalo Avenue – Supplemental Phase II Investigation, Niagara Falls, New York*. April 2014.
3. TurnKey Environmental Restoration, LLC. *Limited Phase II Environmental Investigation Report, 401, 402 and 430 Buffalo Avenue, Niagara Falls, Niagara County, New York*. November 2013.
4. United States Department of Agriculture (USDA), Soil Conservation Service. *Soil Survey of Niagara County, New York*. 1972.
5. Geologic Map of New York, Niagara Sheet, Compiled and Edited by Lawrence V. Rickard and Donald W. Fisher, University of the State of New York, The State Education Department, March 1970.
6. National Oceanic & Atmospheric Administration (NOAA) Satellites and Information. Data Tables through 2000.
7. New York State Department of Environmental Conservation. *DER-10 Technical Guidance for Site Investigation and Remediation*. May 2010.
8. U.S. Environmental Protection Agency. *Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5)*. October 1998.
9. U.S. Environmental Protection Agency, Region II. *CERCLA Quality Assurance Manual, Revision I*. October 1989.
10. U.S. Environmental Protection Agency, *Methods for Chemical Analysis of Water and Wastes*, EPA 600/4-70-020. 1983b.
11. U.S. Environmental Protection Agency. National Functional Guidelines for Organic Data Review (EPA-540/R-94-012), 1994a.
12. U.S. Environmental Protection Agency. National Functional Guidelines for Inorganic Data Review (EPA-540/R-94-013), 1994b.

TABLES

TABLE 1

SAMPLING AND ANALYSIS PLAN

REMEDIAL INVESTIGATION WORK PLAN

402 and 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

Matrix	Investigation Location		Estimated Number of Samples	Full List VOCs [1]	TCL SVOCs	Part 375 List Metals	PCBs	Pesticide	Herbicide
Surface Soil	SS-1	401 Buffalo Avenue Parcel	1		1	1			
	SS-2		1		1	1	1		
	SS-3		1		1	1	1	1	1
	SS-4	402 and 430 Buffalo Avenue Parcels	1		1	1			
	SS-5		1		1	1	1	1	1
	SS-6		1		1	1			
	SS-7		1		1	1			
Subsurface Soil	TP-10	401 Buffalo Avenue Parcel	1		1	1			
	TP-11		1	1	1	1			
	TP-12		1		1	1			
	TP-13		1	1	1	1	1	1	1
	TP-14		1		1	1			
	TP-15		1	1	1	1	1	1	1
	TP-16		1		1	1			
	TP-17		1		1	1	1		
	TP-18		1	1	1	1	1	1	1
	TP-19	402 and 430 Buffalo Avenue Parcels	1		1	1			
	TP-20		2	1	2	2	1	1	1
	TP-21		1		1	1			
	TP-22		1		1	1			
	TP-23		1	1	1	1	1		
	TP-24		2	1	2	2	1	1	1
	TP-25		1		1	1			
	TP-26		2	1	2	2	1	1	1
	TP-27		1		1	1			
	TP-28		1		1	1			
	TP-29		1		1	1			
	MW-1	401 Buffalo Avenue Parcel	1		1	1	1		
	MW-2		1	1	1	1	1	1	1
	MW-3		1	1	1	1	1	1	1
	MW-4		1		1	1	1		
	MW-5	402 and 430 Buffalo Avenue Parcels	1	1	1	1	1	1	1
	MW-6		1		1	1			
	MW-7		1	1	1	1	1	1	1
	MW-8		1		1	1	1		
	MW-9		1		1	1			
QA/QC	Soil	MS	--	1	3	3	2	1	1
		MSD	--	1	3	3	2	1	1
		Blind Dup	--	1	3	3	2	1	1
			39	**15**	**48**	**48**	**24**	**15**	**15**
Groundwater [5]	MW-1	401 Buffalo Avenue Parcel	1	1	1	1	1	1	1
	MW-2		1	1	1	1	1	1	1
	MW-3		1	1	1	1	1	1	1
	MW-4		1	1	1	1	1	1	1
	MW-5	402 and 430 Buffalo Avenue Parcel	1	1	1	1	1	1	1
	MW-6		1	1	1	1	1	1	1
	MW-7		1	1	1	1	1	1	1
	MW-8		1	1	1	1	1	1	1
	MW-9		1	1	1	1	1	1	1
QA/QC	Groundwater	MS	1	1	1	1	1	1	1
		MSD	1	1	1	1	1	1	1
		Blind Dup	1	1	1	1	1	1	1
	Submersible Pump	Equipment Blank	1	1	1	1	1	1	1
			13	**13**	**13**	**13**	**13**	**13**	**13**

Notes:

1. Full List VOCs = TCL plus CP-51 VOCs via EPA Method 8260.
2. All locations shall be sampled and archived by the laboratory for potential analysis / reanalysis.
3. GW field parameters including: pH, specific conductance, temperature, DO, ORP, and turbidity will be collected and recorded.
4. Additional samples may be collected if field screening results indicate potential contamination (e.g., elevated PID readings above 5 ppm).
5. Groundwater metal samples will be analyzed for the dissolved fraction.

Acronyms:

VOCs = volatile organic compounds
SVOCs = semi-volatile organic compounds
TCL = Target Compound List
TAL = Target Analyte List
PCBs = polychlorinated biphenyls

TABLE 2

SAMPLE CONTAINER, VOLUME, PRESERVATION & HOLDING TIME REQUIREMENTS

401, 402, AND 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

Matrix	Parameter [1]	Method [1]	Container Type	Minimum Volume	Preservation (Cool to 2-4 °C for all samples)	Holding Time from Sample Date
Soil/Sediment	TCL + CP-51 VOCs + MTBE	8260B	WMG	16 oz.	Cool to 2-4 °C, Zero Headspace	14 days
	TCL SVOCs & Tetraethyl Lead	8270C	WMG	16 oz.	Cool to 2-4 °C	14 days extrac./40 days
	Part 375 Metals & Total Lead	6010B	WMG	4 oz.	Cool to 2-4 °C	6 months/Hg 28 days
	Pesticides	8081	WMG	8oz	Cool to 2-4 °C	14 days extrac./40 days
	Herbicides	8151	WMG	8oz	Cool to 2-4 °C	14 days extrac./40 days
	PCBs	8082	WMG	4 oz.	Cool to 2-4 °C	14 days extrac./40 days
Groundwater	TCL +CP-51 VOCs + MTBE	8260B	glass vial	3 - 4 oz.	HCl to pH<2, Zero Headspace, Cool to 2-4 °C	14 days
	TCL SVOCs & Tetraethyl Lead	8270C	amber glass	1000 ml	Cool to 2-4 °C	7 days extrac/40 days
	Part 375 Metals & Total Lead	6010B	plastic	600 ml	HNO_3 to pH<2, Cool to 2-4 °C	6 months/Hg 28 days
	PCBs	8082	amber glass	1000 ml	Cool to 2-4 °C	7 days extrac/40 days

References:

1. Test Methods for Evaluating Solid Wastes, USEPA SW-846, Update III, 1991.

Notes:

1. EPA-approved methods published in Reference 1 above may be used. The list of analytes, laboratory method and the method detection limit for each parameter are included in Tables 1 and 2 of the QAPP.

Acronyms:

VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
TCL = Target Compound List
TAL = Target Analyte List
WMG = Wide Mouth Glass

TABLE 3

SUMMARY OF FIELD OPERATING PROCEDURES

REMEDIAL INVESTIGATION WORK PLAN

401, 402 AND 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

TurnKey FOP No.	Procedure
001.0	Abandonment of Boreholes Procedure
002.0	Abandonment of Monitoring Wells Procedure
004.3	Ambient Air/Subslab Vapor Sample Collection Procedure
007.0	Calibration and Maintenance of Portable Dissolved Oxygen Meter
008.0	Calibration and Maintenance of Portable Field pH/Eh Meter
009.0	Calibration and Maintenance of Portable Field Turbidity Meter
011.0	Calibration and Maintenance of Portable Photoionization Detector
012.0	Calibration and Maintenance of Portable Specific Conductance Meter
015.0	Documentation Requirements for Drilling and Well Installation
017.0	Drill Site Selection Procedure
018.0	Drilling and Excavation Equipment Decontamination Procedures
021.0	Establishing Horizontal and Vertical Control
022.0	Groundwater Level Measurement
023.1	Gorundwater Purging procedures Prior to Sample Collection
024.1	Groundwater Sample Collection Procedures
026.1	Hollow Stem Auger (HSA) Drilling Procedures
031.2	Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedure
032.1	Management of Investigation-Derived Waste (IDW)
033.0	Monitoring Well Construction for Hollow Stem Auger Boreholes
036.0	Monitoring Well Development Procedures
039.1	NAPL Detection and Sample Collection Procedure
046.0	Sample Labeling, Storage and Shipment Procedures
047.0	Screening of Soil Samples for Organic Vapors During Drilling Activities
054.2	Soil Description Procedures Using The Visual-Manual Method
057.0	Soil Sample Collection for VOC Analysis - EnCore Sampling
063.2	Surface and Subsurface Soil Sampling Procedures
073.1	Real-Time Air Monitoring During Intrusive Activities
076.0	"Before Going Into the Field" Procedure
078.0	Geoprobe Drilling Procedure
084.0	Calibration and Maintenance of Portable Particulate Meter
085.0	Field Quality Control Procedures

FIGURES

FIGURE 1

SITE LOCATION AND VICINITY MAP

TurnKey Environmental Restoration, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

PROJECT NO.: 0294-013-001

DATE: NOVEMBER 2014

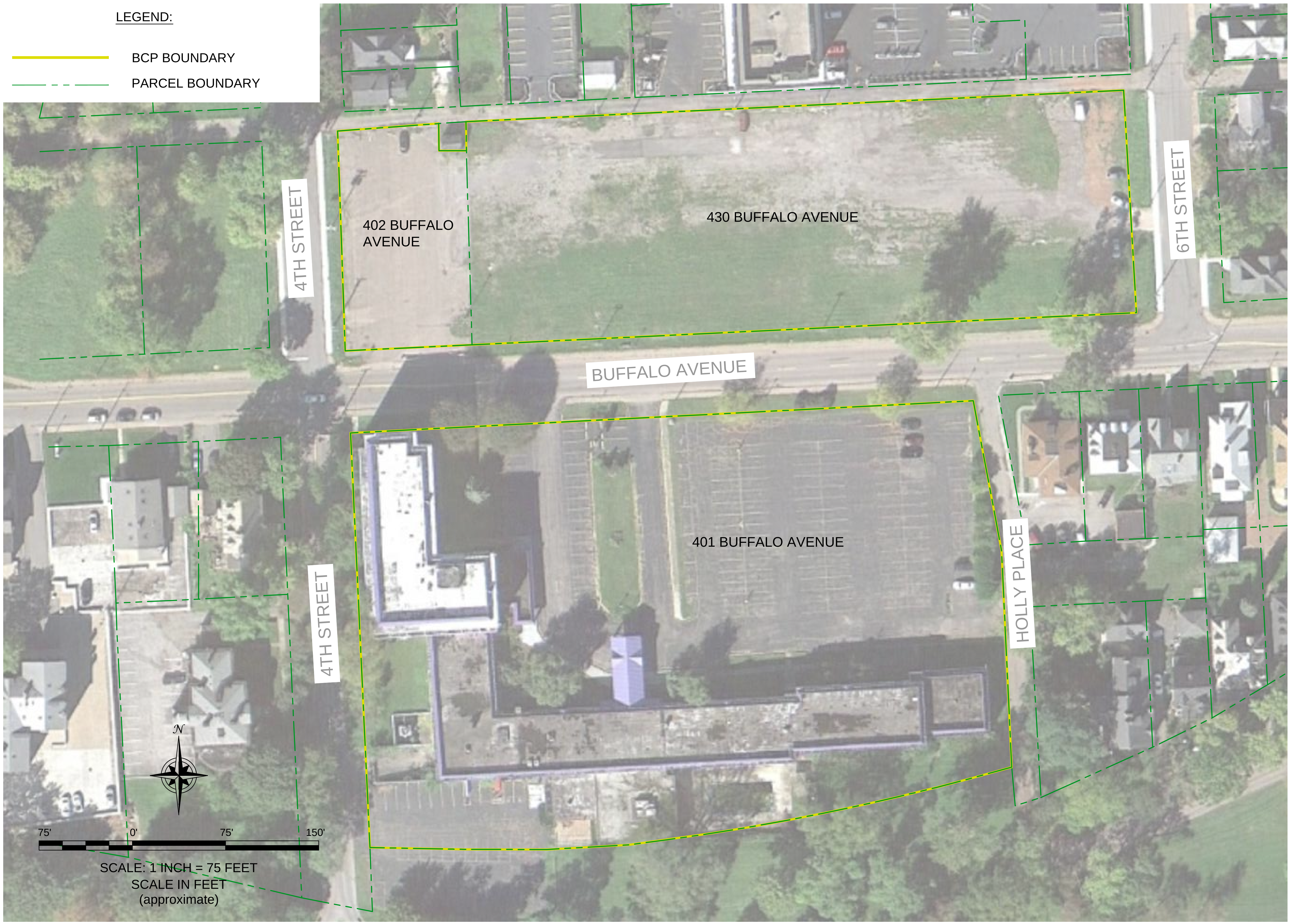
DRAFTED BY: BLR/NTM

REMEDIAL INVESTIGATION WORK PLAN

401, 402, & 430 BUFFALO AVENUE SITE
BCP SITE No. C932164
NIAGARA FALLS, NEW YORK

PREPARED FOR

MERANI HOSPITALITY, INC.



DATE: NOVEMBER 2014
DRAFTED BY: BLR/NTM

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

TURNKEY ENVIRONMENTAL RESTORATION, LLC

JOB NO.: 0294-013-001

SITE PLAN (AERIAL)

REMEDIAL INVESTIGATION WORK PLAN

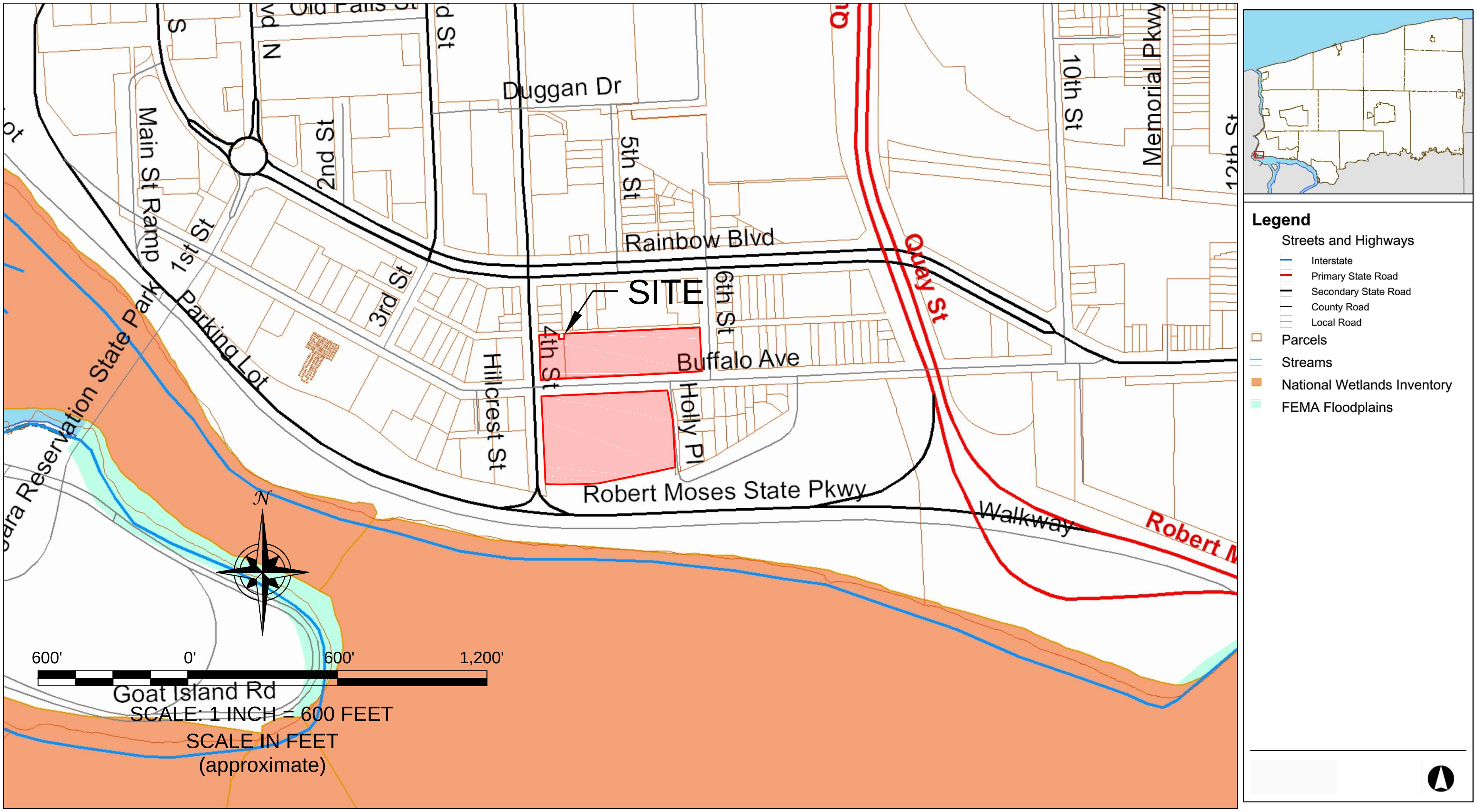
401, 402, & 430 BUFFALO AVENUE SITE
BCP SITE NO. C932164
NIAGARA FALLS, NEW YORK

PREPARED FOR

MERANI HOSPITALITY, INC.

FIGURE 2

DISCLAIMER:
PROPERTY OF TURNKEY ENV. REST., LLC. IMPORTANT: THIS DRAWING PRINT IS LOANED FOR MUTUAL ASSISTANCE AND AS SUCH IS SUBJECT TO RECALL AT ANY TIME. INFORMATION CONTAINED HEREON IS NOT TO BE DISCLOSED OR REPRODUCED IN ANY FORM FOR THE BENEFIT OF PARTIES OTHER THAN NECESSARY SUBCONTRACTORS & SUPPLIERS WITHOUT THE WRITTEN CONSENT OF TURNKEY ENV. REST., LLC.



TurnKey Environmental Restoration, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

PROJECT NO.: 0294-013-001

DATE: NOVEMBER 2014

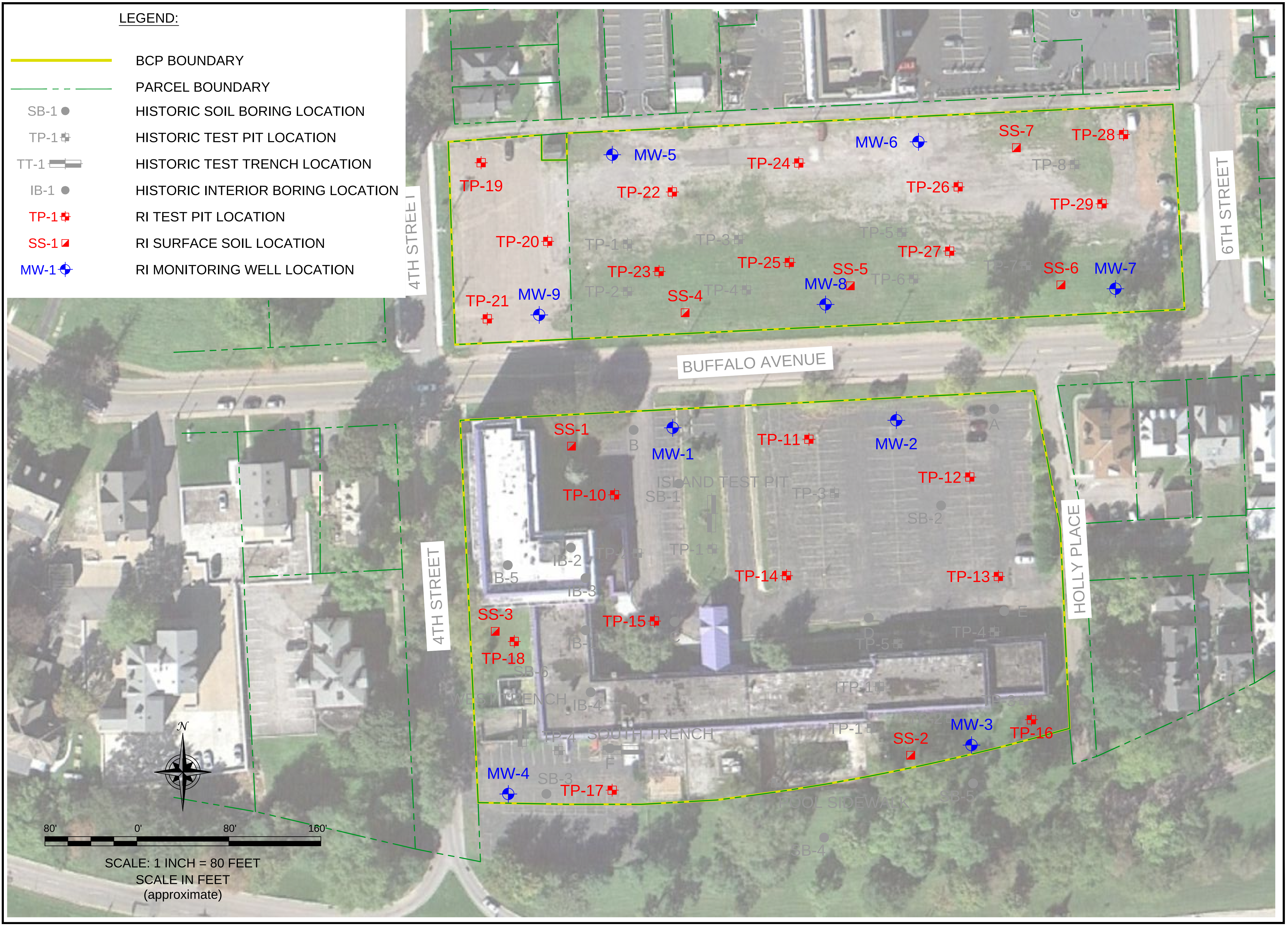
DRAFTED BY: JGT/NTM

WETLAND & FLOODPLAIN MAP

REMEDIAL INVESTIGATION WORK PLAN

401, 402, AND 430 BUFFALO AVENUE SITE
BCP SITE NO. C932164
NIAGARA FALLS, NEW YORK
PREPARED FOR
MERANI HOSPITALITY, INC.

FIGURE 3



DATE: NOVEMBER 2014
DRAFTED BY: BLR/NTM

PLANNED RI SAMPLE LOCATIONS

REMEDIAL INVESTIGATION WORK PLAN

401, 402, & 430 BUFFALO AVENUE SITE
BCP SITE NO. C932164
NIAGARA FALLS, NEW YORK

PREPARED FOR
MERANI HOSPITALITY, INC.

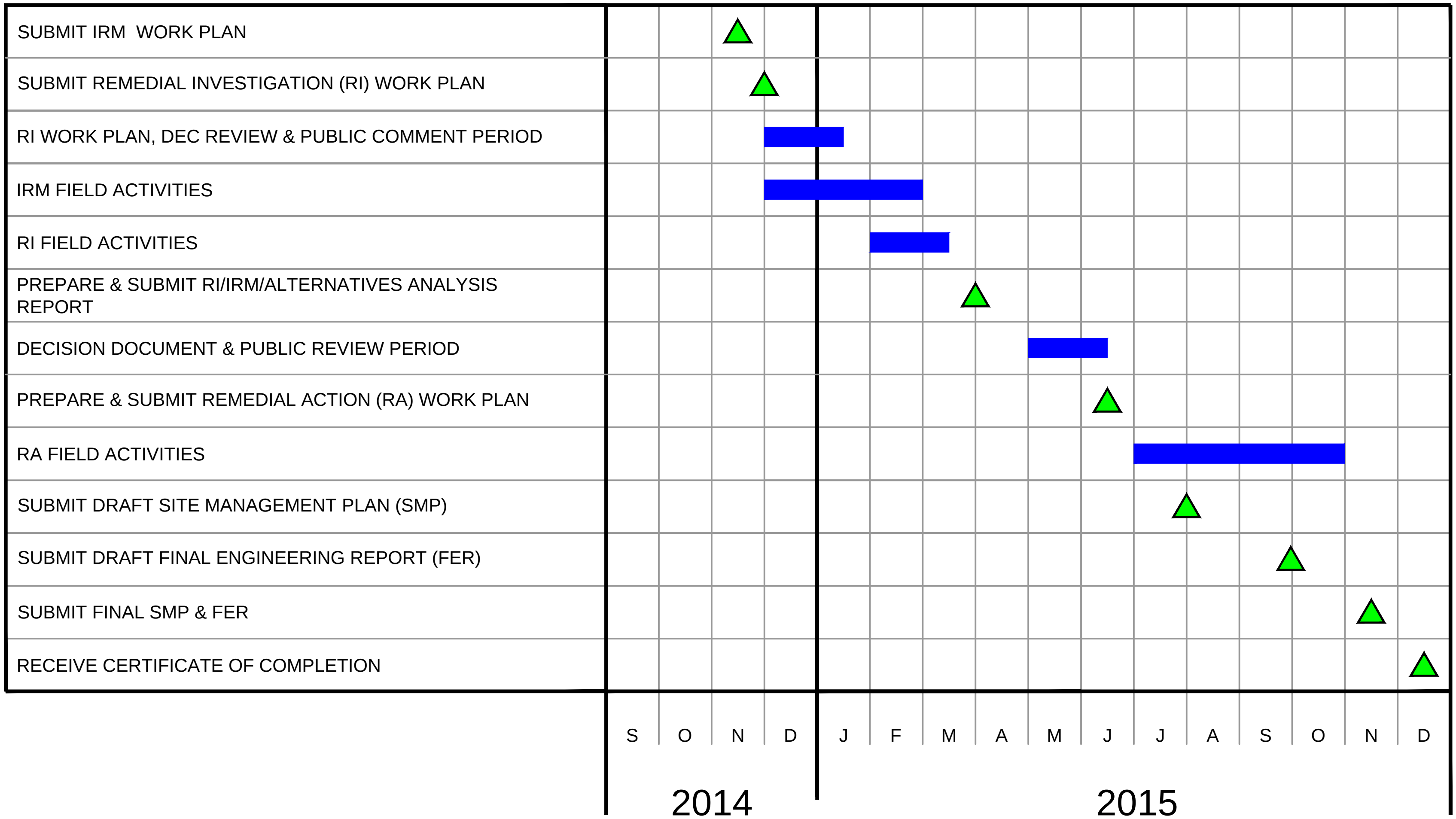
TURNKEY ENVIRONMENTAL RESTORATION, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

JOB NO.: 0294-013-001

FIGURE 4

PROJECT TASKS:



2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

PROJECT NO.: 0294-013-001

DATE: NOVEMBER 2014

DRAFTED BY: NTM

PROJECT SCHEDULE

REMEDIAL INVESTIGATION WORK PLAN

401, 402 & 430 BUFFALO AVENUE SITE
BCP SITE NO. C932164
NIAGARA FALLS, NEW YORK

PREPARED FOR

MERANI HOSPITALITY, INC.

FIGURE 5

APPENDIX A

RESUMES

MICHAEL LESAKOWKSI
PROJECT MANAGER

EDUCATION

Master of Science (Environmental Engineering Science), University of Buffalo, 2008
Bachelor of Science (Biology), State University of New York at Fredonia, 1994

REGISTRATION

40-Hour OSHA Health and Safety Training
Annual 8 Hour OSHA Refreshers
ASTM Training for Commercial Property Transaction Due Diligence

SUMMARY OF EXPERIENCE

Mr. Lesakowski has over 12 years experience in the environmental consulting field at numerous industrial, commercial and hazardous waste sites throughout the northeast United States. A summary of projects Mr. Lesakowski has been involved with include all aspects of New York Brownfield Cleanup Program projects, New York State Superfund Program projects, New York Petroleum Spills Department projects, over 1,000 Phase I Environmental Site Assessments and more than 200 Phase II Site Investigations associated with property acquisition and divestiture and numerous remediation projects ranging from simple underground storage tank (UST) removals to complex groundwater remediation programs. Mr. Lesakowski is proficient in vapor intrusion modeling of chlorinated solvent and petroleum volatile organic compound (VOC) impacted sites. Mr. Lesakowski also has project management and technical consulting experience on several multi-site portfolio environmental due diligence assignments, working with purchasers and lenders to facilitate multi-million dollar real estate transactions. Prior to joining Benchmark, Mr. Lesakowski was a principal in an environmental consulting firm with offices in New York, Pennsylvania, Ohio and Maryland. Mr. Lesakowski is currently managing ten New York Brownfield Cleanup Program sites and several New York Spill Sites. He has managed assessments, investigations and remediation projects on properties with a multitude of historic uses (e.g., petroleum storage terminals, gas stations, automobile dealerships, rail yards, foundries, drycleaners, steel manufacturing, metallurgical plants, metal plating operations, junk yards), media types (surface and subsurface soil, groundwater, sediments, soil vapor, indoor air, building materials) and contaminants (e.g, VOCs, semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), heavy metals).

DETAILED EXPERIENCE

May 2006 –present Project Manager, Benchmark Environmental Engineering and Science, PLLC

- Recently completed a Remedial Investigation (RI), Interim Remedial Measures (IRM) and Remedial Alternatives Analysis under the NYSDEC Brownfield Cleanup Program for two former gasoline station and automotive repair facilities with significant soil and groundwater petroleum VOC impact. The remediation approach for both sites involves removal of abandoned underground storage tanks, product dispensers and piping, removal of in-ground hydraulic lifts, soil excavation, and extraction and treatment of impacted groundwater. Final Engineering Reports and Site Management Plans were approved by the NYSDEC in December 2009 and Certificates of Completion were also issued in December 2009.

- Currently managing a Remedial Investigation (RI), Interim Remedial Measures (IRM) and Remedial Alternatives Analysis under the NYSDEC Brownfield Cleanup Program sites at two historic heavy industrial facilities in Niagara Falls, NY. The Remedial Investigations involve collecting over 100 surface and subsurface soil and sediment samples and installing and sampling groundwater monitoring wells on each approximate 15-acre parcel slated for future mixed used commercial and industrial development. IRMs include excavation of chromium-impacted, arsenic-impacted and SVOC-impacted soil in several areas of the Site, drum and tank removal, catch basin and sump cleaning, smoke stack deposits remediation, and chemical waste removal. Certificates of completion are anticipated in 2010.

- Currently managing a NYSDEC Brownfield Cleanup Program site formerly used as drycleaner in western New York with significant soil and groundwater chlorinated VOC impact. Soil was successfully remediated using soil vapor extraction (SVE) to unrestricted soil cleanup objectives (SCOs) and groundwater remediation involves in-situ treatment of impacted groundwater. An active sub-slab depressurization system design and installation is planned in the new building during construction.

- Managed a site assessment and site investigations for a portfolio of retail gasoline stations in western New York. Project tasks include a historical review to determine sites' histories, review of previous technical reports, soil and groundwater investigations and remediation cost estimating for site cleanups. This project also involves forensic analyses of soil and groundwater samples to estimate the relative time of historic spills to determine the liability and responsibility for remediation of historic petroleum spills on-site.

- Managed a Phase I/Phase II site investigations for the Buffalo Urban Development Corporation for two parcels in the City of Buffalo encompassing approximately 100-acres. The project involves Phase I ESAs to assess potential historic concerns in a historic heavy industrial area and subsequent soil and groundwater investigations to investigate subsurface environmental conditions.

- Managed a Remedial Investigation (RI) and Remedial Alternatives Analysis under the NYSDEC Brownfield Cleanup Program for a small-arms shooting range with significant lead and semi-volatile organic compound (SVOC) impact. The RI involved collecting over 1,000 soil samples on 26-acre parcel slated for future mixed-use commercial and residential development. Bench-scale testing was completed to select a substrate to treat the characteristic hazardous soil to below toxicity characteristic leaching procedure (TCLP) thresholds. A Remedial Action Work Plan, which called for in-situ stabilization of characteristic hazardous soil and off-site disposal was prepared and approved by the NYSDEC. The remediation is planned for Spring 2010.

- Managed Site Remediation at a former drycleaner, bus garage and asphalt plant under the NYSDEC Brownfield Cleanup Program with significant chlorinated volatile organic compound (cVOC) impact.

The remediation approach involved underground tank removal, in-ground hydraulic lift removal, hazardous soil excavation, and enhanced biodegradation of groundwater. The Site received its certificate of completion in December 2008. The Property is currently developed with an up-scale hotel. The project is highlighted on NYSDEC website as a Brownfield Success Story.

- Managed a Remedial Investigation (RI), Interim Remedial Measure (IRM) and Remedial Alternatives Analysis under the NYSDEC Brownfield Cleanup Program for a former automotive repair facility with significant soil and groundwater chlorinated VOC impact. The remediation approach involved negotiated soil and groundwater cleanup objectives, limited soil excavation and enhanced biodegradation of groundwater. The Site received its certificate of completion in February 2008.

- Managed Remedial Investigation (RI), Interim Remedial Measure (IRM) and Remedial Alternatives Analysis under the NYSDEC Brownfield Cleanup Program at a former lumber yard with chromium impact in Niagara Falls, NY. The remediation approach involved excavation and off-Site disposal of hazardous and non-hazardous soil. The Site received its certificate of completion in December 2007.

December 2000 - April 2006
April 1999 - April 2000 EVP, Environmental Scientist, LCS, Inc., Buffalo, New York

- Managed the investigation of a former gasoline station and adjacent manufactured gas plant (MGP) as part of one of the largest Brownfield redevelopment projects in western New York. The project involves site redevelopment from a historic MGP site and adjacent gasoline station to a multi-million dollar commercial office complex. Acting on behalf of the developer (Duke Realty) and future tenant (HealthNow New York), preliminary investigations were completed to evaluate the nature and location of contaminants. Subsequent site investigation and remediation was completed via a Remedial Investigation (RI) and Interim Remedial Measures (IRM) under the New York State Brownfield Cleanup Program, saving months and significant cost. As a concurrent assignment, acted as a technical consultant to the developer and future tenant on negotiations and advisement on development of an environmental liability transfer arrangement between the purchaser/tenant (client), seller and a national remediation contractor.

- Managed investigation and remediation of former filling station and service station in western New York. Site investigations indicated that impacted soil and groundwater was present as a result of former gasoline and waste oil USTs and hydraulic lifts. Remedial work included removal of four USTs, two hydraulic lifts and 500 cubic yards of petroleum impacted soil.

- Managed investigation and remediation of a dry-cleaning facility located in central New York. Task included soil and groundwater sampling proximate the dry-cleaning facility (exterior) and within the dry-cleaner and adjacent tenants. Sub-slab and indoor air testing was also completed. Remedial work involved removal of hazardous soil, in-situ groundwater remediation via enhanced bioremediation and long-term monitoring.

- Senior project management/technical oversight of all investigation and remediation projects completed in New York, Pennsylvania, Maryland and Ohio.

- Managed due diligence activities as agent for a purchaser of 48 gasoline service stations in Illinois. Tasks included Phase I ESAs, compliance auditing of current UST systems to Illinois and USEPA regulations and remediation cost estimating for sites with known impacts and/or on-going remediation.

- Managed environmental consulting and due diligence activities for a purchaser of 182 gasoline service stations in Maryland, Virginia and Washington, DC. Tasks included Phase I ESAs, remediation cost estimating for sites with known impacts and/or on-going remediation and interfacing with the client's lenders to facilitate a $110 million dollar real estate transaction.

- Played a key role in developing a liability transfer agreement for the transfer of a portfolio of gasoline stations with known petroleum impact. Tasks included oversight of remediation cost estimates and interfacing with the attorneys, insurance brokers, client and property sellers to develop and present the liability transfer arrangement.

- Managed investigation and remediation of former filling station and service station in Syracuse, New York. Site investigations indicated that impacted soil and groundwater was present as a result of former gasoline USTs. Remedial work included removal of 1,200 cubic yards of petroleum impacted soil in three areas of the site. Negotiated cleanup objectives allowed the site to be considered "inactive," and the NYSDEC did not further remedial action.

- Managed environmental due diligence, including Phase I/Phase II investigations of five active service stations in central and eastern upstate New York for a potential purchaser. Phase I ESAs indicated a history of gasoline stations on-site. In conjunction with the purchaser and seller, it was negotiated that a baseline assessment of soil and groundwater impact would be completed to establish responsibility for addressing contamination going forward. The purchaser was able to purchase the sites with no liability for historic petroleum spills on-site.

- Managed investigation and remediation of a former automobile dealership in Rochester, New York. Site investigations, competed with oversight of NYSDEC Spills division, indicated soil impact as a result of leaking gasoline, diesel and waste oil USTs and floor drain discharges. Remedial tasks included a removal of four USTs and associated pump dispensers, closing/sealing interior floor drains and excavation and off-site disposal of 1,500 cubic yards of impacted soil.

- Performed fieldwork at a 50-acre industrial park in western New York. Task included a soil boring and monitoring well installation program, development and sampling of monitoring wells and a hydraulic conductivity assessment. Subsequent remedial tasks included removal of six underground storage tanks and petroleum-impacted soil and a long-term groundwater monitoring plan.

April 2000 to December 2000
Environmental Scientist, GZA GeoEnvironmental, Buffalo, New York

- Performed fieldwork and reporting for RI/FS of NYSDEC superfund site in Long Island, NY. Investigation activities at this former metal plating facility included soil investigation, monitoring well installation and groundwater sampling, hydraulic conductivity testing, and floor drain/cess pool investigation. IRM activities included closure of interior floor drains and removal of heavy metals impacted soil.

- Soil and groundwater investigation at a former dry-cleaning facility in Buffalo, New York. Site investigations included exterior and interior soil borings and monitoring well installations. The negotiated cleanup plan, based on future site use and the urban location of the site, allowed the site owner to address low-level groundwater impact via monitored natural attenuation and long-term monitoring.

NATHAN T. MUNLEY
SENIOR PROJECT ENVIRONMENTAL SCIENTIST

EDUCATION

Masters of Science (Biology) 2004; State University of New York, Binghamton University

Bachelors of Science (Health Science) 1995; State University of New York, College at Cortland

Masters of Science (Engineering Science) (Currently Enrolled); State University of New York, University at Buffalo - Department of Environmental Engineering and Science.

Graduate coursework in: Stream Bank Restoration and Design, Biological Treatment Systems, Physiochemical Unit Processes, Aquatic Chemistry, Hazardous Waste Management, Hydrologic Engineering, Geographic Information Systems (GIS), and Computer Aided Design (CAD)

REGISTRATION AND AFFILIATIONS

Certified OSHA 40-Hour Hazardous Waste Site Training
Annual 8-Hour OSHA Refresher
Member – Society of Wetland Scientists

SUMMARY OF EXPERIENCE

Mr. Munley has over 10 years of experience in the environmental field ranging from conducting environmental research to consulting on environmental science and engineering projects. Environmental consulting projects that Mr. Munley has completed include a wide range of environmental site assessment, investigation, and remediation assignments including: Phase I & II Environmental Site Assessments (ESAs); Brownfield Cleanup Program investigation and cleanup; soil and groundwater treatment design projects, wetland mitigation permitting and design; Petroleum Bulk Storage (PBS) and Chemical Bulk Storage (CBS) permitting and closure, and hazardous waste site remediation projects. Prior to joining TurnKey, Mr. Munley was a researcher conducting laboratory and field based experiments investigated lake acidification and non-point source pollution degradation of wetlands. Mr. Munley has particular interests into the environmental site assessment, investigation, remedial design, and redevelopment of former industrial sites (Brownfields).

REPRESENTATIVE EXPERIENCE

June 2005 to Present: TurnKey Environmental Restoration, LLC

- Served as lead scientist on recently completed 30 gpm leachate collection, conveyance and pre-treatment system for a RCRA hazardous cleanup at former steel manufacturing site. The project included the assessment, evaluation and selection of treatment technology, and design of leachate pre-treatment system, including leachate collection and conveyance, petroleum product separation, pH adjustment, filtration, and VOC treatment via air stripping; and coordination and permit approval with local municipal sewer authority and regulatory agency (NYSDEC).

- Recently served as Project Scientist for a 22-acre Brownfield Cleanup Program Site cleanup encompassing 10 adjoining parcels Niagara Falls, NY. The BCP project included preparation of the BCP Application, as well as the. The RI involved collecting over 100 surface, subsurface soil and sediment samples; installing and sampling groundwater monitoring wells. IRMs include excavation of chromium-impacted, arsenic-impacted and SVOC-impacted soil in several areas of the Site, drum and tank removal, catch basin and sump cleaning, smoke stack deposits remediation, and hazardous and non-hazardous chemical waste removal. The Certificate of completion was received in 2010.

- Currently managing the completion of Brownfield Cleanup Program (BCP) activities of a former automobile dealership and service station located in Lockport, New York. Project task included preparation of the BCP application, and Remedial Investigation (RI), Interim Remedial Measures (IRM), and Alternatives Analysis (AAR) Work Plan, oversight of remedial subcontractors, correspondence with NYSDEC representatives; completion of the RI-AAR-IRM Report, and Final Engineering Report (FER). Certificate of Completion (COC) is expected in December 2011.

- Recently completed the decommissioning of a former industrial facility in Niagara Falls, New York. Project tasks included: managing the characterization, cleanup and closure of petroleum bulk storage (PBS) and chemical bulk storage (CBS) facilities and associated NYSDEC licensing; cleanup, recycling and/or disposal of accumulated hazardous materials; characterization and disposal of PCB-containing waste materials; characterization and disposal of spent industrial raw materials; and oversight and management of recycling and/or disposal of universal waste materials including batteries, UV-lamps, and mercury containing-wastes.

- Completed investigation, remediation and NYSDEC spill closure activities at over 15 gasoline service station throughout western New York.

- Managed completion of multiple NYSDEC PBS Site Assessment Reports in compliance with 40CFR 280.43 regulations for large-scale retail gasoline and car washing company with locations throughout western New York. The completed reports were accepted by, and were successful in mitigating further regulatory compliance action by the NYSDEC.

- Recently assisted in the drafting and completion of a Universal Waste Management Plan for a large municipal government which included more than 100 separate facilities which are required to comply with the plan.

- Recently completed multiple Spill Prevention, Control, and Countermeasure (SPCC) plans for large multi-national manufacturing company with facilities throughout central New York.

- Recently completed a large 10-acre multi-parcel Phase I ESA for a wind turbine project located within a highly contaminated urban Site listed on the NYS Inactive Hazardous Waste Site list. Project tasks included a review of historic technical reports, and soil and groundwater investigation documents to determine potential impacts of the known contamination related to the proposed wind farm redevelopment. Coordination with multiple regulatory agencies, owner/operators and legal representatives were imperative for the successful outcome of the project. In addition to the Phase I ESA, a wetland assessment was completed to determine potential wetland issues related to the project.

- Served as Project Scientist responsible for all aspects of Phase I Environmental Site Assessment for nearly 50 properties in New York State.

April 2001 to June 2004	Research Scientist Research Foundation

- Designed research plans and conducted long-term field and greenhouse experiments on the impacts of acid precipitation on the lakes of the Adirondack Mountains (NYS)
- Conducted field sampling and water quality monitoring
- Experienced in wetland and plant identification
- Mapped experimental constructed wetland site using GPS and GIS (ESRI ArcGIS)
- Managed multiple bench-scale, greenhouse, and field-based experiments

PUBLICATIONS/PRESENTATIONS

- Presenter – Technical Papers
  Munley, Nathan T., Titus, John H., and Zhu, Weixing. "Nutrient Retention in Vegetated Buffer Strips: Testing the Effects of Different Species Assemblages." International Society of Wetland Scientist, The 25th Annual Conference, Seattle, WA. July 2004.

APPENDIX B

PREVIOUS INVESTIGATION

(PROVIDED ELECTRONICALLY)

Limited Phase II Environmental Investigation Report

401, 402, & 430 Buffalo Avenue Site
Niagara Falls, New York

November 2013 0271-013-001

Prepared For:

Slater Law Firm, PLLC

Prepared By:

TurnKey Environmental Restoration, LLC

2558 Hamburg Turnpike, Suite 300, Buffalo, New York | phone: (716) 856-0635 | fax: (716) 856-0583

LIMITED PHASE II ENVIRONMENTAL INVESTIGATION REPORT

401, 402 & 430 Buffalo Avenue Site
Niagara Falls, New York

November 2013 0271-013-001

Prepared for:

The Slater Law Firm, PLLC

LIMITED PHASE II ENVIRONMENTAL INVESTIGATION REPORT

401, 402, & 430 Buffalo Avenue Site

Niagara Falls, New York

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LIMITED PHASE II ENVIRONMENTAL INVESTIGATION REPORT

401, 402, & 430 Buffalo Avenue Site

Niagara Falls, New York

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APPENDICES

1.0 INTRODUCTION

1.1 Background and Site Description

TurnKey Environmental Restoration, LLC (TurnKey) performed a Limited Phase II Environmental Investigation on behalf of The Slater Law Firm at 401,402, & 430 Buffalo Avenue, City of Niagara Falls, Niagara County, New York (Site; see Figure 1). This investigation was performed to assess the condition of subsurface soil at the Site.

The subject property is located in a highly developed commercial and residential area of Niagara Falls, New York. The subject Site, addressed at 401, 402, & 430 Buffalo Ave, is also identified as Tax ID Nos. 159.13-2-9, 159.54-1-46, 159.54-1-47, and 159.54-1-45. The Site, totaling approximately 6.21-acres, is bordered by commercial and residential properties to the north, Robert Moses Parkway to the south, residential properties to the east, and vacant and residential properties to the west. The Site is improved with one multi-story hotel building on the 401 Buffalo Ave Parcel.

This Limited Phase II investigation included completion of a soil investigation to assess potential environmental impacts from chemical constituents of concern, including volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and Resource Conservation and Recovery Act (RCRA) metals.

2.0 SUBSURFACE SOIL/FILL INVESTIGATION

2.1 Soil Borings

On October 3rd, DDS Companies (DDS) utilized a track-mounted drill rig to complete three soil borings, identified as SB-1 through SB-3 at various locations across the Site (see Figure 2), which were observed by TurnKey. Soil samples were generally collected within each borehole continuously from the ground surface until boring terminus. Any down-hole equipment was decontaminated between boreholes with an Alconox/water wash followed by a tap water rinse. The cutting shoes were decontaminated in a similar manner between the collections of each sample. Soil samples were collected for laboratory analysis from SB-1 and SB-2. Boring logs are presented in Appendix A.

2.2 Test Pits

On October 4th, 2013, TurnKey mobilized a track-mounted excavator to the Site and excavated eight test pits, identified as TP-1 through TP-8, at various locations across the Site. Test pit locations are shown on Figure 2. Soil samples were collected for laboratory analytical analysis from TP-1 and TP-3 through TP-7. Test pit logs are presented in Appendix A. Soil descriptions were completed in the field via visual characterization of excavated soils and test pit excavation faces using the Unified Soil Classification System (USCS), and scanned for total volatile organic vapors with a calibrated MiniRae 2000 PID equipped with a 10.6 eV lamp.

2.3 Laboratory Analysis

Soil samples collected from soil borings and test pits were placed in pre-cleaned, laboratory provided sample bottles using dedicated stainless steel sampling tools, and cooled to 4° C in the field. The samples were transported under chain-of-custody command to Alpha Analytical of Westborough, MA for analysis. Soil boring samples SB-1 and SB-2 were analyzed for of Target Compound List (TCL) volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and Resource Conservation and Recovery Act (RCRA) metals. TP-1 and TP-3 through TP-7 were analyzed for PAHs, while TP-1, TP-3, TP-5, and TP-7 were also analyzed for RCRA metals and polychlorinated biphenyls (PCBs).

3.0 INVESTIGATION FINDINGS

Three soil borings (SB-1 through SB-3) and eight test pits (TP-1 through TP-10) were completed and eight soil/fill samples were collected for analysis. Table 1 presents a summary of the soil sample results. Each compound that was analyzed and detected above the laboratory reporting limit is listed on the table with its associated result to provide a complete data summary. For comparison purposes, Table 1 presents soil cleanup objectives (SCOs) for each of the detected parameters as published in 6 NYCRR Part 375 Soil Cleanup Objectives dated May 2010. Appendix B contains a copy of the laboratory analytical data package.

3.1 Qualitative Soil Screening

Soil samples were screened via headspace for VOCs using a MiniRae 2000 PID. PID measurements ranged from 0 ppm (most locations) to 46.2 ppm in SB-1 and 22.3 ppm in SB-2. Fill material was noted at varying thickness across the Site, generally consisting of sand, brick and concrete. Refer to soil boring and test pit logs in Appendix A for a summary of soil classification for each sample interval, field observations, and PID measurements.

3.2 Site Geology/Hydrogeology

The subsurface soil/fill for the 401 Buffalo Avenue parcel of the Site observed in SB-1 through SB-3 was typically characterized as asphalt overlying poorly graded sand. Soil/fill observed in TP-1 through TP-8 on the 430 Buffalo Avenue parcel was characterized as gravel sub-base with varying amounts and depths of fill material (i.e., brick, concrete) overlying a sandy lean clay layer in test pits TP-2, TP-4, TP-6, and TP-7. Equipment refusal was encountered at TP-1 (6 fbgs), TP-3 (4.5 fbgs), TP-5 (3 fbgs) and TP-8 (3 fbgs).

The property is located within the Erie-Ontario lake plain physiographic province, which is typified by little topographic relief, except in the immediate vicinity of major drainage ways. Surface soils are generally characterized as urban land with level to gently sloping land in which 80 percent or more of the soil surface is covered by asphalt, concrete, buildings, or other impervious structures typical of an urban environment. In addition, the presence of overburden fill material is widespread and common throughout the City of Niagara Falls.

Groundwater flow direction likely follows regional topography in the vicinity of the subject property and is to the south toward the Niagara River. Local groundwater flows, however, may be influenced by subsurface features, such as excavations, utilities, and localized fill-conditions. Groundwater was encountered between approximately four and ten fbgs during soil borings; groundwater was not encountered during test pit excavations. Test pit and soil boring logs are presented in Appendix A.

3.3 Soil Analytical Results

Soil samples from SB-1, SB-2, TP-1 and TP-3 through and TP-7 were analyzed for PAHs. Soil samples from soil borings SB-1 and SB-2 were also analyzed for TCL VOCs and RCRA metals. Test pits TP-1, TP-3, TP-5 and TP-7 were also analyzed for RCRA metals and PCBs. As indicated on Table 1, the analytical data results indicate several PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, were detected above their respective Unrestricted, Restricted-Residential and/or Commercial Use SCOs in TP-1, TP-3 and TP-5. Two RCRA metals (barium and lead) were detected above their respective Unrestricted, Restricted-Residential and/or Commercial Use SCOs in SB-1, TP-1, TP-3, TP-5 and TP-7.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of this Limited Phase II Environmental Investigation at the Site, TurnKey offers the following conclusions and recommendations:

- Elevated PID readings indicative of VOCs impactes were observed in SB-1 and SB-2;
- Several PAHs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene, were detected above their respective Unrestricted, Restricted-Residential and/or Commercial Use SCOs in TP-1, TP-3 and TP-5;
- Two RCRA metals, barium and lead, were detected above their respective Unrestricted, Restricted-Residential and/or Commercial Use SCOs in SB-1, TP-1, TP-3, TP-5 and TP-7.
- Based on the findings of this investigation, additional Site investigation and remediation appears warranted prior to Site redevelopment. We understand that your client is considering redeveloping the property; based on environmental impacts noted during this investigation, the Site may be eligible for the New York Brownfield Cleanup Program.

5.0 LIMITATIONS

This report has been prepared for the exclusive use of The Slater Law Firm, PLLC. The contents of this report are limited to information available at the time of the site investigation activities and to data referenced herein, and assume all referenced historic information sources to be true and accurate. The findings herein may be relied upon only at the discretion of The Slater Law Firm, PLLC. Use of or reliance on this report or its findings by any other person or entity is prohibited without written permission of TurnKey Environmental Restoration, LLC.

TABLES

TABLE 1

SUMMARY OF SOIL ANALYTICAL RESULTS

401, 402, 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NY

Parameter[1]	Unrestricted Use SCOs[2]	Restricted Residential SCOs[2]	Commercial Use SCOs[2]	Sample Locations							
				SB-1 (0-2)	SB-2 (6-8)	TP-1 (1-6)	TP-3 (1-4.5)	TP-4 (1-2)	TP-5 (1-3)	TP-6 (2-4)	TP-7 (2-4)
				10/3/2013	10/3/2013	10/4/2013	10/4/2013	10/4/2013	10/4/2013	10/4/2013	10/4/2013
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [3]											
2-Methylnaphthalene	--	--	--	0.2 J	ND	ND	0.69 J	ND	ND	ND	ND
Acenaphthene	**20**	**100**	**500**	ND	ND	0.35	1.4	ND	2.2	0.046 J	0.052 J
Acenaphthylene	**100**	**100**	**500**	ND	ND	0.14 J	0.31 J	ND	2.2	ND	ND
Anthracene	**100**	**100**	**500**	0.042 J	ND	0.96	3.1	ND	9.8	ND	0.2
Benzo(a)anthracene	**1**	**1**	**5.6**	0.21	ND	**3.3**	**5.9**	0.1 J	**31**	0.14	0.47
Benzo(a)pyrene	**1**	**1**	**1**	0.19	ND	**2.9**	**5.1**	0.087 J	**30**	0.12 J	0.41
Benzo(b)fluoranthene	**1**	**1**	**5.6**	0.31	ND	**3.8**	**6.3**	0.12	**38**	0.16	0.53
Benzo(g,h,i)perylene	**100**	**100**	**500**	0.14 J	ND	1.8	3.1	ND	18	0.077 J	0.22
Benzo(k)fluoranthene	**0.8**	**3.9**	**56**	0.095 J	ND	**1.4**	**2.5**	0.05 J	**14**	0.06 J	0.23
Chrysene	**1**	**3.9**	**56**	0.31	ND	**3.2**	**5.7**	ND	**31**	0.15	0.47
Dibenzo(a,h)anthracene	**0.33**	**0.33**	**0.56**	ND	ND	**0.49**	**0.82**	ND	**5**	ND	0.069 J
Fluoranthene	**100**	**100**	**500**	0.63	ND	6.8	12	0.18	68	0.27	0.93
Fluorene	**30**	**100**	**500**	ND	ND	0.4	1.4	ND	2.8	ND	0.061 J
Indeno(1,2,3-cd)pyrene	**0.5**	**0.5**	**5.6**	0.13	ND	**1.9**	**3.2**	0.059 J	**19**	0.082 J	0.24
Naphthalene	**12**	**100**	**500**	0.11 J	ND	0.16 J	1.9	ND	0.92 J	ND	ND
Phenanthrene	**100**	**100**	**500**	0.52	ND	4	11	0.094 J	29	0.17	0.65
Pyrene	**100**	**100**	**500**	0.5	ND	5.6	10	0.16	56	0.23	0.75
Total PCBs - mg/Kg [3]											
Aroclor 1260	0.1	3.2	1	--	--	ND	ND	--	0.0284 J	--	ND
Total Metals - mg/Kg											
Arsenic	**13**	**16**	**16**	7.2	1.1	9.6	8.9	--	6	--	6.3
Barium	**350**	**820**	**400**	64	12	**950**	**1000**	--	**970**	--	59
Cadmium	**2.5**	**7.5**	**9.3**	0.72	0.92	2.1	2.1	--	1.8	--	0.78
Chromium	**30**	**180**	**1500**	7.6	3	27	19	--	8.9	--	9.6
Lead	**63**	**450**	**1000**	**100**	23	**2700**	**6200**	--	**2100**	--	**130**
Silver	**2**	**8.3**	**1500**	0.12 J	ND	0.2 J	0.24 J	--	0.22	--	ND
Mercury	**0.18**	**0.73**	**2.8**	ND	ND	0.05 J	0.03 J	--	0.17 J	--	0.09

Notes:

1. Only those parameters detected at a minimum of one sample location are presented in this table; all other compounds were reported as non-detect.
2. Values per 6NYCRR Part 375 Soil Cleanup Objectives (December 2006).
3. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparison to SCOs.
4. Samples SB-1 and SB-2 was also analysed for TCL VOCs; all reported as non-detect.

Definitions:

ND = Parameter not detected above laboratory detection limit.
"--" = Sample not analyzed for parameter or no SCO available for the parameter.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.

BOLD	= Result exceeds Part 375 Unrestricted Use SCOs.
BOLD	= Result exceeds Part 375 Restricted Residential Use SCOs.
BOLD	= Result exceeds Part 375 Commercial Use SCOs.

FIGURES

FIGURE 1

TurnKey Environmental Restoration, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

PROJECT NO.: 0271-013-001

DATE: OCTOBER 2013

DRAFTED BY: JGT

SITE LOCATION AND VICINITY MAP

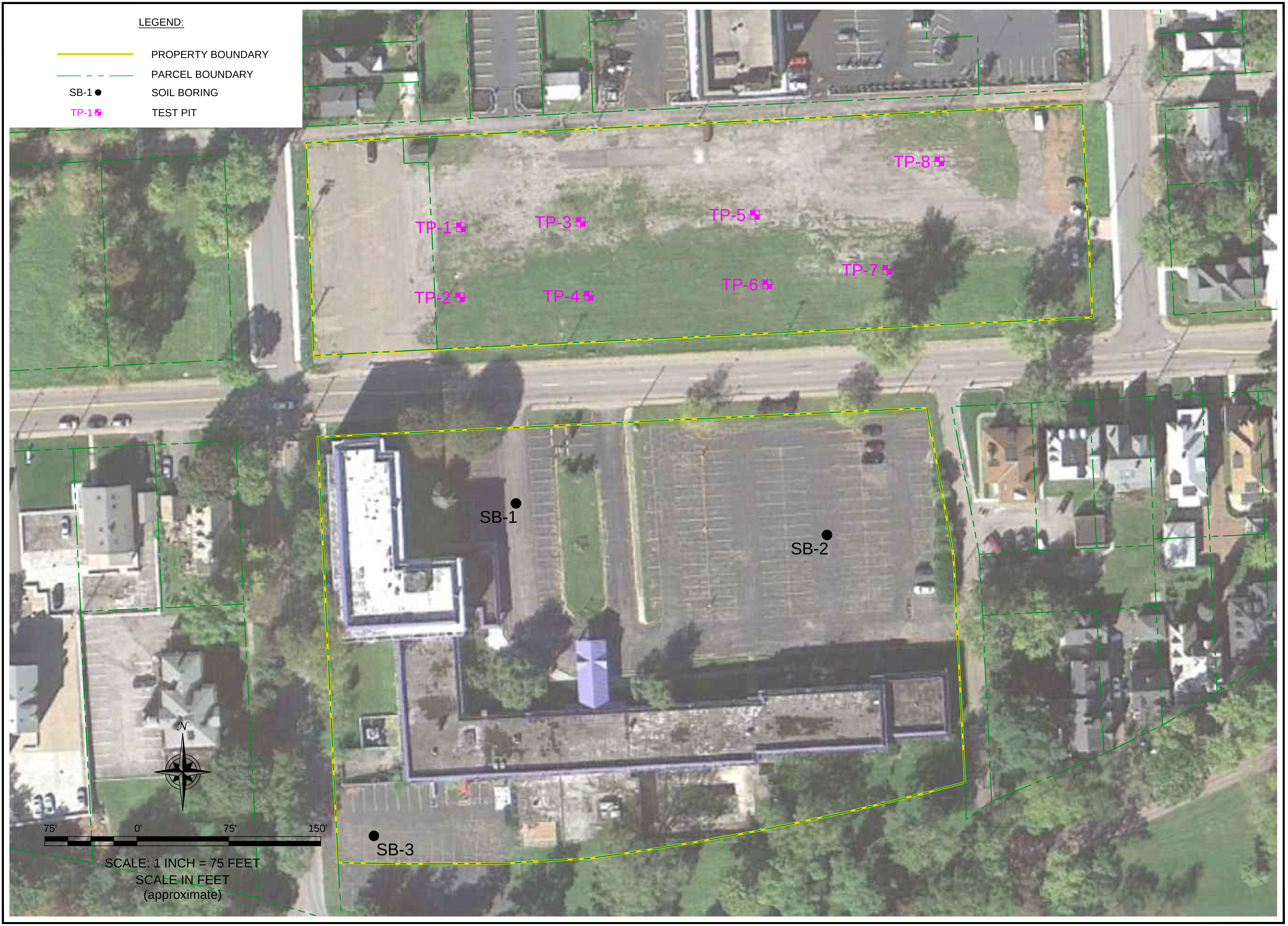
LIMITED PHASE II ENVIORNMENTAL INVESTIGATION

401, 402, & 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

PREPARED FOR

SLATER LAW FIRM, PLLC



DATE: OCTOBER 2013
DRAFTED BY: JGT

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

TURNKEY ENVIRONMENTAL RESTORATION, LLC

JOB NO.: 0271-013-001

SITE PLAN (AERIAL)

LIMITED PHASE II ENVIRONMENTAL INVESTIGATION

401, 402, & 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

PREPARED FOR

SLATER LAW FIRM, PLLC

FIGURE 2

DISCLAIMER:
PROPERTY OF TURNKEY ENV. REST., LLC. IMPORTANT: THIS DRAWING PRINT IS LOANED FOR MUTUAL ASSISTANCE AND AS SUCH IS SUBJECT TO RECALL AT ANY TIME. INFORMATION CONTAINED HEREON IS NOT TO BE DISCLOSED OR REPRODUCED IN ANY FORM FOR THE BENEFIT OF PARTIES OTHER THAN NECESSARY SUBCONTRACTORS & SUPPLIERS WITHOUT THE WRITTEN CONSENT OF TURNKEY ENV. REST., LLC.

APPENDIX A

SOIL BORING AND TEST PIT LOGS

Project No: 0271-013-001

Borehole Number: SB-01

Project: Limited Phase II Environmental Investigation

A.K.A.:

Client: The Slater Law Firm, PLLC

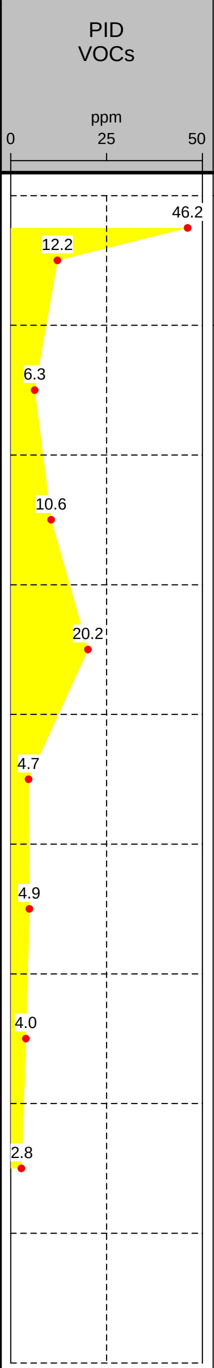
Logged By: PWW

Site Location: 401, 402 and 430 Buffalo Avenue, Niagara Falls

Checked By: BCH

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE			SAMPLE			Lab Sample	Well Completion Details or Remarks
Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)		
0.0	0.0 0.0	Ground Surface ***Ashphalt***					
	-1.0 1.0	***Poorly Graded Sand*** Blackish brown, moist, mostly fine sand, trace non-plastic fines, loose when disturbed, no odors	S-1	NA	3.0	Sampled (0-2')	
		Poorlyl Graded Sand with Silt Brown, moist to wet (3.5'), mostly fine sand, few non-plastic fines, loose when disturbed, no odors					
	-4.0 4.0	As above, wet	S-2	NA	4.0		▽ *DTW = 4 fbgs*
5.0							
		No odors					
	-8.0 8.0	As above	S-3	NA	4.0		
10.0							
	-12.0 12.0	As above	S-4	NA	4.0		
15.0							
	-16.0 16.0	End of Borehole					



Drilled By: DDS Companies
Drill Rig Type: 66 DT Geoprobe Track Mounted Rig
Drill Method: Direct Push with 4' Macro-core
Comments:
Drill Date(s): 10-3-13

Hole Size: 3"
Stick-up: NA
Datum: Mean Sea Level

Sheet: 1 of 1

Project No: 0271-013-001

Borehole Number: SB-02

Project: Limited Phase II Environmental Investigation

A.K.A.:

Client: The Slater Law Firm, PLLC

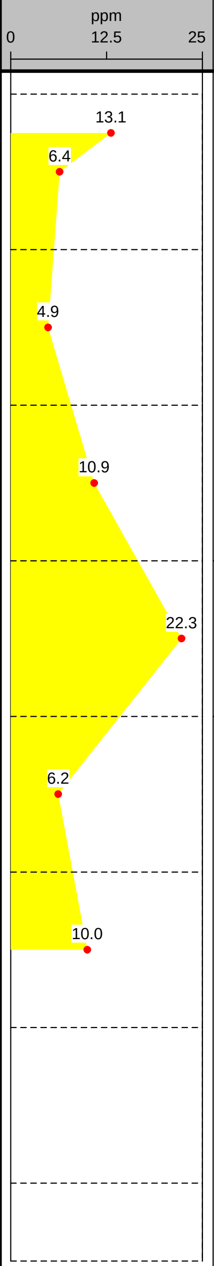
Logged By: PWW

Site Location: 401, 402 and 430 Buffalo Avenue, Niagara Falls

Checked By: BCH

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE			SAMPLE				PID VOCs ppm	Lab Sample	Well Completion Details or Remarks
Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)	Symbol			
0.0	0.0 0.0	Ground Surface ***Ashphalt*** ***Silt with Sand*** Brown, moist, mostly non-plastic fines with little fine sand, low dry strength, low toughness, very dense massive	S-1	NA	2.2				
5.0	-4.0 4.0	As above No odors	S-2	NA	4.0			Sampled (6-8')	
10.0	-8.0 8.0	As above, moist to wet (10.5')	S-3	NA	4.0				DTW = 10.5 fbgs
15.0	-12.0 12.0	End of Borehole							



Drilled By: DDS Companies
Drill Rig Type: 66 DT Geoprobe Track Mounted Rig
Drill Method: Direct Push with 4' Macro-core
Comments:
Drill Date(s): 10-3-13

Hole Size: 3"
Stick-up: NA
Datum: Mean Sea Level

Sheet: 1 of 1

Project No: 0271-013-001

Borehole Number: SB-03

Project: Limited Phase II Environmental Investigation

A.K.A.:

Client: The Slater Law Firm, PLLC

Logged By: PWW

Site Location: 401, 402 and 430 Buffalo Avenue, Niagara Falls

Checked By: BCH

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE			SAMPLE						
Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)	Symbol	PID VOCs ppm (0 – 12.5 – 25)	Lab Sample	Well Completion Details or Remarks
0.0	0.0 0.0	Ground Surface							
		Ashphalt							
		Poorly Graded Sand Blackish brown, moist, mostly fine sand, trace non-plastic fines, loose when disturbed					0.0		
	-1.0 1.0	***Poorly Graded Sand with Silt*** Brown, moist, mostly fine sand, few non-plastic fines, loose when disturbed, no odors	S-1	NA	3.0		0.0 0.0		
5.0	-4.0 4.0	As above, moist to wet (4.5')	S-2	NA	4.0		0.0 0.0		*DTW = 4.5 fbgs* ▼
10.0	-8.0 8.0	As above, wet	S-3	NA	4.0		0.0 0.0		
15.0	-12.0 12.0	End of Borehole							

Drilled By: DDS Companies
Drill Rig Type: 66 DT Geoprobe Track Mounted Rig
Drill Method: Direct Push with 4' Macro-core
Comments:
Drill Date(s): 10-3-13

Hole Size: 3"
Stick-up: NA
Datum: Mean Sea Level

Sheet: 1 of 1

TEST PIT EXCAVATION LOG

Project No: 0271-013-001

Test Pit I.D.: TP-01

Project: Limited Phase II Environmental Investigation

Logged By: PWW

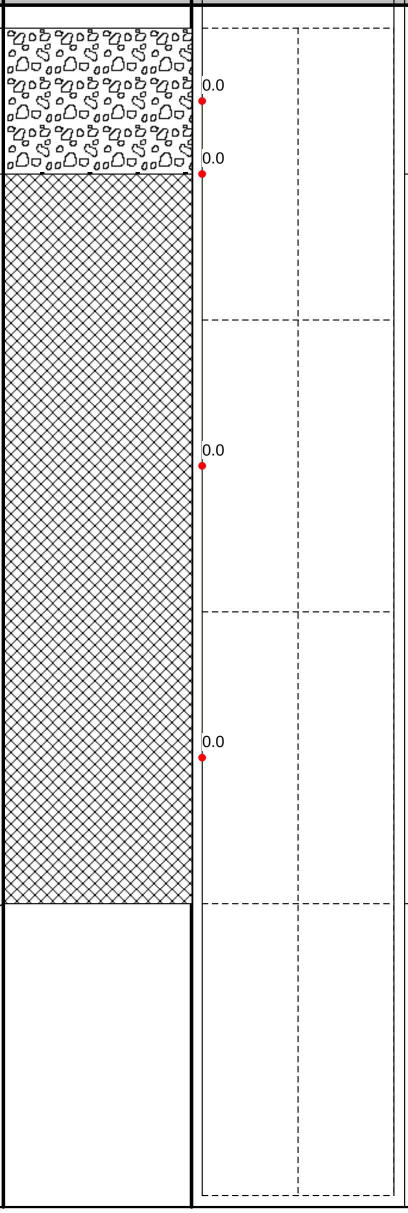
Client: The Slater Law Firm, PLLC

Checked By: BCH

Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE



Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Lithologic Symbol	PID VOCs (ppm)	Lab Sample	Remarks
	0.0	Ground Surface				
0.0	0.0	**Gravel Sub-base**		0.0 0.0		
	-1.0 1.0	**Fill** Reddish brown, moist, mostly red and yellow brick, concrete, little fine sand, loose when disturbed,		0.0 0.0	Sampled (1-6')	
5.0						
	-6.0 6.0	refusal on suspected concrete @ 6 fbgs End of Test Pit				

Excavated By: Turnkey Environmental Restoration
Excavator Type: Bobcat Excavator ZHS430
Excavation Date(s): 10-4-13
Comments:

Length: 9'
Width: 2.5'
Depth: 6'

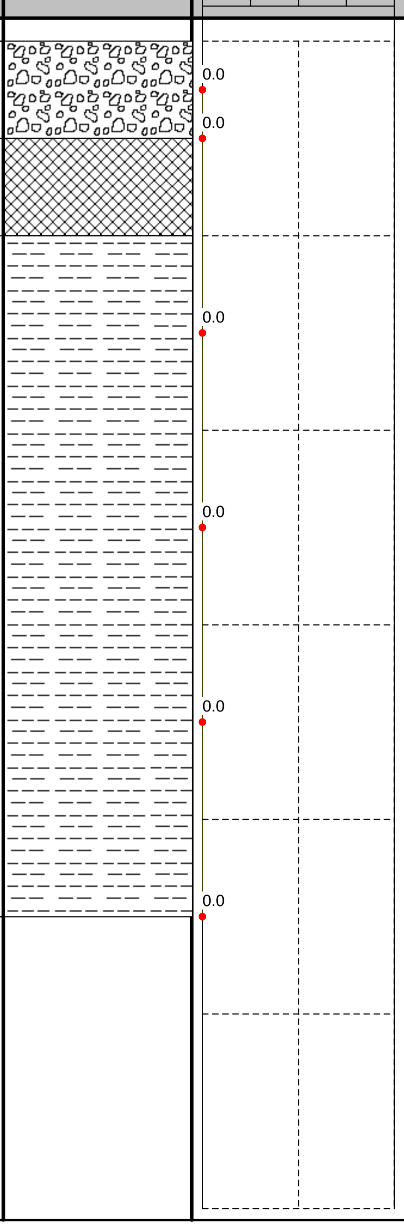
Depth to Water: None
Visual Impacts: None
Olfactory Observations: None

TEST PIT EXCAVATION LOG

Project No: 0271-013-001
Test Pit I.D.: TP-02
Project: Limited Phase II Environmental Investigation
Logged By: PWW
Client: The Slater Law Firm, PLLC
Checked By: BCH
Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE



Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Lithologic Symbol	PID VOCs ppm	Lab Sample	Remarks
0.0	0.0 0.0	Ground Surface				
	-1.0	**Gravel Sub-base**		0.0 0.0		
	1.0 -2.0	**Fill** Brown, moist, mostly non-plastic fines with brick, loose when disturbed				
5.0	2.0 -9.0	**Sandy Lean Clay** Reddish brown, moist, mostly medium plasticity fines, some fine sand, stiff, massive		0.0 0.0 0.0 0.0		
10.0	9.0	End of Test Pit				

Excavated By: Turnkey Environmental Restoration
Length: 9'
Depth to Water: None
Excavator Type: Bobcat Excavator ZHS430
Width: 2.5'
Visual Impacts: None
Excavation Date(s): 10-4-13
Depth: 9'
Olfactory Observations: None
Comments:

Sheet: 1 of 1

TEST PIT EXCAVATION LOG

Project No: 0271-013-001
Test Pit I.D.: TP-03
Project: Limited Phase II Environmental Investigation
Logged By: PWW
Client: The Slater Law Firm, PLLC
Checked By: BCH
Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE

Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Lithologic Symbol	PID VOCs ppm (0 25 50 75 100)	Lab Sample	Remarks
0.0	0.0	Ground Surface				
	0.0	***Gravel Sub-base***	▨	0.0 0.0		
	-1.0 1.0	***Fill*** Reddish brown, moist, mostly red and yellow brick, concrete, little fine sand, loose when disturbed, refusal on suspected concrete @ 4.5 fbgs	▨	0.0 0.0	Sampled fill (1-4.5')	
	-4.5 4.5	End of Test Pit				
5.0						

Excavated By: Turnkey Environmental Restoration
Excavator Type: Bobcat Excavator ZHS430
Excavation Date(s): 10-4-13
Comments:

Length: 9'
Width: 2.5'
Depth: 4.5'

Depth to Water: None
Visual Impacts: None
Olfactory Observations: None

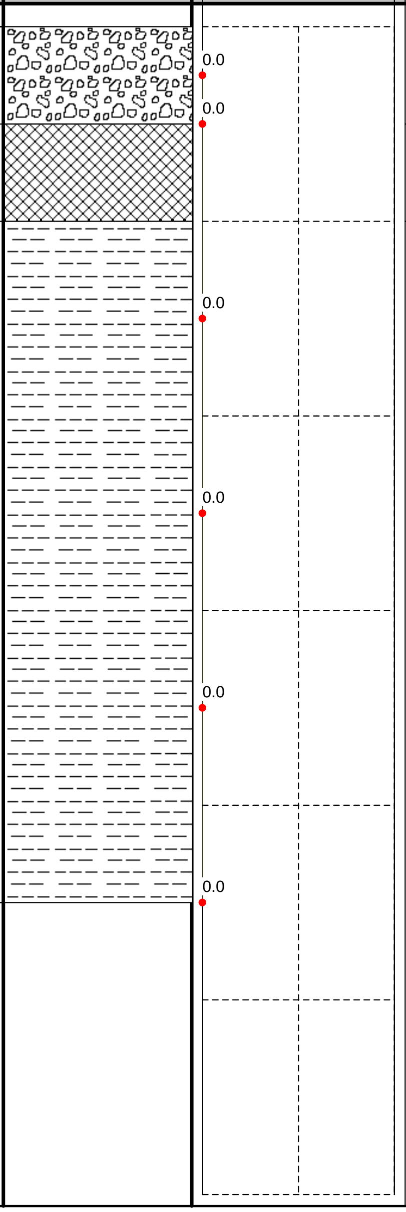
Sheet: 1 of 1

TEST PIT EXCAVATION LOG

Project No: 0271-013-001
Test Pit I.D.: TP-04
Project: Limited Phase II Environmental Investigation
Logged By: PWW
Client: The Slater Law Firm, PLLC
Checked By: BCH
Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE



Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Lithologic Symbol	PID VOCs (ppm)	Lab Sample	Remarks
0.0	0.0 0.0	Ground Surface ***Gravel Sub-base***		0.0 0.0		
	-1.0 1.0	***Fill*** Brown, moist, mostly non-plastic fines with brick, loose when disturbed			Sampled (1-2')	
	-2.0 2.0	***Sandy Lean Clay*** Reddish brown, moist, mostly medium plasticity fines, some fine sand, stiff, massive		0.0		
5.0				0.0 0.0		
	-9.0 9.0	End of Test Pit		0.0		
10.0						

Excavated By: Turnkey Environmental Restoration
Excavator Type: Bobcat Excavator ZHS430
Excavation Date(s): 10-4-13
Comments:

Length: 9'
Width: 2.5'
Depth: 9'

Depth to Water: None
Visual Impacts: None
Olfactory Observations: None

TEST PIT EXCAVATION LOG

Project No: 0271-013-001
Test Pit I.D.: TP-05
Project: Limited Phase II Environmental Investigation
Logged By: PWW
Client: The Slater Law Firm, PLLC
Checked By: BCH
Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE

Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Lithologic Symbol	PID VOCs ppm (0 25 50 75 100)	Lab Sample	Remarks
	0.0	Ground Surface				
0.0	0.0	**Gravel Sub-base**		0.0 0.0		
	-1.0 1.0	**Fill** Reddish brown, moist, mostly red and yellow brick, concrete, little fine sand, loose when disturbed,	▨	0.0 0.0	Sampled (1-3')	
	-3.0 3.0	refusal on suspected concrete @ 3 fbgs End of Test Pit				
5.0						

Excavated By: Turnkey Environmental Restoration
Excavator Type: Bobcat Excavator ZHS430
Excavation Date(s): 10-4-13
Comments:

Length: 9'
Width: 2.5'
Depth: 3'

Depth to Water: None
Visual Impacts: None
Olfactory Observations: None

Sheet: 1 of 1

TEST PIT EXCAVATION LOG

Project No: 0271-013-001

Test Pit I.D.: TP-06

Project: Limited Phase II Environmental Investigation

Logged By: PWW

Client: The Slater Law Firm, PLLC

Checked By: BCH

Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE

Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Lithologic Symbol	PID VOCs ppm (0 25 50 75 100)	Lab Sample	Remarks
	0.0	Ground Surface				
0.0	0.0 -1.0	**Gravel Sub-base**		0.0 0.0		
	1.0 -2.0	**Fill** Brown, moist, mostly non-plastic fines with brick, loose when disturbed				
	2.0 -9.0	**Sandy Lean Clay** Reddish brown, moist, mostly medium plasticity fines, some fine sand, stiff, massive		0.0 0.0 0.0 0.0	Sampled (2-4')	
5.0						
	9.0	End of Test Pit				
10.0						

Excavated By: Turnkey Environmental Restoration
Excavator Type: Bobcat Excavator ZHS430
Excavation Date(s): 10-4-13
Comments:

Length: 9'
Width: 2.5'
Depth: 9'

Depth to Water: None
Visual Impacts: None
Olfactory Observations: None

TEST PIT EXCAVATION LOG

Project No: 0271-013-001

Test Pit I.D.: TP-07

Project: Limited Phase II Environmental Investigation

Logged By: PWW

Client: The Slater Law Firm, PLLC

Checked By: BCH

Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE

Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	PID VOCs ppm (0 25 50 75 100)	Lab Sample	Remarks
0.0	0.0 0.0	Ground Surface **Gravel Sub-base**	0.0 0.0		
	-1.0 1.0	**Fill** Brown, moist, mostly non-plastic fines with brick, loose when disturbed		Sampled (1-3')	
	-2.0 2.0	**Sandy Lean Clay** Reddish brown, moist, mostly medium plasticity fines, some fine sand, stiff, massive	0.0 0.0 0.0		
5.0					
	-9.0 9.0	End of Test Pit	0.0		
10.0					

Excavated By: Turnkey Environmental Restoration
Excavator Type: Bobcat Excavator ZHS430
Excavation Date(s): 10-4-13
Comments:

Length: 9'
Width: 2.5'
Depth: 9'

Depth to Water: None
Visual Impacts: None
Olfactory Observations: None

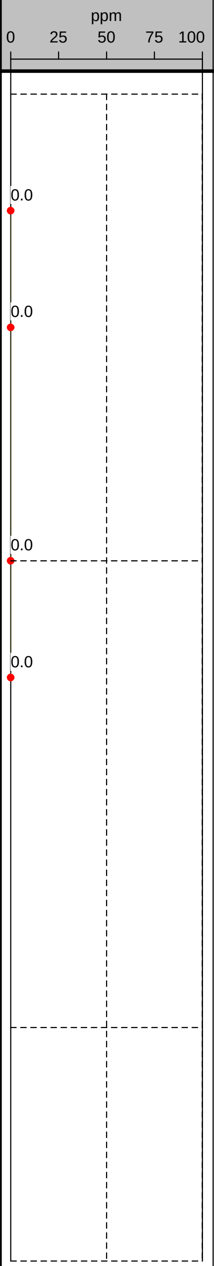
TEST PIT EXCAVATION LOG

Project No: 0271-013-001
Test Pit I.D.: TP-08
Project: Limited Phase II Environmental Investigation
Logged By: PWW
Client: The Slater Law Firm, PLLC
Checked By: BCH
Site Location: 401, 402 & 430 Buffalo Avenue, Niagara Falls

TurnKey Environmental Restoration, LLC
2558 Hamburg Turnpike, Suite 300
Buffalo, NY 14218
(716) 856-0635

SUBSURFACE PROFILE

Depth (fbgs)	Elev. /Depth	Description (ASTM D2488: Visual-Manual Procedure)	Lithologic Symbol	PID VOCs ppm	Lab Sample	Remarks
0.0	0.0 0.0	Ground Surface ***Gravel Sub-base***		0.0 0.0		
	-1.0 1.0	***Fill*** Reddish brown, moist, mostly red and yellow brick, concrete, little fine sand, loose when disturbed, refusal on suspected concrete @ 3 fbgs	▨	0.0 0.0		
	-3.0 3.0	End of Test Pit				
5.0						



Excavated By: Turnkey Environmental Restoration
Length: 9'
Depth to Water: None
Excavator Type: Bobcat Excavator ZHS430
Width: 2.5'
Visual Impacts: None
Excavation Date(s): 10-4-13
Depth: 3'
Olfactory Observations: None
Comments:

Sheet: 1 of 1

APPENDIX B

LABORATORY ANALYTICAL DATA SUMMARY PACKAGE

ANALYTICAL REPORT

Lab Number:	L1320014
Client:	Benchmark & Turnkey Companies 2558 Hamburg Turnpike Suite 300 Buffalo, NY 14218
ATTN:	Mike Lesakowski
Phone:	(716) 856-0599
Project Name:	401, 402 + 430 BUFFALO AVE.
Project Number:	0271-013-001
Report Date:	10/16/13

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), USDA (Permit #P-330-11-00240), NC (666), TX (T104704476), DOD (L2217), US Army Corps of Engineers.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name: 401, 402 + 430 BUFFALO AVE.
Project Number: 0271-013-001

Lab Number: L1320014
Report Date: 10/16/13

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L1320014-01	SB-1 (0-2)	BUFFALO AVE. NIAGARA FALLS	10/03/13 10:00
L1320014-02	SB-2 (6-8)	BUFFALO AVE. NIAGARA FALLS	10/03/13 10:30
L1320014-03	TP-1 (1-6)	BUFFALO AVE. NIAGARA FALLS	10/04/13 12:45
L1320014-04	TP-3 (1-4.5)	BUFFALO AVE. NIAGARA FALLS	10/04/13 13:05
L1320014-05	TP-5 (1-3)	BUFFALO AVE. NIAGARA FALLS	10/04/13 13:40
L1320014-06	TP-7 (1-3)	BUFFALO AVE. NIAGARA FALLS	10/04/13 14:25
L1320014-07	TP-4 (1-2)	BUFFALO AVE. NIAGARA FALLS	10/04/13 13:15
L1320014-08	TP-6 (2-4)	BUFFALO AVE. NIAGARA FALLS	10/04/13 14:00

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Performance criteria for CAM and RCP methods allow for some LCS compound failures to occur and still be within method compliance. In these instances, the specific failures are not narrated but are noted in the associated QC table. This information is also incorporated in the Data Usability format for our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples.

Please contact Client Services at 800-624-9220 with any questions.

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Volatile Organics

Any reported concentrations that are below 200 ug/kg may be biased low due to the sample not being collected according to 5035-L/5035A-L low-level specifications.

Semivolatile Organics

L1320014-03 and -04 have elevated detection limits due to the dilutions required by the sample matrices.
L1320014-05 has elevated detection limits due to the dilution required by the matrix interferences encountered during the concentration of the sample and the analytical dilution required by the sample matrix.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kelly Stenstrom Kelly Stenstrom

Title: Technical Director/Representative Date: 10/16/13

ORGANICS

VOLATILES

SAMPLE RESULTS

Lab ID:	L1320014-01	Date Collected:	10/03/13 10:00
Client ID:	SB-1 (0-2)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Analytical Method:	1,8260C		
Analytical Date:	10/15/13 20:55		
Analyst:	BN		
Percent Solids:	88%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Volatile Organics by GC/MS - Westborough Lab						
Methylene chloride	ND		ug/kg	11	2.3	1
1,1-Dichloroethane	ND		ug/kg	1.7	0.20	1
Chloroform	ND		ug/kg	1.7	0.42	1
Carbon tetrachloride	ND		ug/kg	1.1	0.24	1
1,2-Dichloropropane	ND		ug/kg	4.0	0.26	1
Dibromochloromethane	ND		ug/kg	1.1	0.35	1
1,1,2-Trichloroethane	ND		ug/kg	1.7	0.35	1
Tetrachloroethene	ND		ug/kg	1.1	0.16	1
Chlorobenzene	ND		ug/kg	1.1	0.40	1
Trichlorofluoromethane	ND		ug/kg	5.7	0.14	1
1,2-Dichloroethane	ND		ug/kg	1.1	0.17	1
1,1,1-Trichloroethane	ND		ug/kg	1.1	0.13	1
Bromodichloromethane	ND		ug/kg	1.1	0.26	1
trans-1,3-Dichloropropene	ND		ug/kg	1.1	0.14	1
cis-1,3-Dichloropropene	ND		ug/kg	1.1	0.14	1
Bromoform	ND		ug/kg	4.6	0.47	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	1.1	0.19	1
Benzene	ND		ug/kg	1.1	0.13	1
Toluene	ND		ug/kg	1.7	0.13	1
Ethylbenzene	ND		ug/kg	1.1	0.17	1
Chloromethane	ND		ug/kg	5.7	0.89	1
Bromomethane	ND		ug/kg	2.3	0.38	1
Vinyl chloride	ND		ug/kg	2.3	0.16	1
Chloroethane	ND		ug/kg	2.3	0.36	1
1,1-Dichloroethene	ND		ug/kg	1.1	0.23	1
trans-1,2-Dichloroethene	ND		ug/kg	1.7	0.24	1
Trichloroethene	ND		ug/kg	1.1	0.17	1
1,2-Dichlorobenzene	ND		ug/kg	5.7	0.21	1
1,3-Dichlorobenzene	ND		ug/kg	5.7	0.21	1
1,4-Dichlorobenzene	ND		ug/kg	5.7	0.28	1
Methyl tert butyl ether	ND		ug/kg	2.3	0.12	1

SAMPLE RESULTS

Lab ID:	L1320014-01	Date Collected:	10/03/13 10:00
Client ID:	SB-1 (0-2)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
p/m-Xylene	ND		ug/kg	2.3	0.37	1
o-Xylene	ND		ug/kg	2.3	0.31	1
cis-1,2-Dichloroethene	ND		ug/kg	1.1	0.17	1
Styrene	ND		ug/kg	2.3	0.35	1
Dichlorodifluoromethane	ND		ug/kg	11	0.25	1
Acetone	ND		ug/kg	11	3.5	1
Carbon disulfide	ND		ug/kg	11	2.3	1
2-Butanone	ND		ug/kg	11	0.40	1
4-Methyl-2-pentanone	ND		ug/kg	11	0.28	1
2-Hexanone	ND		ug/kg	11	0.21	1
Bromochloromethane	ND		ug/kg	5.7	0.22	1
1,2-Dibromoethane	ND		ug/kg	4.6	0.20	1
n-Butylbenzene	ND		ug/kg	1.1	0.22	1
sec-Butylbenzene	ND		ug/kg	1.1	0.23	1
tert-Butylbenzene	ND		ug/kg	5.7	0.64	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	5.7	0.90	1
Isopropylbenzene	ND		ug/kg	1.1	0.19	1
p-Isopropyltoluene	ND		ug/kg	1.1	0.22	1
n-Propylbenzene	ND		ug/kg	1.1	0.14	1
1,2,3-Trichlorobenzene	ND		ug/kg	5.7	0.19	1
1,2,4-Trichlorobenzene	ND		ug/kg	5.7	0.90	1
1,3,5-Trimethylbenzene	ND		ug/kg	5.7	0.16	1
1,2,4-Trimethylbenzene	ND		ug/kg	5.7	0.65	1
Methyl Acetate	ND		ug/kg	23	0.87	1
Cyclohexane	ND		ug/kg	23	1.2	1
1,4-Dioxane	ND		ug/kg	110	20.	1
Freon-113	ND		ug/kg	23	0.31	1
Methyl cyclohexane	ND		ug/kg	4.6	1.4	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	96		70-130
Toluene-d8	94		70-130
4-Bromofluorobenzene	94		70-130
Dibromofluoromethane	85		70-130

SAMPLE RESULTS

Lab ID:	L1320014-02	Date Collected:	10/03/13 10:30
Client ID:	SB-2 (6-8)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Analytical Method:	1,8260C		
Analytical Date:	10/15/13 21:30		
Analyst:	BN		
Percent Solids:	91%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methylene chloride	ND		ug/kg	11	2.2	1
1,1-Dichloroethane	ND		ug/kg	1.6	0.20	1
Chloroform	ND		ug/kg	1.6	0.41	1
Carbon tetrachloride	ND		ug/kg	1.1	0.23	1
1,2-Dichloropropane	ND		ug/kg	3.8	0.25	1
Dibromochloromethane	ND		ug/kg	1.1	0.34	1
1,1,2-Trichloroethane	ND		ug/kg	1.6	0.33	1
Tetrachloroethene	ND		ug/kg	1.1	0.15	1
Chlorobenzene	ND		ug/kg	1.1	0.38	1
Trichlorofluoromethane	ND		ug/kg	5.5	0.13	1
1,2-Dichloroethane	ND		ug/kg	1.1	0.16	1
1,1,1-Trichloroethane	ND		ug/kg	1.1	0.12	1
Bromodichloromethane	ND		ug/kg	1.1	0.25	1
trans-1,3-Dichloropropene	ND		ug/kg	1.1	0.13	1
cis-1,3-Dichloropropene	ND		ug/kg	1.1	0.14	1
Bromoform	ND		ug/kg	4.4	0.46	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	1.1	0.19	1
Benzene	ND		ug/kg	1.1	0.13	1
Toluene	ND		ug/kg	1.6	0.12	1
Ethylbenzene	ND		ug/kg	1.1	0.16	1
Chloromethane	ND		ug/kg	5.5	0.86	1
Bromomethane	ND		ug/kg	2.2	0.37	1
Vinyl chloride	ND		ug/kg	2.2	0.16	1
Chloroethane	ND		ug/kg	2.2	0.35	1
1,1-Dichloroethene	ND		ug/kg	1.1	0.23	1
trans-1,2-Dichloroethene	ND		ug/kg	1.6	0.23	1
Trichloroethene	ND		ug/kg	1.1	0.17	1
1,2-Dichlorobenzene	ND		ug/kg	5.5	0.20	1
1,3-Dichlorobenzene	ND		ug/kg	5.5	0.20	1
1,4-Dichlorobenzene	ND		ug/kg	5.5	0.26	1
Methyl tert butyl ether	ND		ug/kg	2.2	0.11	1

SAMPLE RESULTS

Lab ID:	L1320014-02	Date Collected:	10/03/13 10:30
Client ID:	SB-2 (6-8)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified

Volatile Organics by GC/MS - Westborough Lab

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
p/m-Xylene	ND		ug/kg	2.2	0.35	1
o-Xylene	ND		ug/kg	2.2	0.30	1
cis-1,2-Dichloroethene	ND		ug/kg	1.1	0.16	1
Styrene	ND		ug/kg	2.2	0.34	1
Dichlorodifluoromethane	ND		ug/kg	11	0.24	1
Acetone	ND		ug/kg	11	3.4	1
Carbon disulfide	ND		ug/kg	11	2.2	1
2-Butanone	ND		ug/kg	11	0.39	1
4-Methyl-2-pentanone	ND		ug/kg	11	0.27	1
2-Hexanone	ND		ug/kg	11	0.21	1
Bromochloromethane	ND		ug/kg	5.5	0.22	1
1,2-Dibromoethane	ND		ug/kg	4.4	0.20	1
n-Butylbenzene	ND		ug/kg	1.1	0.22	1
sec-Butylbenzene	ND		ug/kg	1.1	0.23	1
tert-Butylbenzene	ND		ug/kg	5.5	0.62	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	5.5	0.87	1
Isopropylbenzene	ND		ug/kg	1.1	0.18	1
p-Isopropyltoluene	ND		ug/kg	1.1	0.21	1
n-Propylbenzene	ND		ug/kg	1.1	0.14	1
1,2,3-Trichlorobenzene	ND		ug/kg	5.5	0.18	1
1,2,4-Trichlorobenzene	ND		ug/kg	5.5	0.87	1
1,3,5-Trimethylbenzene	ND		ug/kg	5.5	0.16	1
1,2,4-Trimethylbenzene	ND		ug/kg	5.5	0.63	1
Methyl Acetate	ND		ug/kg	22	0.84	1
Cyclohexane	ND		ug/kg	22	1.2	1
1,4-Dioxane	ND		ug/kg	110	19.	1
Freon-113	ND		ug/kg	22	0.30	1
Methyl cyclohexane	ND		ug/kg	4.4	1.4	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	97		70-130
Toluene-d8	90		70-130
4-Bromofluorobenzene	90		70-130
Dibromofluoromethane	86		70-130

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 10/15/13 13:04
Analyst: BN

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01-02 Batch: WG644364-3					
Methylene chloride	ND		ug/kg	10	2.0
1,1-Dichloroethane	ND		ug/kg	1.5	0.18
Chloroform	ND		ug/kg	1.5	0.37
Carbon tetrachloride	ND		ug/kg	1.0	0.21
1,2-Dichloropropane	ND		ug/kg	3.5	0.23
Dibromochloromethane	ND		ug/kg	1.0	0.31
1,1,2-Trichloroethane	ND		ug/kg	1.5	0.30
Tetrachloroethene	ND		ug/kg	1.0	0.14
Chlorobenzene	ND		ug/kg	1.0	0.35
Trichlorofluoromethane	ND		ug/kg	5.0	0.12
1,2-Dichloroethane	ND		ug/kg	1.0	0.15
1,1,1-Trichloroethane	ND		ug/kg	1.0	0.11
Bromodichloromethane	ND		ug/kg	1.0	0.23
trans-1,3-Dichloropropene	ND		ug/kg	1.0	0.12
cis-1,3-Dichloropropene	ND		ug/kg	1.0	0.13
Bromoform	ND		ug/kg	4.0	0.41
1,1,2,2-Tetrachloroethane	ND		ug/kg	1.0	0.17
Benzene	ND		ug/kg	1.0	0.12
Toluene	0.25	J	ug/kg	1.5	0.11
Ethylbenzene	ND		ug/kg	1.0	0.15
Chloromethane	ND		ug/kg	5.0	0.78
Bromomethane	1.2	J	ug/kg	2.0	0.34
Vinyl chloride	ND		ug/kg	2.0	0.14
Chloroethane	ND		ug/kg	2.0	0.32
1,1-Dichloroethene	ND		ug/kg	1.0	0.20
trans-1,2-Dichloroethene	ND		ug/kg	1.5	0.21
Trichloroethene	ND		ug/kg	1.0	0.15
1,2-Dichlorobenzene	ND		ug/kg	5.0	0.18
1,3-Dichlorobenzene	ND		ug/kg	5.0	0.18
1,4-Dichlorobenzene	ND		ug/kg	5.0	0.24
Methyl tert butyl ether	ND		ug/kg	2.0	0.10

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 10/15/13 13:04
Analyst: BN

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01-02 Batch: WG644364-3					
p/m-Xylene	ND		ug/kg	2.0	0.32
o-Xylene	ND		ug/kg	2.0	0.27
cis-1,2-Dichloroethene	ND		ug/kg	1.0	0.15
Styrene	ND		ug/kg	2.0	0.31
Dichlorodifluoromethane	ND		ug/kg	10	0.22
Acetone	ND		ug/kg	10	3.1
Carbon disulfide	ND		ug/kg	10	2.0
2-Butanone	ND		ug/kg	10	0.36
4-Methyl-2-pentanone	ND		ug/kg	10	0.24
2-Hexanone	ND		ug/kg	10	0.19
Bromochloromethane	ND		ug/kg	5.0	0.20
1,2-Dibromoethane	ND		ug/kg	4.0	0.18
n-Butylbenzene	ND		ug/kg	1.0	0.20
sec-Butylbenzene	ND		ug/kg	1.0	0.20
tert-Butylbenzene	ND		ug/kg	5.0	0.56
1,2-Dibromo-3-chloropropane	ND		ug/kg	5.0	0.79
Isopropylbenzene	ND		ug/kg	1.0	0.17
p-Isopropyltoluene	ND		ug/kg	1.0	0.19
Naphthalene	ND		ug/kg	5.0	0.77
n-Propylbenzene	ND		ug/kg	1.0	0.12
1,2,3-Trichlorobenzene	ND		ug/kg	5.0	0.17
1,2,4-Trichlorobenzene	ND		ug/kg	5.0	0.79
1,3,5-Trimethylbenzene	ND		ug/kg	5.0	0.14
1,2,4-Trimethylbenzene	ND		ug/kg	5.0	0.57
Methyl Acetate	ND		ug/kg	20	0.76
Cyclohexane	ND		ug/kg	20	1.1
1,4-Dioxane	ND		ug/kg	100	17.
Freon-113	ND		ug/kg	20	0.27
Methyl cyclohexane	ND		ug/kg	4.0	1.3

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 10/15/13 13:04
Analyst: BN

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 01-02 Batch: WG644364-3					

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	90		70-130
Toluene-d8	94		70-130
4-Bromofluorobenzene	96		70-130
Dibromofluoromethane	89		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.
Lab Number: L1320014
Project Number: 0271-013-001
Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02 Batch: WG644364-1 WG644364-2								
Methylene chloride	105		99		70-130	6		30
1,1-Dichloroethane	103		100		70-130	3		30
Chloroform	100		98		70-130	2		30
Carbon tetrachloride	100		100		70-130	0		30
1,2-Dichloropropane	100		93		70-130	7		30
Dibromochloromethane	106		100		70-130	6		30
1,1,2-Trichloroethane	104		97		70-130	7		30
Tetrachloroethene	104		101		70-130	3		30
Chlorobenzene	105		100		70-130	5		30
Trichlorofluoromethane	104		101		70-139	3		30
1,2-Dichloroethane	99		94		70-130	5		30
1,1,1-Trichloroethane	106		101		70-130	5		30
Bromodichloromethane	101		96		70-130	5		30
trans-1,3-Dichloropropene	78		75		70-130	4		30
cis-1,3-Dichloropropene	85		82		70-130	4		30
1,1-Dichloropropene	103		101		70-130	2		30
Bromoform	97		92		70-130	5		30
1,1,2,2-Tetrachloroethane	107		99		70-130	8		30
Benzene	105		101		70-130	4		30
Toluene	102		99		70-130	3		30
Ethylbenzene	108		104		70-130	4		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.
Project Number: 0271-013-001

Lab Number: L1320014
Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02 Batch: WG644364-1 WG644364-2								
Chloromethane	115		111		52-130	4		30
Bromomethane	122		110		57-147	10		30
Vinyl chloride	127		123		67-130	3		30
Chloroethane	112		109		50-151	3		30
1,1-Dichloroethene	109		109		65-135	0		30
trans-1,2-Dichloroethene	104		101		70-130	3		30
Trichloroethene	99		97		70-130	2		30
1,2-Dichlorobenzene	104		99		70-130	5		30
1,3-Dichlorobenzene	106		103		70-130	3		30
1,4-Dichlorobenzene	105		101		70-130	4		30
Methyl tert butyl ether	71		66		66-130	7		30
p/m-Xylene	106		102		70-130	4		30
o-Xylene	104		100		70-130	4		30
cis-1,2-Dichloroethene	102		98		70-130	4		30
Dibromomethane	94		90		70-130	4		30
Styrene	109		104		70-130	5		30
Dichlorodifluoromethane	95		95		30-146	0		30
Acetone	140		**177**	Q	54-140	23		30
Carbon disulfide	104		102		59-130	2		30
2-Butanone	109		126		70-130	14		30
Vinyl acetate	87		80		70-130	8		30

Lab Control Sample Analysis

Batch Quality Control

Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02 Batch: WG644364-1 WG644364-2

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
4-Methyl-2-pentanone	87		82		70-130	6		30
1,2,3-Trichloropropane	102		97		68-130	5		30
2-Hexanone	103		117		70-130	13		30
Bromochloromethane	96		92		70-130	4		30
2,2-Dichloropropane	79		77		70-130	3		30
1,2-Dibromoethane	103		97		70-130	6		30
1,3-Dichloropropane	99		94		69-130	5		30
1,1,1,2-Tetrachloroethane	100		95		70-130	5		30
Bromobenzene	104		100		70-130	4		30
n-Butylbenzene	111		107		70-130	4		30
sec-Butylbenzene	111		107		70-130	4		30
tert-Butylbenzene	107		103		70-130	4		30
o-Chlorotoluene	111		106		70-130	5		30
p-Chlorotoluene	108		104		70-130	4		30
1,2-Dibromo-3-chloropropane	90		83		68-130	8		30
Hexachlorobutadiene	98		95		67-130	3		30
Isopropylbenzene	106		102		70-130	4		30
p-Isopropyltoluene	107		104		70-130	3		30
Naphthalene	94		87		70-130	8		30
Acrylonitrile	97		92		70-130	5		30
Isopropyl Ether	97		92		66-130	5		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.
Lab Number: L1320014
Project Number: 0271-013-001
Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02 Batch: WG644364-1 WG644364-2								
tert-Butyl Alcohol	98		94		70-130	4		30
n-Propylbenzene	111		106		70-130	5		30
1,2,3-Trichlorobenzene	100		95		70-130	5		30
1,2,4-Trichlorobenzene	99		96		70-130	3		30
1,3,5-Trimethylbenzene	110		106		70-130	4		30
1,2,4-Trimethylbenzene	108		104		70-130	4		30
Methyl Acetate	102		95		51-146	7		30
Ethyl Acetate	99		94		70-130	5		30
Acrolein	107		93		70-130	14		30
Cyclohexane	106		103		59-142	3		30
1,4-Dioxane	97		88		65-136	10		30
Freon-113	107		108		50-139	1		30
1,4-Diethylbenzene	108		105		70-130	3		30
4-Ethyltoluene	111		108		70-130	3		30
1,2,4,5-Tetramethylbenzene	103		99		70-130	4		30
Tetrahydrofuran	96		91		66-130	5		30
Ethyl ether	97		94		67-130	3		30
trans-1,4-Dichloro-2-butene	90		88		70-130	2		30
Methyl cyclohexane	104		104		70-130	0		30
Ethyl-Tert-Butyl-Ether	86		81		70-130	6		30
Tertiary-Amyl Methyl Ether	**53**	Q	**50**	Q	70-130	6		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.

Project Number: 0271-013-001

Lab Number: L1320014

Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02 Batch: WG644364-1 WG644364-2								

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
1,2-Dichloroethane-d4	96		88		70-130
Toluene-d8	101		91		70-130
4-Bromofluorobenzene	99		90		70-130
Dibromofluoromethane	98		88		70-130

SEMIVOLATILES

SAMPLE RESULTS

Lab ID:	L1320014-01	Date Collected:	10/03/13 10:00
Client ID:	SB-1 (0-2)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 14:04		
Analyst:	RC		
Percent Solids:	88%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	150	38.	1
2-Chloronaphthalene	ND		ug/kg	180	60.	1
Fluoranthene	630		ug/kg	110	34.	1
Naphthalene	110	J	ug/kg	180	61.	1
Benzo(a)anthracene	210		ug/kg	110	36.	1
Benzo(a)pyrene	190		ug/kg	150	45.	1
Benzo(b)fluoranthene	310		ug/kg	110	37.	1
Benzo(k)fluoranthene	95	J	ug/kg	110	35.	1
Chrysene	310		ug/kg	110	36.	1
Acenaphthylene	ND		ug/kg	150	34.	1
Anthracene	42	J	ug/kg	110	31.	1
Benzo(ghi)perylene	140	J	ug/kg	150	38.	1
Fluorene	ND		ug/kg	180	53.	1
Phenanthrene	520		ug/kg	110	36.	1
Dibenzo(a,h)anthracene	ND		ug/kg	110	36.	1
Indeno(1,2,3-cd)pyrene	130	J	ug/kg	150	41.	1
Pyrene	500		ug/kg	110	36.	1
2-Methylnaphthalene	200	J	ug/kg	220	59.	1

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**
Nitrobenzene-d5	60		23-120
2-Fluorobiphenyl	60		30-120
4-Terphenyl-d14	68		18-120

SAMPLE RESULTS

Lab ID:	L1320014-02	Date Collected:	10/03/13 10:30
Client ID:	SB-2 (6-8)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 14:32		
Analyst:	RC		
Percent Solids:	91%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	140	37.	1
2-Chloronaphthalene	ND		ug/kg	180	59.	1
Fluoranthene	ND		ug/kg	110	33.	1
Naphthalene	ND		ug/kg	180	60.	1
Benzo(a)anthracene	ND		ug/kg	110	36.	1
Benzo(a)pyrene	ND		ug/kg	140	44.	1
Benzo(b)fluoranthene	ND		ug/kg	110	37.	1
Benzo(k)fluoranthene	ND		ug/kg	110	35.	1
Chrysene	ND		ug/kg	110	36.	1
Acenaphthylene	ND		ug/kg	140	34.	1
Anthracene	ND		ug/kg	110	30.	1
Benzo(ghi)perylene	ND		ug/kg	140	38.	1
Fluorene	ND		ug/kg	180	52.	1
Phenanthrene	ND		ug/kg	110	36.	1
Dibenzo(a,h)anthracene	ND		ug/kg	110	35.	1
Indeno(1,2,3-cd)pyrene	ND		ug/kg	140	40.	1
Pyrene	ND		ug/kg	110	35.	1
2-Methylnaphthalene	ND		ug/kg	220	58.	1

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**
Nitrobenzene-d5	64		23-120
2-Fluorobiphenyl	61		30-120
4-Terphenyl-d14	63		18-120

SAMPLE RESULTS

Lab ID:	L1320014-03 D	Date Collected:	10/04/13 12:45
Client ID:	TP-1 (1-6)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 16:23		
Analyst:	RC		
Percent Solids:	81%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	350		ug/kg	320	83.	2
2-Chloronaphthalene	ND		ug/kg	400	130	2
Fluoranthene	6800		ug/kg	240	74.	2
Naphthalene	160	J	ug/kg	400	130	2
Benzo(a)anthracene	3300		ug/kg	240	79.	2
Benzo(a)pyrene	2900		ug/kg	320	99.	2
Benzo(b)fluoranthene	3800		ug/kg	240	82.	2
Benzo(k)fluoranthene	1400		ug/kg	240	77.	2
Chrysene	3200		ug/kg	240	79.	2
Acenaphthylene	140	J	ug/kg	320	75.	2
Anthracene	960		ug/kg	240	67.	2
Benzo(ghi)perylene	1800		ug/kg	320	84.	2
Fluorene	400		ug/kg	400	120	2
Phenanthrene	4000		ug/kg	240	79.	2
Dibenzo(a,h)anthracene	490		ug/kg	240	78.	2
Indeno(1,2,3-cd)pyrene	1900		ug/kg	320	90.	2
Pyrene	5600		ug/kg	240	78.	2
2-Methylnaphthalene	ND		ug/kg	480	130	2

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	77		23-120
2-Fluorobiphenyl	80		30-120
4-Terphenyl-d14	80		18-120

SAMPLE RESULTS

Lab ID:	L1320014-04 D	Date Collected:	10/04/13 13:05
Client ID:	TP-3 (1-4.5)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 16:51		
Analyst:	RC		
Percent Solids:	74%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	1400		ug/kg	880	230	5
2-Chloronaphthalene	ND		ug/kg	1100	360	5
Fluoranthene	12000		ug/kg	660	200	5
Naphthalene	1900		ug/kg	1100	360	5
Benzo(a)anthracene	5900		ug/kg	660	220	5
Benzo(a)pyrene	5100		ug/kg	880	270	5
Benzo(b)fluoranthene	6300		ug/kg	660	220	5
Benzo(k)fluoranthene	2500		ug/kg	660	210	5
Chrysene	5700		ug/kg	660	220	5
Acenaphthylene	310	J	ug/kg	880	210	5
Anthracene	3100		ug/kg	660	180	5
Benzo(ghi)perylene	3100		ug/kg	880	230	5
Fluorene	1400		ug/kg	1100	320	5
Phenanthrene	11000		ug/kg	660	220	5
Dibenzo(a,h)anthracene	820		ug/kg	660	210	5
Indeno(1,2,3-cd)pyrene	3200		ug/kg	880	240	5
Pyrene	10000		ug/kg	660	210	5
2-Methylnaphthalene	690	J	ug/kg	1300	350	5

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	74		23-120
2-Fluorobiphenyl	71		30-120
4-Terphenyl-d14	72		18-120

SAMPLE RESULTS

Lab ID:	L1320014-05 D	Date Collected:	10/04/13 13:40
Client ID:	TP-5 (1-3)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 17:19		
Analyst:	RC		
Percent Solids:	87%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	2200		ug/kg	1800	460	12
2-Chloronaphthalene	ND		ug/kg	2200	730	12
Fluoranthene	68000		ug/kg	1300	410	12
Naphthalene	920	J	ug/kg	2200	740	12
Benzo(a)anthracene	31000		ug/kg	1300	440	12
Benzo(a)pyrene	30000		ug/kg	1800	550	12
Benzo(b)fluoranthene	38000		ug/kg	1300	450	12
Benzo(k)fluoranthene	14000		ug/kg	1300	430	12
Chrysene	31000		ug/kg	1300	440	12
Acenaphthylene	2200		ug/kg	1800	420	12
Anthracene	9800		ug/kg	1300	370	12
Benzo(ghi)perylene	18000		ug/kg	1800	470	12
Fluorene	2800		ug/kg	2200	640	12
Phenanthrene	29000		ug/kg	1300	440	12
Dibenzo(a,h)anthracene	5000		ug/kg	1300	430	12
Indeno(1,2,3-cd)pyrene	19000		ug/kg	1800	500	12
Pyrene	56000		ug/kg	1300	440	12
2-Methylnaphthalene	ND		ug/kg	2700	720	12

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	82		23-120
2-Fluorobiphenyl	78		30-120
4-Terphenyl-d14	82		18-120

SAMPLE RESULTS

Lab ID:	L1320014-06	Date Collected:	10/04/13 14:25
Client ID:	TP-7 (1-3)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 15:00		
Analyst:	RC		
Percent Solids:	88%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	52	J	ug/kg	150	38.	1
2-Chloronaphthalene	ND		ug/kg	180	60.	1
Fluoranthene	930		ug/kg	110	34.	1
Naphthalene	ND		ug/kg	180	62.	1
Benzo(a)anthracene	470		ug/kg	110	36.	1
Benzo(a)pyrene	410		ug/kg	150	45.	1
Benzo(b)fluoranthene	530		ug/kg	110	37.	1
Benzo(k)fluoranthene	230		ug/kg	110	35.	1
Chrysene	470		ug/kg	110	36.	1
Acenaphthylene	ND		ug/kg	150	35.	1
Anthracene	200		ug/kg	110	31.	1
Benzo(ghi)perylene	220		ug/kg	150	38.	1
Fluorene	61	J	ug/kg	180	53.	1
Phenanthrene	650		ug/kg	110	36.	1
Dibenzo(a,h)anthracene	69	J	ug/kg	110	36.	1
Indeno(1,2,3-cd)pyrene	240		ug/kg	150	41.	1
Pyrene	750		ug/kg	110	36.	1
2-Methylnaphthalene	ND		ug/kg	220	59.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	48		23-120
2-Fluorobiphenyl	52		30-120
4-Terphenyl-d14	62		18-120

SAMPLE RESULTS

Lab ID:	L1320014-07	Date Collected:	10/04/13 13:15
Client ID:	TP-4 (1-2)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 15:28		
Analyst:	RC		
Percent Solids:	89%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	150	38.	1
2-Chloronaphthalene	ND		ug/kg	180	60.	1
Fluoranthene	180		ug/kg	110	34.	1
Naphthalene	ND		ug/kg	180	62.	1
Benzo(a)anthracene	100	J	ug/kg	110	36.	1
Benzo(a)pyrene	87	J	ug/kg	150	45.	1
Benzo(b)fluoranthene	120		ug/kg	110	37.	1
Benzo(k)fluoranthene	50	J	ug/kg	110	35.	1
Chrysene	120		ug/kg	110	36.	1
Acenaphthylene	ND		ug/kg	150	35.	1
Anthracene	ND		ug/kg	110	31.	1
Benzo(ghi)perylene	61	J	ug/kg	150	38.	1
Fluorene	ND		ug/kg	180	53.	1
Phenanthrene	94	J	ug/kg	110	36.	1
Dibenzo(a,h)anthracene	ND		ug/kg	110	36.	1
Indeno(1,2,3-cd)pyrene	59	J	ug/kg	150	41.	1
Pyrene	160		ug/kg	110	36.	1
2-Methylnaphthalene	ND		ug/kg	220	59.	1

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**
Nitrobenzene-d5	50		23-120
2-Fluorobiphenyl	51		30-120
4-Terphenyl-d14	62		18-120

SAMPLE RESULTS

Lab ID:	L1320014-08	Date Collected:	10/04/13 14:00
Client ID:	TP-6 (2-4)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	10/09/13 01:24
Analytical Date:	10/12/13 15:56		
Analyst:	RC		
Percent Solids:	87%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	150	38.	1
2-Chloronaphthalene	ND		ug/kg	190	61.	1
Fluoranthene	270		ug/kg	110	34.	1
Naphthalene	ND		ug/kg	190	62.	1
Benzo(a)anthracene	140		ug/kg	110	37.	1
Benzo(a)pyrene	120	J	ug/kg	150	46.	1
Benzo(b)fluoranthene	160		ug/kg	110	38.	1
Benzo(k)fluoranthene	60	J	ug/kg	110	36.	1
Chrysene	150		ug/kg	110	37.	1
Acenaphthylene	ND		ug/kg	150	35.	1
Anthracene	46	J	ug/kg	110	31.	1
Benzo(ghi)perylene	77	J	ug/kg	150	39.	1
Fluorene	ND		ug/kg	190	54.	1
Phenanthrene	170		ug/kg	110	36.	1
Dibenzo(a,h)anthracene	ND		ug/kg	110	36.	1
Indeno(1,2,3-cd)pyrene	82	J	ug/kg	150	42.	1
Pyrene	230		ug/kg	110	36.	1
2-Methylnaphthalene	ND		ug/kg	220	60.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	55		23-120
2-Fluorobiphenyl	58		30-120
4-Terphenyl-d14	65		18-120

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

Method Blank Analysis
Batch Quality Control

Analytical Method:	1,8270D	Extraction Method:	EPA 3546
Analytical Date:	10/09/13 10:55	Extraction Date:	10/09/13 01:24
Analyst:	RC		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-08 Batch: WG642328-1					
Acenaphthene	ND		ug/kg	130	34.
Hexachlorobenzene	ND		ug/kg	99	31.
Bis(2-chloroethyl)ether	ND		ug/kg	150	46.
2-Chloronaphthalene	ND		ug/kg	160	54.
3,3'-Dichlorobenzidine	ND		ug/kg	160	44.
2,4-Dinitrotoluene	ND		ug/kg	160	36.
2,6-Dinitrotoluene	ND		ug/kg	160	42.
Fluoranthene	ND		ug/kg	99	30.
4-Chlorophenyl phenyl ether	ND		ug/kg	160	50.
4-Bromophenyl phenyl ether	ND		ug/kg	160	38.
Bis(2-chloroisopropyl)ether	ND		ug/kg	200	58.
Bis(2-chloroethoxy)methane	ND		ug/kg	180	50.
Hexachlorobutadiene	ND		ug/kg	160	47.
Hexachlorocyclopentadiene	ND		ug/kg	470	110
Hexachloroethane	ND		ug/kg	130	30.
Isophorone	ND		ug/kg	150	44.
Naphthalene	ND		ug/kg	160	55.
Nitrobenzene	ND		ug/kg	150	39.
NDPA/DPA	ND		ug/kg	130	35.
n-Nitrosodi-n-propylamine	ND		ug/kg	160	49.
Bis(2-ethylhexyl)phthalate	ND		ug/kg	160	43.
Butyl benzyl phthalate	ND		ug/kg	160	32.
Di-n-butylphthalate	ND		ug/kg	160	32.
Di-n-octylphthalate	ND		ug/kg	160	41.
Diethyl phthalate	ND		ug/kg	160	35.
Dimethyl phthalate	ND		ug/kg	160	42.
Benzo(a)anthracene	ND		ug/kg	99	32.
Benzo(a)pyrene	ND		ug/kg	130	40.
Benzo(b)fluoranthene	ND		ug/kg	99	33.
Benzo(k)fluoranthene	ND		ug/kg	99	32.
Chrysene	ND		ug/kg	99	32.

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 10/09/13 10:55
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 10/09/13 01:24

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-08 Batch: WG642328-1					
Acenaphthylene	ND		ug/kg	130	31.
Anthracene	ND		ug/kg	99	28.
Benzo(ghi)perylene	ND		ug/kg	130	34.
Fluorene	ND		ug/kg	160	47.
Phenanthrene	ND		ug/kg	99	32.
Dibenzo(a,h)anthracene	ND		ug/kg	99	32.
Indeno(1,2,3-cd)pyrene	ND		ug/kg	130	37.
Pyrene	ND		ug/kg	99	32.
Biphenyl	ND		ug/kg	380	54.
4-Chloroaniline	ND		ug/kg	160	44.
2-Nitroaniline	ND		ug/kg	160	47.
3-Nitroaniline	ND		ug/kg	160	46.
4-Nitroaniline	ND		ug/kg	160	45.
Dibenzofuran	ND		ug/kg	160	55.
2-Methylnaphthalene	ND		ug/kg	200	53.
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	160	51.
Acetophenone	ND		ug/kg	160	51.
2,4,6-Trichlorophenol	ND		ug/kg	99	31.
p-Chloro-m-cresol	ND		ug/kg	160	48.
2-Chlorophenol	ND		ug/kg	160	50.
2,4-Dichlorophenol	ND		ug/kg	150	54.
2,4-Dimethylphenol	ND		ug/kg	160	49.
2-Nitrophenol	ND		ug/kg	360	52.
4-Nitrophenol	ND		ug/kg	230	54.
2,4-Dinitrophenol	ND		ug/kg	790	230
4,6-Dinitro-o-cresol	ND		ug/kg	430	60.
Pentachlorophenol	ND		ug/kg	130	35.
Phenol	ND		ug/kg	160	49.
2-Methylphenol	ND		ug/kg	160	53.
3-Methylphenol/4-Methylphenol	ND		ug/kg	240	54.
2,4,5-Trichlorophenol	ND		ug/kg	160	54.

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 10/09/13 10:55
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 10/09/13 01:24

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-08 Batch: WG642328-1					
Carbazole	ND		ug/kg	160	36.

Surrogate	%Recovery	Qualifier	Acceptance Criteria
2-Fluorophenol	91		25-120
Phenol-d6	84		10-120
Nitrobenzene-d5	77		23-120
2-Fluorobiphenyl	90		30-120
2,4,6-Tribromophenol	117		0-136
4-Terphenyl-d14	115		18-120

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.

Project Number: 0271-013-001

Lab Number: L1320014

Report Date: 10/16/13

Parameter	***LCS %Recovery***	***Qual***	***LCSD %Recovery***	***Qual***	***%Recovery Limits***	***RPD***	***Qual***	***RPD Limits***
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-08 Batch: WG642328-2 WG642328-3								
Acenaphthene	95		112		31-137	16		50
1,2,4-Trichlorobenzene	80		102		38-107	24		50
Hexachlorobenzene	104		118		40-140	13		50
Bis(2-chloroethyl)ether	78		99		40-140	24		50
2-Chloronaphthalene	91		112		40-140	21		50
1,2-Dichlorobenzene	77		104		40-140	30		50
1,3-Dichlorobenzene	76		94		40-140	21		50
1,4-Dichlorobenzene	78		99		28-104	24		50
3,3'-Dichlorobenzidine	52		56		40-140	7		50
2,4-Dinitrotoluene	**104**	Q	**114**	Q	28-89	9		50
2,6-Dinitrotoluene	97		116		40-140	18		50
Fluoranthene	105		124		40-140	17		50
4-Chlorophenyl phenyl ether	98		115		40-140	16		50
4-Bromophenyl phenyl ether	115		119		40-140	3		50
Bis(2-chloroisopropyl)ether	76		95		40-140	22		50
Bis(2-chloroethoxy)methane	82		97		40-117	17		50
Hexachlorobutadiene	77		108		40-140	34		50
Hexachlorocyclopentadiene	57		74		40-140	26		50
Hexachloroethane	74		101		40-140	31		50
Isophorone	89		104		40-140	16		50
Naphthalene	81		106		40-140	27		50

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.

Project Number: 0271-013-001

Lab Number: L1320014

Report Date: 10/16/13

Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-08 Batch: WG642328-2 WG642328-3

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Nitrobenzene	76		99		40-140	26		50
NDPA/DPA	111		124			11		50
n-Nitrosodi-n-propylamine	85		96		32-121	12		50
Bis(2-ethylhexyl)phthalate	107		123		40-140	14		50
Butyl benzyl phthalate	108		126		40-140	15		50
Di-n-butylphthalate	108		124		40-140	14		50
Di-n-octylphthalate	108		122		40-140	12		50
Diethyl phthalate	107		117		40-140	9		50
Dimethyl phthalate	100		110		40-140	10		50
Benzo(a)anthracene	101		114		40-140	12		50
Benzo(a)pyrene	102		116		40-140	13		50
Benzo(b)fluoranthene	102		123		40-140	19		50
Benzo(k)fluoranthene	100		113		40-140	12		50
Chrysene	101		118		40-140	16		50
Acenaphthylene	95		114		40-140	18		50
Anthracene	105		119		40-140	13		50
Benzo(ghi)perylene	97		108		40-140	11		50
Fluorene	102		110		40-140	8		50
Phenanthrene	102		115		40-140	12		50
Dibenzo(a,h)anthracene	99		112		40-140	12		50
Indeno(1,2,3-cd)pyrene	98		113		40-140	14		50

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.

Project Number: 0271-013-001

Lab Number: L1320014

Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-08 Batch: WG642328-2 WG642328-3								
Pyrene	105		117		35-142	11		50
Biphenyl	98		117			18		50
4-Chloroaniline	52		61		40-140	16		50
2-Nitroaniline	103		118		47-134	14		50
3-Nitroaniline	71		72		26-129	1		50
4-Nitroaniline	97		112		41-125	14		50
Dibenzofuran	101		117		40-140	15		50
2-Methylnaphthalene	85		104		40-140	20		50
1,2,4,5-Tetrachlorobenzene	98		**122**	Q	40-117	22		50
Acetophenone	89		104		14-144	16		50
2,4,6-Trichlorophenol	100		119		30-130	17		50
p-Chloro-m-cresol	98		**118**	Q	26-103	19		50
2-Chlorophenol	89		**104**	Q	25-102	16		50
2,4-Dichlorophenol	92		116		30-130	23		50
2,4-Dimethylphenol	97		112		30-130	14		50
2-Nitrophenol	86		106		30-130	21		50
4-Nitrophenol	99		114		11-114	14		50
2,4-Dinitrophenol	83		90		4-130	8		50
4,6-Dinitro-o-cresol	100		108		10-130	8		50
Pentachlorophenol	89		101		17-109	13		50
Phenol	**92**	Q	**112**	Q	26-90	20		50

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.

Project Number: 0271-013-001

Lab Number: L1320014

Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-08 Batch: WG642328-2 WG642328-3								
2-Methylphenol	96		110		30-130.	14		50
3-Methylphenol/4-Methylphenol	101		112		30-130	10		50
2,4,5-Trichlorophenol	103		127		30-130	21		50
Benzoic Acid	84		110			27		50
Benzyl Alcohol	86		103		40-140	18		50
Carbazole	108		120		54-128	11		50

Surrogate	*LCS %Recovery*	*Qual*	*LCSD %Recovery*	*Qual*	*Acceptance Criteria*
2-Fluorophenol	86		107		25-120
Phenol-d6	94		109		10-120
Nitrobenzene-d5	89		101		23-120
2-Fluorobiphenyl	89		110		30-120
2,4,6-Tribromophenol	120		**140**	Q	0-136
4-Terphenyl-d14	113		**127**	Q	18-120

PCBS

SAMPLE RESULTS

Lab ID:	L1320014-03	Date Collected:	10/04/13 12:45
Client ID:	TP-1 (1-6)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8082A	Extraction Date:	10/09/13 12:55
Analytical Date:	10/11/13 00:09	Cleanup Method1:	EPA 3665A
Analyst:	JW	Cleanup Date1:	10/09/13
Percent Solids:	81%	Cleanup Method2:	EPA 3660B
		Cleanup Date2:	10/09/13

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**	**Column**
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	40.2	7.93	1	A
Aroclor 1221	ND		ug/kg	40.2	12.1	1	A
Aroclor 1232	ND		ug/kg	40.2	8.53	1	A
Aroclor 1242	ND		ug/kg	40.2	7.62	1	A
Aroclor 1248	ND		ug/kg	40.2	4.86	1	A
Aroclor 1254	ND		ug/kg	40.2	6.33	1	A
Aroclor 1260	ND		ug/kg	40.2	6.97	1	A
Aroclor 1262	ND		ug/kg	40.2	2.97	1	A
Aroclor 1268	ND		ug/kg	40.2	5.83	1	A

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**	**Column**
2,4,5,6-Tetrachloro-m-xylene	90		30-150	A
Decachlorobiphenyl	106		30-150	A
2,4,5,6-Tetrachloro-m-xylene	85		30-150	B
Decachlorobiphenyl	109		30-150	B

SAMPLE RESULTS

Lab ID:	L1320014-04	Date Collected:	10/04/13 13:05
Client ID:	TP-3 (1-4.5)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8082A	Extraction Date:	10/09/13 12:55
Analytical Date:	10/11/13 00:22	Cleanup Method1:	EPA 3665A
Analyst:	JW	Cleanup Date1:	10/09/13
Percent Solids:	74%	Cleanup Method2:	EPA 3660B
		Cleanup Date2:	10/09/13

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	43.6	8.62	1	A
Aroclor 1221	ND		ug/kg	43.6	13.2	1	A
Aroclor 1232	ND		ug/kg	43.6	9.27	1	A
Aroclor 1242	ND		ug/kg	43.6	8.28	1	A
Aroclor 1248	ND		ug/kg	43.6	5.28	1	A
Aroclor 1254	ND		ug/kg	43.6	6.88	1	A
Aroclor 1260	ND		ug/kg	43.6	7.58	1	A
Aroclor 1262	ND		ug/kg	43.6	3.23	1	A
Aroclor 1268	ND		ug/kg	43.6	6.33	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	71		30-150	A
Decachlorobiphenyl	83		30-150	A
2,4,5,6-Tetrachloro-m-xylene	67		30-150	B
Decachlorobiphenyl	90		30-150	B

SAMPLE RESULTS

Lab ID:	L1320014-05	Date Collected:	10/04/13 13:40
Client ID:	TP-5 (1-3)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8082A	Extraction Date:	10/09/13 12:55
Analytical Date:	10/11/13 00:35	Cleanup Method1:	EPA 3665A
Analyst:	JW	Cleanup Date1:	10/09/13
Percent Solids:	87%	Cleanup Method2:	EPA 3660B
		Cleanup Date2:	10/09/13

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	36.8	7.27	1	A
Aroclor 1221	ND		ug/kg	36.8	11.1	1	A
Aroclor 1232	ND		ug/kg	36.8	7.82	1	A
Aroclor 1242	ND		ug/kg	36.8	6.99	1	A
Aroclor 1248	ND		ug/kg	36.8	4.46	1	A
Aroclor 1254	ND		ug/kg	36.8	5.81	1	A
Aroclor 1260	28.4	J	ug/kg	36.8	6.39	1	B
Aroclor 1262	ND		ug/kg	36.8	2.72	1	A
Aroclor 1268	ND		ug/kg	36.8	5.34	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	69		30-150	A
Decachlorobiphenyl	70		30-150	A
2,4,5,6-Tetrachloro-m-xylene	65		30-150	B
Decachlorobiphenyl	84		30-150	B

SAMPLE RESULTS

Lab ID:	L1320014-06	Date Collected:	10/04/13 14:25
Client ID:	TP-7 (1-3)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8082A	Extraction Date:	10/09/13 12:55
Analytical Date:	10/11/13 00:49	Cleanup Method1:	EPA 3665A
Analyst:	JW	Cleanup Date1:	10/09/13
Percent Solids:	88%	Cleanup Method2:	EPA 3660B
		Cleanup Date2:	10/09/13

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**	**Column**
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	36.0	7.12	1	A
Aroclor 1221	ND		ug/kg	36.0	10.9	1	A
Aroclor 1232	ND		ug/kg	36.0	7.65	1	A
Aroclor 1242	ND		ug/kg	36.0	6.84	1	A
Aroclor 1248	ND		ug/kg	36.0	4.36	1	A
Aroclor 1254	ND		ug/kg	36.0	5.68	1	A
Aroclor 1260	ND		ug/kg	36.0	6.25	1	A
Aroclor 1262	ND		ug/kg	36.0	2.66	1	A
Aroclor 1268	ND		ug/kg	36.0	5.23	1	A

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**	**Column**
2,4,5,6-Tetrachloro-m-xylene	73		30-150	A
Decachlorobiphenyl	84		30-150	A
2,4,5,6-Tetrachloro-m-xylene	68		30-150	B
Decachlorobiphenyl	94		30-150	B

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

Method Blank Analysis
Batch Quality Control

Analytical Method:	1,8082A	Extraction Method:	EPA 3546
Analytical Date:	10/11/13 20:48	Extraction Date:	10/09/13 12:55
Analyst:	JW	Cleanup Method1:	EPA 3665A
		Cleanup Date1:	10/09/13
		Cleanup Method2:	EPA 3660B
		Cleanup Date2:	10/09/13

Parameter	Result	Qualifier	Units	RL	MDL	Column
Polychlorinated Biphenyls by GC - Westborough Lab for sample(s): 03-06 Batch: WG642502-1						
Aroclor 1016	ND		ug/kg	31.9	6.31	A
Aroclor 1221	ND		ug/kg	31.9	9.64	A
Aroclor 1232	ND		ug/kg	31.9	6.79	A
Aroclor 1242	ND		ug/kg	31.9	6.06	A
Aroclor 1248	ND		ug/kg	31.9	3.86	A
Aroclor 1254	ND		ug/kg	31.9	5.04	A
Aroclor 1260	ND		ug/kg	31.9	5.54	A
Aroclor 1262	ND		ug/kg	31.9	2.36	A
Aroclor 1268	ND		ug/kg	31.9	4.63	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	98		30-150	A
Decachlorobiphenyl	95		30-150	A
2,4,5,6-Tetrachloro-m-xylene	82		30-150	B
Decachlorobiphenyl	89		30-150	B

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.

Project Number: 0271-013-001

Lab Number: L1320014

Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Polychlorinated Biphenyls by GC - Westborough Lab Associated sample(s): 03-06 Batch: WG642502-2 WG642502-3									
Aroclor 1016	86		78		40-140	10		50	A
Aroclor 1260	75		73		40-140	3		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	90		88		30-150	A
Decachlorobiphenyl	85		81		30-150	A
2,4,5,6-Tetrachloro-m-xylene	84		88		30-150	B
Decachlorobiphenyl	74		74		30-150	B

METALS

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

SAMPLE RESULTS

Lab ID:	L1320014-01	Date Collected:	10/03/13 10:00
Client ID:	SB-1 (0-2)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	88%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	7.2		mg/kg	0.44	0.09	1	10/09/13 15:30	10/10/13 18:56	EPA 3050B	1,6010C	MG
Barium, Total	64		mg/kg	0.44	0.13	1	10/09/13 15:30	10/10/13 18:56	EPA 3050B	1,6010C	MG
Cadmium, Total	0.72		mg/kg	0.44	0.03	1	10/09/13 15:30	10/10/13 18:56	EPA 3050B	1,6010C	MG
Chromium, Total	7.6		mg/kg	0.44	0.09	1	10/09/13 15:30	10/10/13 18:56	EPA 3050B	1,6010C	MG
Lead, Total	100		mg/kg	2.2	0.09	1	10/09/13 15:30	10/10/13 18:56	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	0.08	0.02	1	10/09/13 17:04	10/10/13 13:41	EPA 7471B	1,7471B	BC
Selenium, Total	ND		mg/kg	0.88	0.13	1	10/09/13 15:30	10/10/13 18:56	EPA 3050B	1,6010C	MG
Silver, Total	0.12	J	mg/kg	0.44	0.09	1	10/09/13 15:30	10/10/13 18:56	EPA 3050B	1,6010C	MG

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

SAMPLE RESULTS

Lab ID:	L1320014-02	Date Collected:	10/03/13 10:30
Client ID:	SB-2 (6-8)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	91%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	1.1		mg/kg	0.42	0.08	1	10/09/13 15:30	10/10/13 19:00	EPA 3050B	1,6010C	MG
Barium, Total	12		mg/kg	0.42	0.13	1	10/09/13 15:30	10/10/13 19:00	EPA 3050B	1,6010C	MG
Cadmium, Total	0.92		mg/kg	0.42	0.03	1	10/09/13 15:30	10/10/13 19:00	EPA 3050B	1,6010C	MG
Chromium, Total	3.0		mg/kg	0.42	0.08	1	10/09/13 15:30	10/10/13 19:00	EPA 3050B	1,6010C	MG
Lead, Total	23		mg/kg	2.1	0.08	1	10/09/13 15:30	10/10/13 19:00	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	0.07	0.02	1	10/11/13 08:10	10/11/13 11:59	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.84	0.13	1	10/09/13 15:30	10/10/13 19:00	EPA 3050B	1,6010C	MG
Silver, Total	ND		mg/kg	0.42	0.08	1	10/09/13 15:30	10/10/13 19:00	EPA 3050B	1,6010C	MG

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

SAMPLE RESULTS

Lab ID:	L1320014-03	Date Collected:	10/04/13 12:45
Client ID:	TP-1 (1-6)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	81%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	9.6		mg/kg	0.49	0.10	1	10/09/13 15:30	10/10/13 19:03	EPA 3050B	1,6010C	MG
Barium, Total	950		mg/kg	0.49	0.15	1	10/09/13 15:30	10/10/13 19:03	EPA 3050B	1,6010C	MG
Cadmium, Total	2.1		mg/kg	0.49	0.03	1	10/09/13 15:30	10/10/13 19:03	EPA 3050B	1,6010C	MG
Chromium, Total	27		mg/kg	0.49	0.10	1	10/09/13 15:30	10/10/13 19:03	EPA 3050B	1,6010C	MG
Lead, Total	2700		mg/kg	2.5	0.10	1	10/09/13 15:30	10/10/13 19:03	EPA 3050B	1,6010C	MG
Mercury, Total	0.05	J	mg/kg	0.09	0.02	1	10/11/13 08:10	10/11/13 12:01	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.98	0.15	1	10/09/13 15:30	10/10/13 19:03	EPA 3050B	1,6010C	MG
Silver, Total	0.20	J	mg/kg	0.49	0.10	1	10/09/13 15:30	10/10/13 19:03	EPA 3050B	1,6010C	MG

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

SAMPLE RESULTS

Lab ID:	L1320014-04	Date Collected:	10/04/13 13:05
Client ID:	TP-3 (1-4.5)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	74%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	8.9		mg/kg	0.51	0.10	1	10/09/13 15:30	10/10/13 19:22	EPA 3050B	1,6010C	MG
Barium, Total	1000		mg/kg	0.51	0.15	1	10/09/13 15:30	10/10/13 19:22	EPA 3050B	1,6010C	MG
Cadmium, Total	2.1		mg/kg	0.51	0.04	1	10/09/13 15:30	10/10/13 19:22	EPA 3050B	1,6010C	MG
Chromium, Total	19		mg/kg	0.51	0.10	1	10/09/13 15:30	10/10/13 19:22	EPA 3050B	1,6010C	MG
Lead, Total	6200		mg/kg	2.6	0.10	1	10/09/13 15:30	10/10/13 19:22	EPA 3050B	1,6010C	MG
Mercury, Total	0.03	J	mg/kg	0.09	0.02	1	10/11/13 08:10	10/11/13 12:03	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	1.0	0.15	1	10/09/13 15:30	10/10/13 19:22	EPA 3050B	1,6010C	MG
Silver, Total	0.24	J	mg/kg	0.51	0.10	1	10/09/13 15:30	10/10/13 19:22	EPA 3050B	1,6010C	MG

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

SAMPLE RESULTS

Lab ID:	L1320014-05	Date Collected:	10/04/13 13:40
Client ID:	TP-5 (1-3)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	87%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	6.0		mg/kg	0.45	0.09	1	10/09/13 15:30	10/10/13 19:26	EPA 3050B	1,6010C	MG
Barium, Total	970		mg/kg	0.45	0.13	1	10/09/13 15:30	10/10/13 19:26	EPA 3050B	1,6010C	MG
Cadmium, Total	1.8		mg/kg	0.45	0.03	1	10/09/13 15:30	10/10/13 19:26	EPA 3050B	1,6010C	MG
Chromium, Total	8.9		mg/kg	0.45	0.09	1	10/09/13 15:30	10/10/13 19:26	EPA 3050B	1,6010C	MG
Lead, Total	2100		mg/kg	2.2	0.09	1	10/09/13 15:30	10/10/13 19:26	EPA 3050B	1,6010C	MG
Mercury, Total	0.17		mg/kg	0.10	0.02	1	10/11/13 08:10	10/11/13 12:05	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.90	0.13	1	10/09/13 15:30	10/10/13 19:26	EPA 3050B	1,6010C	MG
Silver, Total	0.22	J	mg/kg	0.45	0.09	1	10/09/13 15:30	10/10/13 19:26	EPA 3050B	1,6010C	MG

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

SAMPLE RESULTS

Lab ID:	L1320014-06	Date Collected:	10/04/13 14:25
Client ID:	TP-7 (1-3)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	88%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	6.3		mg/kg	0.44	0.09	1	10/09/13 15:30	10/10/13 19:30	EPA 3050B	1,6010C	MG
Barium, Total	59		mg/kg	0.44	0.13	1	10/09/13 15:30	10/10/13 19:30	EPA 3050B	1,6010C	MG
Cadmium, Total	0.78		mg/kg	0.44	0.03	1	10/09/13 15:30	10/10/13 19:30	EPA 3050B	1,6010C	MG
Chromium, Total	9.6		mg/kg	0.44	0.09	1	10/09/13 15:30	10/10/13 19:30	EPA 3050B	1,6010C	MG
Lead, Total	130		mg/kg	2.2	0.09	1	10/09/13 15:30	10/10/13 19:30	EPA 3050B	1,6010C	MG
Mercury, Total	0.09		mg/kg	0.08	0.02	1	10/11/13 08:10	10/11/13 12:06	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.88	0.13	1	10/09/13 15:30	10/10/13 19:30	EPA 3050B	1,6010C	MG
Silver, Total	ND		mg/kg	0.44	0.09	1	10/09/13 15:30	10/10/13 19:30	EPA 3050B	1,6010C	MG

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01 Batch: WG642445-1										
Mercury, Total	ND		mg/kg	0.08	0.02	1	10/09/13 17:04	10/10/13 12:52	1,7471B	BC

Prep Information

Digestion Method: EPA 7471B

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01-06 Batch: WG642577-1										
Arsenic, Total	ND		mg/kg	0.40	0.08	1	10/09/13 15:30	10/10/13 16:16	1,6010C	MG
Barium, Total	ND		mg/kg	0.40	0.12	1	10/09/13 15:30	10/10/13 16:16	1,6010C	MG
Cadmium, Total	ND		mg/kg	0.40	0.03	1	10/09/13 15:30	10/10/13 16:16	1,6010C	MG
Chromium, Total	ND		mg/kg	0.40	0.08	1	10/09/13 15:30	10/10/13 16:16	1,6010C	MG
Lead, Total	ND		mg/kg	2.0	0.08	1	10/09/13 15:30	10/10/13 16:16	1,6010C	MG
Selenium, Total	ND		mg/kg	0.80	0.12	1	10/09/13 15:30	10/10/13 16:16	1,6010C	MG
Silver, Total	ND		mg/kg	0.40	0.08	1	10/09/13 15:30	10/10/13 16:16	1,6010C	MG

Prep Information

Digestion Method: EPA 3050B

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 02-06 Batch: WG642855-1										
Mercury, Total	ND		mg/kg	0.08	0.02	1	10/11/13 08:10	10/11/13 11:37	1,7471B	MC

Prep Information

Digestion Method: EPA 7471B

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.
Lab Number: L1320014
Project Number: 0271-013-001
Report Date: 10/16/13

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01 Batch: WG642445-2 SRM Lot Number: 0518-10-02								
Mercury, Total	102		-		67-133	-		
Total Metals - Westborough Lab Associated sample(s): 01-06 Batch: WG642577-2 SRM Lot Number: 0518-10-02								
Arsenic, Total	100		-		81-119	-		
Barium, Total	96		-		83-118	-		
Cadmium, Total	94		-		82-117	-		
Chromium, Total	97		-		80-119	-		
Lead, Total	94		-		80-120	-		
Selenium, Total	98		-		80-120	-		
Silver, Total	98		-		66-134	-		
Total Metals - Westborough Lab Associated sample(s): 02-06 Batch: WG642855-2 SRM Lot Number: 0518-10-02								
Mercury, Total	111		-		67-133	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.
Project Number: 0271-013-001
Lab Number: L1320014
Report Date: 10/16/13

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01 QC Batch ID: WG642445-4 QC Sample: L1319878-15 Client ID: MS Sample												
Mercury, Total	ND	0.167	0.15	90		-	-		70-130	-		35
Total Metals - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG642577-4 QC Sample: L1319867-20 Client ID: MS Sample												
Arsenic, Total	1.7	10.3	12	100		-	-		75-125	-		35
Barium, Total	18.	171	200	106		-	-		75-125	-		35
Cadmium, Total	0.20J	4.36	4.7	108		-	-		75-125	-		35
Chromium, Total	8.3	17.1	28	115		-	-		75-125	-		35
Lead, Total	5.1	43.6	55	114		-	-		75-125	-		35
Selenium, Total	ND	10.3	9.9	96		-	-		75-125	-		35
Silver, Total	ND	25.7	24	93		-	-		75-125	-		35
Total Metals - Westborough Lab Associated sample(s): 02-06 QC Batch ID: WG642855-4 QC Sample: L1319867-20 Client ID: MS Sample												
Mercury, Total	ND	0.177	0.17	96		-	-		70-130	-		35

Lab Duplicate Analysis

Batch Quality Control

Project Name: 401, 402 + 430 BUFFALO AVE.

Project Number: 0271-013-001

Lab Number: L1320014

Report Date: 10/16/13

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01 QC Batch ID: WG642445-3 QC Sample: L1319878-15 Client ID: DUP Sample						
Mercury, Total	ND	ND	mg/kg	NC		35
Total Metals - Westborough Lab Associated sample(s): 01-06 QC Batch ID: WG642577-3 QC Sample: L1319867-20 Client ID: DUP Sample						
Arsenic, Total	1.7	2.1	mg/kg	21		35
Barium, Total	18.	34	mg/kg	**62**	Q	35
Cadmium, Total	0.20J	0.26J	mg/kg	NC		35
Chromium, Total	8.3	9.5	mg/kg	13		35
Lead, Total	5.1	11	mg/kg	**73**	Q	35
Selenium, Total	ND	ND	mg/kg	NC		35
Silver, Total	ND	ND	mg/kg	NC		35
Total Metals - Westborough Lab Associated sample(s): 02-06 QC Batch ID: WG642855-3 QC Sample: L1319867-20 Client ID: DUP Sample						
Mercury, Total	ND	ND	mg/kg	NC		35

INORGANICS
&
MISCELLANEOUS

Project Name:	401, 402 + 430 BUFFALO AVE.	**Lab Number:**	L1320014
Project Number:	0271-013-001	**Report Date:**	10/16/13

SAMPLE RESULTS

Lab ID:	L1320014-01	Date Collected:	10/03/13 10:00
Client ID:	SB-1 (0-2)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	87.9		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

SAMPLE RESULTS

Lab ID: L1320014-02
Client ID: SB-2 (6-8)
Sample Location: BUFFALO AVE. NIAGARA FALLS
Matrix: Soil

Date Collected: 10/03/13 10:30
Date Received: 10/07/13
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	91.0		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

SAMPLE RESULTS

Lab ID:	L1320014-03	Date Collected:	10/04/13 12:45
Client ID:	TP-1 (1-6)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	80.5		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

SAMPLE RESULTS

Lab ID:	L1320014-04	Date Collected:	10/04/13 13:05
Client ID:	TP-3 (1-4.5)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**	**Date Prepared**	**Date Analyzed**	**Analytical Method**	**Analyst**
General Chemistry - Westborough Lab										
Solids, Total	73.9		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

SAMPLE RESULTS

Lab ID: L1320014-05
Client ID: TP-5 (1-3)
Sample Location: BUFFALO AVE. NIAGARA FALLS
Matrix: Soil

Date Collected: 10/04/13 13:40
Date Received: 10/07/13
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	86.8		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

SAMPLE RESULTS

Lab ID: L1320014-06
Client ID: TP-7 (1-3)
Sample Location: BUFFALO AVE. NIAGARA FALLS
Matrix: Soil

Date Collected: 10/04/13 14:25
Date Received: 10/07/13
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	88.0		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

SAMPLE RESULTS

Lab ID:	L1320014-07	Date Collected:	10/04/13 13:15
Client ID:	TP-4 (1-2)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	88.5		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

SAMPLE RESULTS

Lab ID:	L1320014-08	Date Collected:	10/04/13 14:00
Client ID:	TP-6 (2-4)	Date Received:	10/07/13
Sample Location:	BUFFALO AVE. NIAGARA FALLS	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**	**Date Prepared**	**Date Analyzed**	**Analytical Method**	**Analyst**
General Chemistry - Westborough Lab										
Solids, Total	87.4		%	0.100	NA	1	-	10/08/13 22:55	30,2540G	RT

Project Name: 401, 402 + 430 BUFFALO AVE.
Project Number: 0271-013-001

Lab Duplicate Analysis
Batch Quality Control

Lab Number: L1320014
Report Date: 10/16/13

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-08 QC Batch ID: WG642300-1 QC Sample: L1319885-01 Client ID: DUP Sample						
Solids, Total	62.5	79.9	%	**24**	Q	20

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information **Cooler**	**Custody Seal**
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1320014-01A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8260(14)
L1320014-01B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1320014-01C	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1320014-02A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8260(14)
L1320014-02B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1320014-02C	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1320014-03A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-03B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-03C	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)

*Values in parentheses indicate holding time in days

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1320014-04A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-04B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-04C	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-05A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-05B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-05C	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-06A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-06B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-06C	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1320014-07A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),TS(7)
L1320014-07B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),TS(7)

*Values in parentheses indicate holding time in days

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1320014-08A	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),TS(7)
L1320014-08B	Amber 120ml unpreserved	A	N/A	3.6	Y	Absent	NYTCL-8270(14),TS(7)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NI	- Not Ignitable.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1	- The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A	- Spectra identified as "Aldol Condensation Product".
B	- The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit.
C	- Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
D	- Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
E	- Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
G	- The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.
H	- The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
I	- The lower value for the two columns has been reported due to obvious interference.

Report Format: DU Report with "J" Qualifiers

Data Qualifiers

M	- Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
NJ	- Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
P	- The RPD between the results for the two columns exceeds the method-specified criteria.
Q	- The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
S	- Analytical results are from modified screening analysis.
J	- Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
ND	- Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

Report Format: DU Report with "J" Qualifiers

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

LIMITATION OF LIABILITIES

Certificate/Approval Program Summary

Last revised October 1, 2013 - Westboro Facility

The following list includes only those analytes/methods for which certification/approval is currently held.
For a complete listing of analytes for the referenced methods, please contact your Alpha Customer Service Representative.

Connecticut Department of Public Health Certificate/Lab ID: PH-0574. ***NELAP Accredited Solid Waste/Soil.***

Drinking Water (Inorganic Parameters: Color, pH, Turbidity, Conductivity, Alkalinity, Chloride, Free Residual Chlorine, Fluoride, Calcium Hardness, Sulfate, Nitrate, Nitrite, Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Selenium, Silver, Sodium, Thallium, Zinc, Total Dissolved Solids, Total Organic Carbon, Total Cyanide, Perchlorate. Organic Parameters: Volatile Organics 524.2, Total Trihalomethanes 524.2, 1,2-Dibromo-3-chloropropane (DBCP) 504.1, Ethylene Dibromide (EDB) 504.1, 1,4-Dioxane (Mod 8270). Microbiology Parameters: Total Coliform-MF mEndo (SM9222B), Total Coliform – Colilert (SM9223, Enumeration and P/A), E. Coli. – Colilert (SM9223, Enumeration and P/A), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D), Fecal Coliform-EC Medium (SM 9221E).

Wastewater/Non-Potable Water (Inorganic Parameters: Color, pH, Conductivity, Acidity, Alkalinity, Chloride, Total Residual Chlorine, Fluoride, Total Hardness, Silica, Sulfate, Sulfide, Ammonia, Kjeldahl Nitrogen, Nitrate, Nitrite, O-Phosphate, Total Phosphorus, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Strontium, Thallium, Tin, Titanium, Vanadium, Zinc, Total Residue (Solids), Total Dissolved Solids, Total Suspended Solids (non-filterable), BOD, CBOD, COD, TOC, Total Cyanide, Phenolics, Foaming Agents (MBAS), Bromide, Oil and Grease. Organic Parameters: PCBs, Organochlorine Pesticides, Technical Chlordane, Toxaphene, Acid Extractables (Phenols), Benzidines, Phthalate Esters, Nitrosamines, Nitroaromatics & Isophorone, Polynuclear Aromatic Hydrocarbons, Haloethers, Chlorinated Hydrocarbons, Volatile Organics, TPH (HEM/SGT), CT-Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH. Microbiology Parameters: Total Coliform – MF mEndo (SM9222B), Total Coliform – MTF (SM9221B), E. Coli – Colilert (SM9223 Enumeration), HPC – Pour Plate (SM9215B), Fecal Coliform – MF m-FC (SM9222D), Fecal Coliform – A-1 Broth (SM9221E), Enterococcus - Enterolert.

Solid Waste/Soil (Inorganic Parameters: pH, Sulfide, Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Hexavalent Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Tin, Vanadium, Zinc, Total Cyanide, Ignitability, Phenolics, Corrosivity, TCLP Leach (1311), SPLP Leach (1312 metals only), Reactivity. Organic Parameters: PCBs, PCBs in Oil, Organochlorine Pesticides, Technical Chlordane, Toxaphene, CT-Extractable Petroleum Hydrocarbons (ETPH), MA-EPH, MA-VPH, Dicamba, 2,4-D, 2,4,5-T, 2,4,5-TP(Silvex), Dalapon, Volatile Organics (SW 8260), Acid Extractables (Phenols) (SW 8270), Benzidines (SW 8270), Phthalates (SW 8270), Nitrosamines (SW 8270), Nitroaromatics & Cyclic Ketones (SW 8270), PAHs (SW 8270), Haloethers (SW 8270), Chlorinated Hydrocarbons (SW 8270).)

State of Illinois Certificate/Lab ID: 003155. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM2120B, 2320B, 2510B, 2540C, SM4500CN-CE, 4500F-C, 4500H-B, 4500NO3-F, 5310C, EPA 200.7, 200.8, 245.1, 300.0. Organic Parameters: EPA 504.1, 524.2.)

Wastewater/Non-Potable Water (Inorganic Parameters: SM2120B, 2310B, 2320B, 2340B, 2510B, 2540B, 2540C, 2540D, SM4500CL-E, 4500CN-E, 4500F-C, 4500H-B, 4500NH3-H, 4500NO2-B, 4500NO3-F, 4500P-E, 4500S-D, 4500SO3-B, 5210B, 5220D, 5310C, 5540C, EPA 120.1, 1664A, 200.7, 200.8, 245.1, 300.0, 350.1, 351.1, 353.2, 410.4, 420.1. Organic Parameters: EPA 608, 624, 625.)

Hazardous and Solid Waste (Inorganic Parameters: EPA 1010A, 1030, 1311, 1312, 6010C, 6020A, 7196A, 7470A, 7471B, 9012B, 9014, 9038, 9040C, 9045D, 9050A, 9065, 9251. Organic Parameters: 8011 (NPW only), 8015C, 8081B, 8082A, 8151A, 8260C, 8270D, 8315A, 8330.)

Maine Department of Human Services Certificate/Lab ID: 2009024.
Drinking Water (Inorganic Parameters: SM9215B, 9222D, 9223B, EPA 180.1, 353.2, SM2120B, 2130B, 2320B, 2510C, 2540C, 4500Cl-D, 4500CN-C, 4500CN-E, 4500F-C, 4500H+B, 4500NO3-F, 5310C, EPA 200.7, EPA 200.8, 245.1, EPA 300.0. Organic Parameters: 504.1, 524.2.)

Wastewater/Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 300.0, 350.1, 351.1, 353.2, 410.4, 420.1, 8315A, 9010C, SM2120B, 2310B, 2320B, 2510B, 2540B, 2540C, 2540D, 426C, 4500Cl-E, 4500CN-C, 4500CN-E, 4500F-B, 4500F-C, 4500H+B, 4500Norg-C, 4500NH3-B, 4500NH3-H, 4500NO2-B, 4500NO3-F, 4500P-B, 4500P-E, 4500S2-D, 4500SO3-B, 5540C, 5210B, 5220D, 5310C, 9010B, 9030B, 9040C, 7470A, 7196A, 2340B, EPA 200.7, 6010C, 200.8, 6020A, 245.1, 1311, 1312, 3005A, Enterolert, 9223B, 9222D. Organic Parameters: 608, 624, 625, 8011, 8081B, 8082A, 8330, 8151A, 8260C, 8270D, 3510C, 3630C, 5030B, ME-DRO, ME-GRO, MA-EPH, MA-VPH.)

Solid Waste/Soil (Inorganic Parameters: 9010B, 9012A, 9014, 9040B, 9045C, 6010C, 6020A, 7471B, 7196A, 9050A, 1010, 1030, 9065, 1311, 1312, 3005A, 3050B, 9038, 9251. Organic Parameters: ME-DRO, ME-GRO, MA-EPH, MA-VPH, 8260C, 8270D, 8330, 8151A, 8081B, 8082A, 3540C, 3546, 3580A, 3620C, 3630C, 5030B, 5035.)

Massachusetts Department of Environmental Protection Certificate/Lab ID: M-MA086.
*Drinking Water (*Inorganic Parameters: (EPA 200.8 for: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl) (EPA 200.7 for: Ba,Be,Ca,Cd,Cr,Cu,Na,Ni) 245.1, (300.0 for: Nitrate-N, Fluoride, Sulfate); (EPA 353.2 for: Nitrate-N, Nitrite-N); (SM4500NO3-F for: Nitrate-N and Nitrite-N); 4500F-C, 4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, 2320B, SM2540C, SM4500H-B. Organic Parameters: (EPA 524.2 for: Trihalomethanes, Volatile Organics); (504.1 for: 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane), EPA 332. Microbiology Parameters: SM9215B; ENZ. SUB. SM9223; ColilertQT SM9223B; MF-SM9222D.)

*Non-Potable Water (*Inorganic Parameters:, (EPA 200.8 for: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn); (EPA 200.7 for: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn); 245.1, SM4500H,B, EPA 120.1, SM2510B, 2540C, 2340B, 2320B, 4500CL-E, 4500F-BC, 426C, SM4500NH3-BH, (EPA 350.1 for: Ammonia-N), LACHAT 10-107-06-1-B for Ammonia-N, SM4500NO3-F, 353.2 for Nitrate-N, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, 4500P-B,E, 5220D, EPA 410.4, SM 5210B, 5310C, 4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.
Organic Parameters: (EPA 624 for Volatile Halocarbons, Volatile Aromatics),(608 for: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT,Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs-Water), (EPA 625 for SVOC Acid Extractables and SVOC Base/Neutral Extractables), 600/4-81-045-PCB-Oil. Microbiology Parameters: (ColilertQT SM9223B; Enterolert-QT: SM9222D-MF.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 200307. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM 9222B, 9223B, 9215B, EPA 200.7, 200.8, 300.0, SM4500CN-E, 4500H+B, 4500NO3-F, 2320B, 2510B, 2540C, 4500F-C, 5310C, 2120B, EPA 332.0. Organic Parameters: 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM9222D, 9221B, 9222B, 9221E-EC, EPA 3005A, 200.7, 200.8, 245.1, SW-846 6010C, 6020A, 7196A, 7470A, SM3500-CR-D, EPA 120.1, 300.0, 350.1, 350.2, 351.1, 353.2, 410.4, 420.1, 426C, 1664A, SW-846 9010B, 9010C, 9030, 9040B, 9040C, SM2120B, 2310B, 2320B, 2340B, 2540B, 2540D, 4500H+B, 4500CL-E, 4500CN-E, 4500NH3-H, 4500NO3-F, 4500NO2-B, 4500P-E, 4500-S2-D, 4500SO3-B, 5210B, 5220D, 2510B, 2540C, 4500F-C, 5310C, 5540C, LACHAT 10-204-00-1-A, LACHAT 10-107-06-2-D, 3060A. Organic Parameters: SW-846 3510C, 3630C, 5030B, 8260C, 8270D, 8330, EPA 624, 625, 608, SW-846 8082A, 8081B, 8015C, 8151A, 8330, 8270D-SIM.)

Solid & Chemical Materials (Inorganic Parameters: SW-846 6010C, 6020A, 7196A, 7471B, 1010, 1010A, 1030, 9010C, 9012B, 9014, 9030B, 9040C, 9045C, 9045D, 9050, 9065, 9251, 1311, 1312, 3005A, 3050B, 3060A. Organic Parameters: SW-846 3540C, 3546, 3050B, 3580A, 3620D, 3630C, 5030B, 5035, 8260C, 8270D, 8270D-SIM, 8330, 8151A, 8015B, 8015C, 8082A, 8081B.)

New Hampshire Department of Environmental Services Certificate/Lab ID: 2064. ***NELAP Accredited.***
Drinking Water (Organic Parameters: **EPA 524.2:** Di-isopropyl ether (DIPE), Ethyl-t-butyl ether (ETBE), Tert-amyl methyl ether (TAME)).

Non-Potable Water (Organic Parameters: **EPA 8260C:** 1,3,5-Trichlorobenzene. **EPA 8015C(M):** TPH.)

Solid & Chemical Materials (Organic Parameters: **EPA 8260C:** 1,3,5-Trichlorobenzene.)

New Jersey Department of Environmental Protection Certificate/Lab ID: MA935. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9222B, 9221E, 9223B, 9215B, 4500CN-CE, 4500NO3-F, 4500F-C, EPA 300.0, 200.7, 200.8, 245.1, 2540C, SM2120B, 2320B, 2510B, 5310C, SM4500H-B. Organic Parameters: EPA 332, 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: SM5210B, EPA 410.4, SM5220D, 4500Cl-E, EPA 300.0, SM2120B, 2340B, SM4500F-BC, EPA 200.7, 200.8, 351.1, LACHAT 10-107-06-2-D, EPA 353.2, SM4500NO3-F, 4500NO2-B, EPA 1664A, SM5310C, 4500-PE, EPA 420.1, SM4500P-B5+E, 2540B, 2540C, 2540D, EPA 120.1, SM2510B, 9222D, 9221B, 9221C, 9221E, 9222B, 9215B, 2310B, 2320B, 4500NH3-H, 4500-S D, 4500SO4-E, EPA 350.1, 350.2, SW-846 1312, 7470A, 5540C, SM4500H-B, 4500SO3-B, SM3500Cr-D, 4500CN-CE, EPA 245.1, SW-846 9040B, 9040C, 3005A, 3015, EPA 6010B, 6010C, 6020, 6020A, 7196A, 3060A, SW-846 9010C, 9030B. Organic Parameters: SW-846 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3510C, EPA 608, 624, 625, SW-846 3630C, 5030B, 5030C, 8011, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8330, 1,4-Dioxane by NJ Modified 8270, 8015B, NJ EPH.)

Solid & Chemical Materials (Inorganic Parameters: SW-846, 6010B, 6010C, 6020, 6020A, 7196A, 3060A, 9030B, 1010, 1010A, 1030, 1311, 1312, 3005A, 3050B, 7471A, 7471B, 9010C, 9012B, 9014, 9038, 9040B, 9040C, 9045C, 9045D, 9050A, 9065, 9251. Organic Parameters: SW-846 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8330, 8260B, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 3540C, 3546, 3580A, 3620C, 3630C, 5030B, 5030C, 5035L, 5035H, NJ EPH.)

New York Department of Health Certificate/Lab ID: 11148. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: SM9223B, 9222B, 9215B, EPA 200.8, 200.7, 245.1, SM5310C, EPA 332.0, SM2320B, EPA 300.0, SM2120B, 4500CN-E, 4500F-C, 4500NO3-F, 2540C, SM 2510B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: SM9221E, 9222D, 9221B, 9222B, 9215B, 5210B, 5310C, EPA 410.4, SM5220D, 2310B, 2320B, EPA 200.7, 300.0, SM4500CL-E, 4500F-C, SM15 426C, EPA 350.1, SM4500NH3-BH, EPA 351.1, LACHAT 10-107-06-2, EPA 353.2, SM4500-NO3-F, 4500-NO2-B, 4500P-E, 2340B, 2540C, 2540B, 2540D, EPA 200.8, EPA 6010C, 6020A, EPA 7196A, SM3500Cr-D, EPA 245.1, 7470A, SM2120B, 4500CN-CE, EPA 1664A, EPA 420.1, SM14 510C, EPA 120.1, SM2510B, SM4500S-D, SM5540C, EPA 8315A, 3005A, 9010C, 9030B. Organic Parameters: EPA 624, 8260C, 8270D, 8270D-SIM, 625, 608, 8081B, 8151A, 8330A, 8082A, EPA 3510C, 5030B, 5030C, 8015C, 8011.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1010A, 1030, EPA 6010C, 6020A, 7196A, 7471B, 8315A, 9012B, 9014, 9065, 9050A, 9038, 9251, EPA 1311, 1312, 3005A, 3050B, 9010C, 9030B, 9040C, 9045D. Organic Parameters: EPA 8260C, 8270D, 8270D-SIM, 8015C, 8081B, 8151A, 8330A, 8082A, 3540C, 3546, 3580A, 5035A-H, 5035A-L.)

North Carolina Department of the Environment and Natural Resources Certificate/Lab ID : 666. (Inorganic Parameters: SM2310B, 2320B, 4500Cl-E, 4500Cn-E, 9012B, 9014, Lachat 10-204-00-1-X, 1010A, 1030, 4500NO3-F, 353.2, 4500P-E, 4500SO4-E, 300.0, 4500S-D, 5310B, 5310C, 6010C, 6020A, 200.7, 200.8, 3500Cr-B, 7196A, 245.1, 7470A, 7471B, 1311,1312. Organic Parameters: 608, 8081B, 8082A, 624, 8260B, 625, 8270D, 8151A, 8015C, 504.1, MA-EPH, MA-VPH.)

Drinking Water Program Certificate/Lab ID: 25700. (Inorganic Parameters: Chloride EPA 300.0. Organic Parameters: 524.2)

Pennsylvania Department of Environmental Protection Certificate/Lab ID : 68-03671. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: 200.7, 200.8, 300.0, 332.0, 2120B, 2320B, 2510B, 2540C, 4500-CN-CE, 4500F-C, 4500H+-B, 4500NO3-F, 5310C. Organic Parameters: EPA 524.2, 504.1)

Non-Potable Water (Inorganic Parameters: EPA 120.1, 1312, 3005A,3015, 3060A, 200.7, 200.8, 410.4, 1664A, SM2540D, 5210B, 5220D, 4500-P,BE, 245.1, 300.0, 350.1, 350.2, 351.1, 353.2, 420.1, 6010C, 6020A, 7196A, 7470A, 9030B, 2120B, 2310B, 2320B, 2510B, 2540B, 2540C, 3500Cr-D, 426C, 4500CN-CE, 4500Cl-E, 4500F-B, 4500F-C, 4500H+-B, 4500NH3-H, 4500NO2-B, 4500NO3-F, 4500S-D, 4500SO3-B, 5310BCD, 5540C, 9010C, 9040C. Organic Parameters: EPA 3510C, 3630C, 5030B, 625, 624, 608, 8081B, 8082A, 8151A, 8260C, 8270D, 8270D-SIM, 8330, 8015C, NJ-EPH.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 350.1, 1010, 1030, 1311, 1312, 3005A, 3050B, 3060A, 6010C, 6020A, 7196A, 7471B, 9010C, 9012B, 9014, 9040B, 9045D, 9050A, 9065, SM 4500NH3-BH, 9030B, 9038, 9251. Organic Parameters: 3540C, 3546, 3580A, 3620C, 3630C, 5035, 8015C, 8081B, 8082A, 8151A, 8260C, 8270D, 8270D-SIM, 8330, NJ-EPH.)

Rhode Island Department of Health Certificate/Lab ID: LAO00065. ***NELAP Accredited via NJ-DEP.***
Refer to MA-DEP Certificate for Potable and Non-Potable Water.
Refer to NJ-DEP Certificate for Potable and Non-Potable Water.

Texas Commisson on Environmental Quality Certificate/Lab ID: T104704476. ***NELAP Accredited.***
Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664, 200.7, 200.8, 245.1, 245.2, 300.0, 350.1, 351.1, 353.2, 410.4, 420.1, 6010, 6020, 7196, 7470, 9040, SM 2120B, 2310B, 2320B, 2510B, 2540B, 2540C, 2540D, 426C, 4500CL-E, 4500CN-E, 4500F-C, 4500H+B, 4500NH3-H, 4500NO2B, 4500P-E, 4500 S2¯D, 510C, 5210B, 5220D, 5310C, 5540C. Organic Parameters: EPA 608, 624, 625, 8081, 8082, 8151, 8260, 8270, 8330.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1311, 1312, 9012, 9014, 9040, 9045, 9050, 9065.)

Virginia Division of Consolidated Laboratory Services Certificate/Lab ID: 460195. ***NELAP Accredited.***
Drinking Water (Inorganic Parameters: EPA 200.7, 200.8, 300.0, 2510B, 2120B, 2540C, 4500CN-CE, 245.1, 2320B, 4500F-C, 4500NO3-F, 4500H+B, 5310C. Organic Parameters: EPA 504.1, 524.2.)

Non-Potable Water (Inorganic Parameters: EPA 120.1, 1664A, 200.7, 200.8, 245.1, 300.0, 350.1, 351.1, 351.2, 3005A, 3015, 1312, 6010B, 6010C, 3060A, 353.2, 420.1, 2340B, 6020, 6020A, SM4500S-D, SM4500-CN-CE, Lachat 10-204-00-1-X, 7196A, 7470A, 2310B, 2320B, 2510B, 2540B, 2540C, 2540D, 3500Cr-D, 426C, 4500Cl-E, 4500F-B, 4500F-C,

4500NH3-H, 4500NO2-B, 4500NO3-F, 4500 SO3-B, 4500H-B, 4500PE, 510AC, 5210B, 5310B 5310C, 5540C, 9010Cm 9030B, 9040C. Organic Parameters: EPA 3510C, 3630C, 5030B, 8260B, 608, 624, 625, 8011, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8260C, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330,)

Solid & Hazardous Waste (Inorganic Parameters: EPA 1010A, 1030, 3060A, 3050B, 1311, 1312, 6010B, 6010C, 6020, , 7196A, 7471A, 7471B, 6020A, 9010C, 9012B, 9030B, 9014, 9038, 9040C, 9045D, 9251, 9050A, 9065. Organic Parameters: EPA 5030B, 5035, 3540C, 3546, 3550B, 3580A, 3620C, 3630C, 6020A, 8260B, 8260C, 8015B, 8015C, 8081A, 8081B, 8082, 8082A, 8151A, 8270C, 8270D, 8270C-SIM, 8270D-SIM, 8330.)

Department of Defense, L-A-B Certificate/Lab ID: L2217.
Drinking Water (Inorganic Parameters: SM 4500H-B. Organic Parameters: EPA 524.2, 504.1.)

Non-Potable Water (Inorganic Parameters: EPA 200.7, 200.8, 6010C, 6020A, 245.1, 7470A, 9040B, 9010B, 180.1, 300.0, 332.0, 6860, 351.1, 353.2, 9060, 1664A, SM 4500CN-E, 4500H-B, 4500Norg-C, 4500NO3-F, 5310C, 2130B, 2320B, 2340B, 2540C, 5540C, 3005A, 3015, 9056, 7196A, 3500-Cr-D. Organic Parameters: EPA 8015C, 8151A, 8260C, 8270D, 8270D-SIM, 8330A, 8082A, 8081B, 3510C, 5030B, MassDEP EPH, MassDEP VPH.)

Solid & Hazardous Waste (Inorganic Parameters: EPA 200.7, 6010C, 6020A, 7471A, 6860, 1311, 1312, 3050B, 7196A, 9040B, 9045C, 9010C, 9012B, 9251, SM3500-CR-D, 4500CN-CE, 2540G, Organic Parameters: EPA 8015C, 8151A, 8260C, 8270D, 8270D-SIM, 8330A/B-prep, 8082A, 8081B, 3540C, 3546, 3580A, 5035A, MassDEP EPH, MassDEP VPH.)

The following analytes are not included in our current NELAP/TNI Scope of Accreditation:
EPA 524.2: Acetone, 2-Butanone (Methyl ethyl ketone (MEK)), Tert-butyl alcohol, 2-Hexanone, Tetrahydrofuran, 1,3,5-Trichlorobenzene, 4-Methyl-2-pentanone (MIBK), Carbon disulfide, Diethyl ether. **EPA 8260B:** 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene. **EPA 8260 Non-potable water matrix:** Iodomethane (methyl iodide), Methyl methacrylate. **EPA 8260 Soil matrix:** Tert-amyl methyl ether (TAME), Diisopropyl ether (DIPE), Azobenzene. **EPA 8330A:** PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT. **EPA 8270C:** Methyl naphthalene, Dimethyl naphthalene, Total Methylnapthalenes, Total Dimethylnaphthalenes, 1,4-Diphenylhydrazine. **EPA 625:** 4-Chloroaniline, 4-Methylphenol. Total Phosphorus in a soil matrix, TKN in a soil matrix, NO2 in a soil matrix, NO3 in a soil matrix. **EPA 9071:** Total Petroleum Hydrocarbons, Oil & Grease.

L1320014

CHAIN OF CUSTODY

PAGE ____ OF ____

Date Rec'd In Lab: 10/7/13

ALPHA Job #: ~~L132~~ RS

ALPHA ANALYTICAL

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

Client Information

Client: Turnkey
Address: 2558 Hamburg Turnpike
Buffalo NY 14218
Phone: (716) 856-0599
Fax: (716) 856-0583
Email:

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: 401, 402 + 430 Buffalo Ave
Project Location: Buffalo Ave Niagara Falls
Project #: 0271-013-001
Project Manager: Mike Lesakowski
ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH *(only confirmed if pre-approved!)*

Date Due: 10/14/13 Time:

Report Information - Data Deliverables

☐ FAX ☐ EMAIL
☒ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program	*Criteria*

Other Project Specific Requirements/Comments/Detection Limits:

SAMPLE HANDLING

Filtration ________
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS: TCL+stars VOC	PAH	RCRA Metals	PCBs	Sample Specific Comments	TOTAL # BOTTLES
20014 .1	SB-1 (0-2)	10-3-13	1030	Soil	PWW	X	X	X			3
.2	SB-2 (6-8)	10-3-13	1030	↓	↓	X	X	X			3
.3	TP-1 (1-6)	10-4-13	1245				X	X	X		3
.4	TP-3 (1-4.5)	10-4-13	1305				X	X	X		3
.5	TP-5 (1-3)	10-4-13	1340				X	X	X		3
.6	TP-7 (1-3)	10-4-13	1425				X	X	X		3
.7	TP-4 (1-2)	10-4-13	1315				X				2
.8	TP-6 (2-4)	10-4-13	1400	↓	↓		X				2

Container Type	
Preservative	

Relinquished By:	Date/Time	Received By:	Date/Time
Paul W Werthman	10-7-13 1600	Jamie Rickey	10-7-13 / 1700
Jamie Rickey	10-7-13 / 1920	Joe T Donato	10-7-13 / 1920
Joe Donato	10-7-13 2320		10 7 13 2320
	10 7 13 2345	Richard Scott	10/7/13 2345

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)

www.benchmarkturnkey.com

Strong Advocates, Effective Solutions, Integrated Implementation

TurnKey
Environmental
Restoration, LLC

April 16, 2014

Mr. Craig Slater, Esq.
The Slater Law Firm
26 Mississippi Street, Suite 400
Buffalo NY 14203

Re: 401 Buffalo Avenue – Supplemental Investigation
Niagara Falls, New York

Dear Mr. Slater:

TurnKey Environmental Restoration, LLC (TurnKey) conducted a supplemental investigation on behalf of The Slater Law Firm at the 401 Buffalo Avenue, Niagara Falls, New York Site (see Figure A). The supplemental investigation was completed to further investigate and assess potential environmental impacts on the former commercial-industrial property.

As you are aware, the 401 Buffalo Avenue parcel is currently under review by the New York State Department of Environmental Conservation (NYSDEC) for acceptance into the Brownfield Cleanup Program (BCP), as part of a single large-scale remediation and redevelopment project that also includes the adjoining 402 and 430 Buffalo Avenue parcels. During a recent NYSDEC review, the Department requested additional investigation for the 401 Buffalo Avenue parcel prior to eligibility determination.

BACKGROUND

Historically, the Site was owned and operated by both the National Biscuit Company and Union Carbide Corporation between approximately 1901 through 1966. Previous investigations have identified multiple recognized environmental conditions (RECs) for the Site.

An October 2013 Site Inspection of the existing vacant municipally-condemned hotel building identified RECs including:

- Oil-leaking former hotel operation equipment in the basement, including compressors, elevator equipment, and transformers;
- Wide-spread floor staining in the basement associated with former mechanical system equipment (as noted above);
- Improper storage and handling of hazardous chemicals, including corrosive boiler chemicals, solvents, lubricants, degreasers, paints, thinners, hydraulic oils and maintenance equipment fuels, pesticides and herbicides, pool and water treatment chemicals;
- Former transformer vessels with staining noted;
- Sumps, floor drains and vent stacks noted in basement. Staining noted proximate to several floor drains;
- Numerous ASTs of unknown contents in the basement;
- Illegal dumping and vandalism; and,
- Universal and e-waste throughout the building

SCOPE OF WORK

TurnKey completed a supplemental investigation at the Site on March 26, 2014. The supplemental investigation included a limited subsurface investigation, an interior building inspection, and the interior boring investigation. Prior to the supplemental investigation, underground utilizes DigSafeNY was notified and cleared for intrusive activities.

Subsurface Investigation

TurnKey mobilized a track-mounted mini-excavator to the Site and excavated four (4) test pits, identified as TP-1 through TP-4 (see Figure A). Soil descriptions were completed in the field via visual characterization of excavated soils and test pit excavation faces using the Unified Soil Classification System (USCS), and scanned for total volatile organic vapors with a photoionization detector (PID) equipped with a 10.6 eV lamp. Soil samples were collected for laboratory analytical analysis from TP-1. Details of the laboratory analysis are provided below.

The subsurface soil/fill was typically characterized as asphalt and sub-base gravel fill overlying poorly graded sand, underlain by brown sandy clay. Evidence of a black fill material with brick fragments was noted between 2-3 feet below ground surface in TP-2.

Interior Building Inspection

TurnKey completed a site inspection of the facility in October 2013, as described above. Based on the evident illegal dumping and vandalism at the site, a walk over inspection was completed prior to investigation activities. Findings of the site inspection, by location, include:

- Boiler Room – multiple unknown aboveground storage tanks (AST), oil staining noted on floors and walls, multiple floor drains/sumps.
- Southern Elevator Control Room – oil leaking from elevator controller, oil noted on support structure (bolts in concrete floor), floor and walls, floor cracks evident.
- Maintenance Room – flammable and hazardous materials noted, stored improperly and leaking on floor. Floor cracks and severely corroded storage cabinet, floor drain/sumps present.
- East Elevator Control Room – oil leaking form elevator controller, oil noted floor and walls, floor cracks evident
- Electrical-transformer Room – three (3) transformers have been destroyed/vandalized. Oil and contents spill to floor.

As noted above, active transformers were present on-Site during previous investigations. During the March 2014 supplemental investigation site inspection, it was discovered that all three (3) large transformers had been vandalized for an apparent copper theft (see photolog in Attachment 1). The transformers had been overturned with oil being dumped to the floor and remnant pieces of the transformer being disassembled on-Site. No placards or information denoting that the transformer oil was PCB-free oil, or indicating the year of production, was evident. Based on the size of the transformers, it is assumed that approximately 120-gallons of potential PCB-containing transformer oil were spilled.

Based on the discovery of the vandalized transformers, the New York State Department of Environmental Conservation (NYSDEC) was contacted and Spill No. 1312160 was assigned to the Site. As this parcel, and the adjoining 402 and 430 Buffalo Avenue parcels are currently being considered for acceptance into the Brownfield Cleanup Program, NYSDEC Region 9 Division of Environmental Remediation (DER) representatives were notified about the spill.

Interior Boring Investigation

TurnKey personnel completed five (5) interior borings, identified as IB-1 through IB-5. Borings were advanced by coring through the concrete floor, and utilizing a hand-held stainless steel hand auger to collect the subslab sample.

During interior borings, TurnKey personnel inspected the recovered soil/fill material for visual and/or olfactory evidence of contamination, and scanned soils with a photoionization detector (PID). Field evidence of petroleum odors were noted in IB-3 (Maintenance Rm.), IB-4 (East Elevator Rm.), and IB-5 (Transformer Rm.). PIDs are sensitive to moisture and humidity, and due to the high levels of moisture in the air, PID readings appeared inaccurate and highly variable, and as such not utilized during the interior boring investigation.

Soil samples were collected from all five (5) interior boring locations. Details of the laboratory analysis are provided below.

Laboratory Analysis

Soil samples collected from the interior soil borings and test pits were placed in pre-cleaned, laboratory provided sample bottles using dedicated stainless steel sampling tools, and cooled to 4° C in the field. The samples were transported under chain-of-custody command to the analytical laboratory for analysis. Interior boring samples, IB-1 through IB-5, were analyzed selectively for Target Compound List (TCL) volatile organic compounds (VOCs), base-neutral fraction semi-volatile organic compounds (SVOCs), Resource Conservation and Recovery Act (RCRA) metals, and polychlorinated biphenyls (PCBs).

The soil/fill sample from TP-1 was collected and analyzed for SVOCs and metals, as described above. Analytical results are presented on Table 1. Laboratory analytical package is attached electronically in Attachment 2.

Summary of Results

- NYSDEC Spill No. 1312160 was assigned to the Site related to the vandalism/destruction of three transformers and spilling of approximately 120-gallons of potential PCB-containing transformer oil.
- Leaking oil-containing equipment and oil-contaminated floors, walls, and equipment were noted in the Boiler Room, Maintenance Room, and both elevator control rooms.
- Improperly stored maintenance solvents and hazardous materials were noted in the maintenance room.
- Field evidence of petroleum odors were noted in three of the five interior boring locations, including IB-3, IB-4, and IB-5.
- Black fill material including brick fragments was detected in TP-1.
- Laboratory analytical results indicate that elevated PCBs above Part 375 Unrestricted Use Soil Cleanup Objectives (SCOs) were detected for Aroclor 1248, Aroclor 1254, and Aroclor 1260 in IB-4 and IB-5, respectively.
- Elevated lead was detected above its Part 375 Unrestricted Use SCOs in TP-1.

Recommendations

- TurnKey recommends that additional sample(s) be collected from the spilled transformer oil to determine if PCBs are present. The spill area should be secured and spill containment measures should be employed to limit any additional contamination as result of the vandalism. If PCB-oil is present, remediation and disposal will need to be in accordance with applicable local, state and federal regulations.
- All current oil-leaking equipment in the maintenance, boiler and elevator control rooms should be emptied of oil, properly containerized and characterized for off-site disposal and/or recycling.
- Residual oil-contaminated floors, walls, drains, sumps, and equipment should be decontaminated. All oil-contaminated material needs to be characterized and disposed/recycled in accordance with applicable regulations based on the analytical results.

- Black-stained fill material with elevated lead levels encountered during future intrusive activities will need to be properly characterized for off-site disposal and handled in accordance with applicable local, state and federal regulations.
- It is likely that during intrusive and/or demolition activities, petroleum impacted soil/fill under the existing concrete slab and foundation will be encountered, and should be disposed of in accordance with applicable local, state and federal regulations.
- TurnKey recommends contacting the NYSDEC, Region 9 Spill Coordinator to discuss the findings of this report.

Please contact us if you have any questions.

Sincerely,
TurnKey Environmental Restoration, LLC

Nathan T. Munley
Sr. Project Scientist

Michael A. Lesakowski
Sr. Project Manager

cc: F. Merani (Merani Hospitality)

File: 0271-013-001

TABLE

TurnKey Environmental Restoration, LLC

TABLE 1

SUMMARY OF SOIL ANALYTICAL RESULTS

401 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

Parameter^1	**Unrestricted Use SCOs^2**	**Sample Locations**							
		SB-1 (0-2)	**SB-2 (6-8)**	**TP-1 (2-3)**	**IB-1**	**IB-2**	**IB-3**	**IB-4**	**IB-5**
		10/3/2013		**3/26/2014**					
Volatile Organic Compounds (VOCs) - mg/Kg ^{3}									
1,2,3-Trichlorobenzene	**--**	ND	ND	NA	ND	ND	ND	ND	0.014
1,2,4,5-Tetramethylbenzene	**--**	ND	ND	NA	ND	ND	ND	ND	0.00052 J
1,2,4-Trichlorobenzene	**--**	ND	ND	NA	ND	ND	ND	ND	0.06
1,4-Diethylbenzene	**--**	ND	ND	NA	ND	ND	ND	ND	0.00057 J
4-Ethyltoluene	**--**	ND	ND	NA	ND	ND	ND	ND	0.00031 J
Acetone	**0.05**	ND	ND	NA	ND	ND	ND	0.012	ND
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg ^{3}									
1,2,4-Trichlorobenzene	**--**	ND	ND	ND	ND	NA	ND	ND	0.067 J
2-Methylnaphthalene	**--**	0.2 J	ND	0.24	ND	NA	ND	ND	ND
Acenaphthene	**20**	ND	ND	0.097 J	ND	NA	ND	ND	ND
Acenaphthylene	**100**	ND	ND	ND	ND	NA	ND	ND	ND
Anthracene	**100**	0.042 J	ND	0.24	ND	NA	ND	ND	ND
Benzo(a)anthracene	**1**	0.21	ND	0.44	ND	NA	ND	ND	ND
Benzo(a)pyrene	**1**	0.19	ND	0.35	ND	NA	ND	ND	ND
Benzo(b)fluoranthene	**1**	0.31	ND	0.41	ND	NA	ND	ND	ND
Benzo(g,h,i)perylene	**100**	0.14 J	ND	0.19	ND	NA	ND	ND	ND
Benzo(k)fluoranthene	**0.8**	0.095 J	ND	0.18	ND	NA	ND	ND	ND
Bis(2-ethylhexyl) phthalate	**--**	ND	ND	ND	ND	NA	ND	ND	0.3
Carbazole	**--**	ND	ND	0.098 J	ND	NA	ND	ND	ND
Chrysene	**1**	0.31	ND	0.39	ND	NA	ND	ND	ND
Dibenzo(a,h)anthracene	**0.33**	ND	ND	0.049 J	ND	NA	ND	ND	ND
Dibenzofuran	**--**	ND	ND	0.11 J	ND	NA	ND	ND	ND
Fluoranthene	**100**	0.63	ND	1.1	ND	NA	ND	ND	ND
Fluorene	**30**	ND	ND	0.11 J	ND	NA	ND	ND	ND
Indeno(1,2,3-cd)pyrene	**0.5**	0.13 J	ND	0.23	ND	NA	ND	ND	ND
Naphthalene	**12**	0.11 J	ND	0.16 J	ND	NA	ND	ND	ND
Phenanthrene	**100**	0.52	ND	1	ND	NA	ND	ND	ND
Pyrene	**100**	0.5	ND	0.83	ND	NA	ND	ND	ND
Total PCBs - mg/Kg ^{3}									
Aroclor 1248	**0.1**	NA	NA	NA	NA	NA	NA	**0.367**	ND
Aroclor 1254	**0.1**	NA	NA	NA	NA	NA	NA	**0.121**	ND
Aroclor 1260	**0.1**	NA	NA	NA	NA	NA	NA	ND	**0.128**
Total Metals - mg/Kg									
Arsenic	**13**	7.2	1.1	13	2.8	NA	3.5	2.1	2.6
Barium	**350**	64	12	62	18	NA	11	3.1	12
Cadmium	**2.5**	0.72	0.92	0.26 J	0.17 J	NA	0.19 J	1.7	0.3 J
Chromium	**30**	7.6	3	10	7.5	NA	6.3	4.3	5.4
Lead	**63**	**100**	23	**210**	12	NA	9.2	37	14
Selenium	**3.9**	ND	ND	ND	ND	NA	ND	ND	ND
Silver	**2**	0.12 J	ND	ND	0.59	NA	ND	ND	0.47
Mercury	**0.18**	ND	ND	0.12	ND	NA	ND	ND	ND

Notes:

1. Only those parameters detected at a minimum of one sample location are presented in this table; all other compounds were reported as non-detect.
2. Values per 6NYCRR Part 375 Soil Cleanup Objectives (December 2006).
3. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparison to SCOs.
4. Samples SB-1 and SB-2 was also analysed for TCL VOCs; all reported as non-detect.

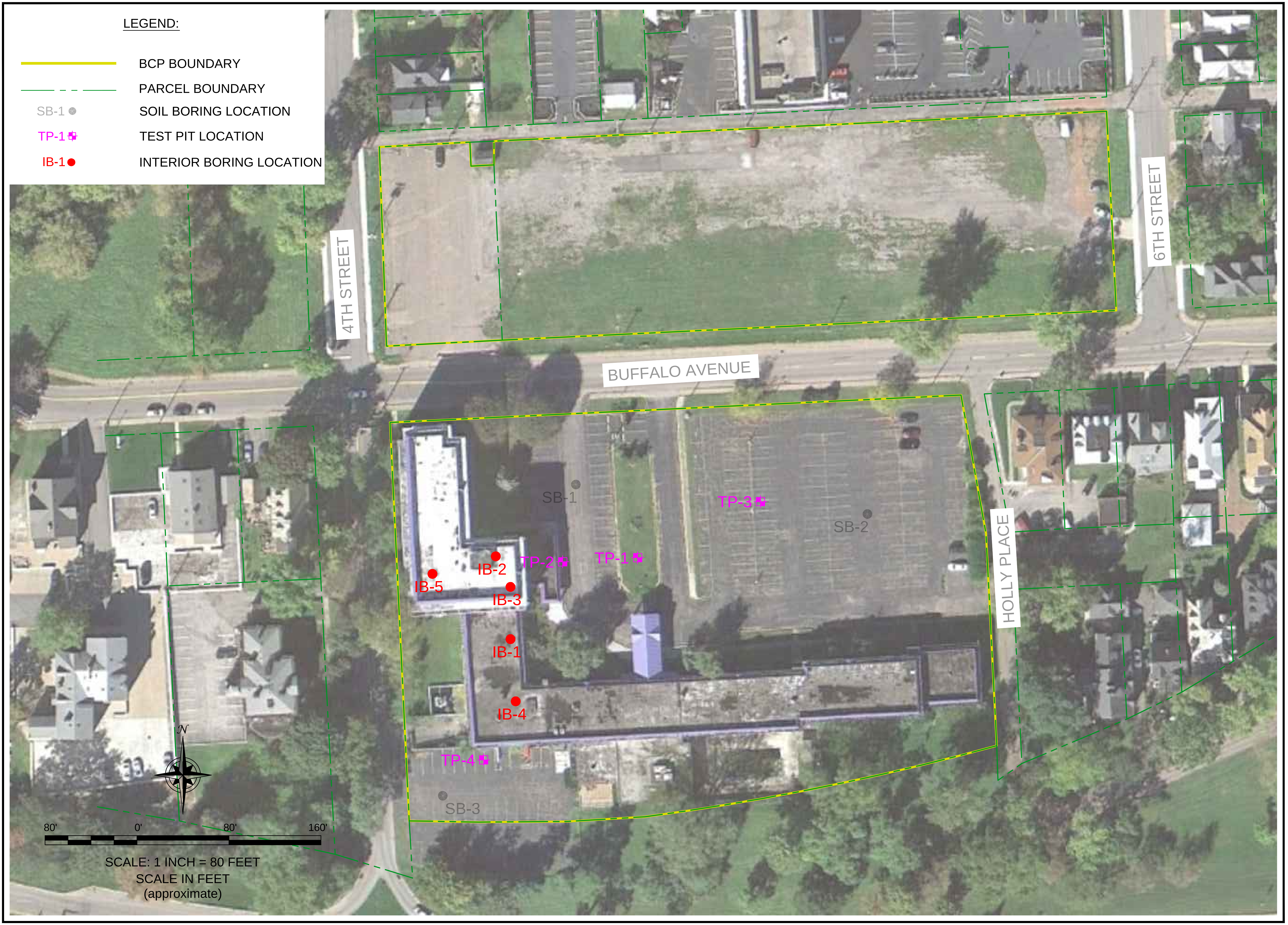
Definitions:

ND = Parameter not detected above laboratory detection limit.
NA = Sample not analyzed for parameter.
"--" = No SCO available for the parameter.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.

BOLD = Result exceeds Part 375 Unrestricted Use SCOs.

FIGURE

F:\CAD\TurnKey\Slater Law\401-430 Buffalo Ave\Supplemental Investigation\Figure A; Sample Locations.dwg



DATE: APRIL 2014
DRAFTED BY: BLR

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

TURNKEY ENVIRONMENTAL RESTORATION, LLC

JOB NO.: 0294-013-001

SAMPLE LOCATIONS

SUPPLEMENTAL INVESTIGATION
401 BUFFALO AVENUE SITE
NIAGARA FALLS, NEW YORK
PREPARED FOR
MERANI HOSPITALITY, INC.

FIGURE A

DISCLAIMER:
PROPERTY OF TURNKEY ENV. REST., LLC. IMPORTANT: THIS DRAWING PRINT IS LOANED FOR MUTUAL ASSISTANCE AND AS SUCH IS SUBJECT TO RECALL AT ANY TIME. INFORMATION CONTAINED HEREON IS NOT TO BE DISCLOSED OR REPRODUCED IN ANY FORM FOR THE BENEFIT OF PARTIES OTHER THAN NECESSARY SUBCONTRACTORS & SUPPLIERS WITHOUT THE WRITTEN CONSENT OF TURNKEY ENV. REST., LLC.

ATTACHMENT 1

PHOTOLOG

SITE PHOTOGRAPHS

Photo 1:

Photo 2:

Photo 3:

Photo 4:

Photo 1:	Transformer Room (pre-copper theft vandalism – November 2013)
Photo 2:	Vandalized overturned transformers (March 2014)
Photo 3:	Interior boring location – note staining on floor in elevator control room
Photo 4:	Oil staining on wall and floor in boiler room

SITE PHOTOGRAPHS

Photo 5:

Photo 6:

Photo 7:

Photo 8:

Photo 5: Oil contaminated equipment in elevator control room.

Photo 6: Leaking elevator control equipment. Note oil staining on floor.

Photo 7: Improper storage of hazardous maintenance solvents and degreaser.

Photo 8: Leaking maintenance solvents and degreasers.

SITE PHOTOGRAPHS

Photo 9:

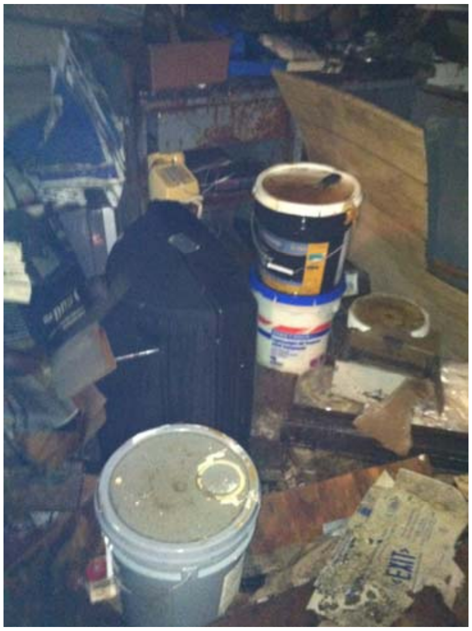


Photo 10:

Photo 11:

Photo 12:

Photo 9:	Improper chemical storage.
Photo 10:	Leaking elevator control equipment, with oil staining on floor.
Photo 11:	Leaking elevator control equipment, with oil staining on floor.
Photo 12:	Large floor drain sump and trench.

ATTACHMENT 2

LABORATORY ANALYTICAL DATA PACKAGE

ANALYTICAL REPORT

Lab Number:	L1406459
Client:	Benchmark & Turnkey Companies 2558 Hamburg Turnpike Suite 300 Buffalo, NY 14218
ATTN:	Mike Lesakowski
Phone:	(716) 856-0599
Project Name:	401 BUFFALO AVE.
Project Number:	0294-013-001
Report Date:	04/14/14

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), USDA (Permit #P-330-11-00240), NC (666), TX (T104704476), DOD (L2217), US Army Corps of Engineers.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

Alpha Sample ID	Client ID	Sample Location	Collection Date/Time
L1406459-01	TP-1 (2-3)	401 BUFFALO AVE.	03/26/14 09:05
L1406459-02	IB-1	401 BUFFALO AVE.	03/26/14 13:41
L1406459-03	IB-2	401 BUFFALO AVE.	03/26/14 13:57
L1406459-04	IB-3	401 BUFFALO AVE.	03/26/14 14:06
L1406459-05	IB-4	401 BUFFALO AVE.	03/26/14 14:20
L1406459-06	IB-5	401 BUFFALO AVE.	03/26/14 14:30

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Performance criteria for CAM and RCP methods allow for some LCS compound failures to occur and still be within method compliance. In these instances, the specific failures are not narrated but are noted in the associated QC table. This information is also incorporated in the Data Usability format for our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Case Narrative (continued)

Report Submission

This final report replaces the partial report issued April 10, 2014. At the client's request, the analyses of Semivolatile Organics and PCBs were performed on L1406459-03.

A previously-issued partial report replaced the partial report issued April 3, 2014. At the client's request, all Volatile and Semivolatile Organics data were evaluated for the presence of TICs. The report was amended to include Volatile Organics TICs on L1406459-05 and -06.

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Volatile Organics

Any reported concentrations that are below 200 ug/kg may be biased low due to the sample not being collected according to 5035-L/5035A-L low-level specifications.

Semivolatile Organics

L1406459-05 has elevated detection limits due to the dilution required by matrix interferences encountered during the concentration of the sample.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Kelly Stenstrom Kelly Stenstrom

Title: Technical Director/Representative

Date: 04/14/14

ORGANICS

VOLATILES

SAMPLE RESULTS

Lab ID:	L1406459-04	Date Collected:	03/26/14 14:06
Client ID:	IB-3	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		
Analytical Method:	1,8260C		
Analytical Date:	03/31/14 15:09		
Analyst:	BN		
Percent Solids:	87%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Volatile Organics by GC/MS - Westborough Lab						
Methylene chloride	ND		ug/kg	11	2.3	1
1,1-Dichloroethane	ND		ug/kg	1.7	0.20	1
Chloroform	ND		ug/kg	1.7	0.42	1
Carbon tetrachloride	ND		ug/kg	1.1	0.24	1
1,2-Dichloropropane	ND		ug/kg	4.0	0.26	1
Dibromochloromethane	ND		ug/kg	1.1	0.35	1
1,1,2-Trichloroethane	ND		ug/kg	1.7	0.35	1
Tetrachloroethene	ND		ug/kg	1.1	0.16	1
Chlorobenzene	ND		ug/kg	1.1	0.40	1
Trichlorofluoromethane	ND		ug/kg	5.7	0.14	1
1,2-Dichloroethane	ND		ug/kg	1.1	0.17	1
1,1,1-Trichloroethane	ND		ug/kg	1.1	0.13	1
Bromodichloromethane	ND		ug/kg	1.1	0.26	1
trans-1,3-Dichloropropene	ND		ug/kg	1.1	0.14	1
cis-1,3-Dichloropropene	ND		ug/kg	1.1	0.14	1
1,1-Dichloropropene	ND		ug/kg	5.7	0.52	1
Bromoform	ND		ug/kg	4.6	0.48	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	1.1	0.20	1
Benzene	ND		ug/kg	1.1	0.14	1
Toluene	ND		ug/kg	1.7	0.13	1
Ethylbenzene	ND		ug/kg	1.1	0.17	1
Chloromethane	ND		ug/kg	5.7	0.90	1
Bromomethane	ND		ug/kg	2.3	0.39	1
Vinyl chloride	ND		ug/kg	2.3	0.16	1
Chloroethane	ND		ug/kg	2.3	0.36	1
1,1-Dichloroethene	ND		ug/kg	1.1	0.24	1
trans-1,2-Dichloroethene	ND		ug/kg	1.7	0.24	1
Trichloroethene	ND		ug/kg	1.1	0.17	1
1,2-Dichlorobenzene	ND		ug/kg	5.7	0.21	1
1,3-Dichlorobenzene	ND		ug/kg	5.7	0.21	1
1,4-Dichlorobenzene	ND		ug/kg	5.7	0.28	1

SAMPLE RESULTS

Lab ID:	L1406459-04	Date Collected:	03/26/14 14:06
Client ID:	IB-3	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/kg	2.3	0.12	1
p/m-Xylene	ND		ug/kg	2.3	0.37	1
o-Xylene	ND		ug/kg	2.3	0.31	1
cis-1,2-Dichloroethene	ND		ug/kg	1.1	0.17	1
Dibromomethane	ND		ug/kg	11	0.19	1
Styrene	ND		ug/kg	2.3	0.35	1
Dichlorodifluoromethane	ND		ug/kg	11	0.25	1
Acetone	ND		ug/kg	11	3.6	1
Carbon disulfide	ND		ug/kg	11	2.3	1
2-Butanone	ND		ug/kg	11	0.41	1
Vinyl acetate	ND		ug/kg	11	0.55	1
4-Methyl-2-pentanone	ND		ug/kg	11	0.28	1
1,2,3-Trichloropropane	ND		ug/kg	11	0.26	1
2-Hexanone	ND		ug/kg	11	0.22	1
Bromochloromethane	ND		ug/kg	5.7	0.22	1
2,2-Dichloropropane	ND		ug/kg	5.7	0.26	1
1,2-Dibromoethane	ND		ug/kg	4.6	0.20	1
1,3-Dichloropropane	ND		ug/kg	5.7	0.20	1
1,1,1,2-Tetrachloroethane	ND		ug/kg	1.1	0.36	1
Bromobenzene	ND		ug/kg	5.7	0.24	1
n-Butylbenzene	ND		ug/kg	1.1	0.23	1
sec-Butylbenzene	ND		ug/kg	1.1	0.24	1
tert-Butylbenzene	ND		ug/kg	5.7	0.64	1
o-Chlorotoluene	ND		ug/kg	5.7	0.18	1
p-Chlorotoluene	ND		ug/kg	5.7	0.18	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	5.7	0.90	1
Hexachlorobutadiene	ND		ug/kg	5.7	0.48	1
Isopropylbenzene	ND		ug/kg	1.1	0.19	1
p-Isopropyltoluene	ND		ug/kg	1.1	0.22	1
Acrylonitrile	ND		ug/kg	11	0.27	1
n-Propylbenzene	ND		ug/kg	1.1	0.14	1
1,2,3-Trichlorobenzene	ND		ug/kg	5.7	0.19	1
1,2,4-Trichlorobenzene	ND		ug/kg	5.7	0.90	1
1,3,5-Trimethylbenzene	ND		ug/kg	5.7	0.16	1
1,2,4-Trimethylbenzene	ND		ug/kg	5.7	0.66	1
1,4-Dioxane	ND		ug/kg	110	20.	1
1,4-Diethylbenzene	ND		ug/kg	4.6	0.18	1
4-Ethyltoluene	ND		ug/kg	4.6	0.13	1
1,2,4,5-Tetramethylbenzene	ND		ug/kg	4.6	0.15	1

SAMPLE RESULTS

Lab ID:	L1406459-04	Date Collected:	03/26/14 14:06
Client ID:	IB-3	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Ethyl ether	ND		ug/kg	5.7	0.30	1
trans-1,4-Dichloro-2-butene	ND		ug/kg	5.7	0.51	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	100		70-130
Toluene-d8	96		70-130
4-Bromofluorobenzene	99		70-130
Dibromofluoromethane	100		70-130

SAMPLE RESULTS

Lab ID: L1406459-05
Client ID: IB-4
Sample Location: 401 BUFFALO AVE.
Matrix: Soil
Analytical Method: 1,8260C
Analytical Date: 03/31/14 15:37
Analyst: BN
Percent Solids: 91%

Date Collected: 03/26/14 14:20
Date Received: 03/27/14
Field Prep: Not Specified

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Volatile Organics by GC/MS - Westborough Lab						
Methylene chloride	ND		ug/kg	11	2.2	1
1,1-Dichloroethane	ND		ug/kg	1.6	0.20	1
Chloroform	ND		ug/kg	1.6	0.41	1
Carbon tetrachloride	ND		ug/kg	1.1	0.23	1
1,2-Dichloropropane	ND		ug/kg	3.9	0.25	1
Dibromochloromethane	ND		ug/kg	1.1	0.34	1
1,1,2-Trichloroethane	ND		ug/kg	1.6	0.34	1
Tetrachloroethene	ND		ug/kg	1.1	0.15	1
Chlorobenzene	ND		ug/kg	1.1	0.38	1
Trichlorofluoromethane	ND		ug/kg	5.5	0.13	1
1,2-Dichloroethane	ND		ug/kg	1.1	0.16	1
1,1,1-Trichloroethane	ND		ug/kg	1.1	0.12	1
Bromodichloromethane	ND		ug/kg	1.1	0.25	1
trans-1,3-Dichloropropene	ND		ug/kg	1.1	0.13	1
cis-1,3-Dichloropropene	ND		ug/kg	1.1	0.14	1
1,1-Dichloropropene	ND		ug/kg	5.5	0.50	1
Bromoform	ND		ug/kg	4.4	0.46	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	1.1	0.19	1
Benzene	ND		ug/kg	1.1	0.13	1
Toluene	ND		ug/kg	1.6	0.12	1
Ethylbenzene	ND		ug/kg	1.1	0.16	1
Chloromethane	ND		ug/kg	5.5	0.86	1
Bromomethane	ND		ug/kg	2.2	0.37	1
Vinyl chloride	ND		ug/kg	2.2	0.16	1
Chloroethane	ND		ug/kg	2.2	0.35	1
1,1-Dichloroethene	ND		ug/kg	1.1	0.23	1
trans-1,2-Dichloroethene	ND		ug/kg	1.6	0.23	1
Trichloroethene	ND		ug/kg	1.1	0.17	1
1,2-Dichlorobenzene	ND		ug/kg	5.5	0.20	1
1,3-Dichlorobenzene	ND		ug/kg	5.5	0.20	1
1,4-Dichlorobenzene	ND		ug/kg	5.5	0.27	1

SAMPLE RESULTS

Lab ID:	L1406459-05	Date Collected:	03/26/14 14:20
Client ID:	IB-4	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/kg	2.2	0.12	1
p/m-Xylene	ND		ug/kg	2.2	0.36	1
o-Xylene	ND		ug/kg	2.2	0.30	1
cis-1,2-Dichloroethene	ND		ug/kg	1.1	0.16	1
Dibromomethane	ND		ug/kg	11	0.18	1
Styrene	ND		ug/kg	2.2	0.34	1
Dichlorodifluoromethane	ND		ug/kg	11	0.24	1
Acetone	12		ug/kg	11	3.4	1
Carbon disulfide	ND		ug/kg	11	2.2	1
2-Butanone	ND		ug/kg	11	0.39	1
Vinyl acetate	ND		ug/kg	11	0.53	1
4-Methyl-2-pentanone	ND		ug/kg	11	0.27	1
1,2,3-Trichloropropane	ND		ug/kg	11	0.25	1
2-Hexanone	ND		ug/kg	11	0.21	1
Bromochloromethane	ND		ug/kg	5.5	0.22	1
2,2-Dichloropropane	ND		ug/kg	5.5	0.25	1
1,2-Dibromoethane	ND		ug/kg	4.4	0.20	1
1,3-Dichloropropane	ND		ug/kg	5.5	0.19	1
1,1,1,2-Tetrachloroethane	ND		ug/kg	1.1	0.35	1
Bromobenzene	ND		ug/kg	5.5	0.23	1
n-Butylbenzene	ND		ug/kg	1.1	0.22	1
sec-Butylbenzene	ND		ug/kg	1.1	0.23	1
tert-Butylbenzene	ND		ug/kg	5.5	0.62	1
o-Chlorotoluene	ND		ug/kg	5.5	0.18	1
p-Chlorotoluene	ND		ug/kg	5.5	0.17	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	5.5	0.87	1
Hexachlorobutadiene	ND		ug/kg	5.5	0.47	1
Isopropylbenzene	ND		ug/kg	1.1	0.18	1
p-Isopropyltoluene	ND		ug/kg	1.1	0.21	1
Acrylonitrile	ND		ug/kg	11	0.26	1
n-Propylbenzene	ND		ug/kg	1.1	0.14	1
1,2,3-Trichlorobenzene	ND		ug/kg	5.5	0.18	1
1,2,4-Trichlorobenzene	ND		ug/kg	5.5	0.87	1
1,3,5-Trimethylbenzene	ND		ug/kg	5.5	0.16	1
1,2,4-Trimethylbenzene	ND		ug/kg	5.5	0.63	1
1,4-Dioxane	ND		ug/kg	110	19.	1
1,4-Diethylbenzene	ND		ug/kg	4.4	0.18	1
4-Ethyltoluene	ND		ug/kg	4.4	0.13	1
1,2,4,5-Tetramethylbenzene	ND		ug/kg	4.4	0.14	1

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

SAMPLE RESULTS

Lab ID:	L1406459-05	Date Collected:	03/26/14 14:20
Client ID:	IB-4	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Volatile Organics by GC/MS - Westborough Lab						
Ethyl ether	ND		ug/kg	5.5	0.29	1
trans-1,4-Dichloro-2-butene	ND		ug/kg	5.5	0.49	1
Tentatively Identified Compounds						
Unknown Alcohol	5.9	J	ug/kg			1

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**
1,2-Dichloroethane-d4	101		70-130
Toluene-d8	99		70-130
4-Bromofluorobenzene	104		70-130
Dibromofluoromethane	100		70-130

SAMPLE RESULTS

Lab ID:	L1406459-06	Date Collected:	03/26/14 14:30
Client ID:	IB-5	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		
Analytical Method:	1,8260C		
Analytical Date:	03/31/14 16:05		
Analyst:	BN		
Percent Solids:	92%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Volatile Organics by GC/MS - Westborough Lab						
Methylene chloride	ND		ug/kg	11	2.2	1
1,1-Dichloroethane	ND		ug/kg	1.6	0.19	1
Chloroform	ND		ug/kg	1.6	0.40	1
Carbon tetrachloride	ND		ug/kg	1.1	0.23	1
1,2-Dichloropropane	ND		ug/kg	3.8	0.25	1
Dibromochloromethane	ND		ug/kg	1.1	0.33	1
1,1,2-Trichloroethane	ND		ug/kg	1.6	0.33	1
Tetrachloroethene	ND		ug/kg	1.1	0.15	1
Chlorobenzene	ND		ug/kg	1.1	0.38	1
Trichlorofluoromethane	ND		ug/kg	5.4	0.13	1
1,2-Dichloroethane	ND		ug/kg	1.1	0.16	1
1,1,1-Trichloroethane	ND		ug/kg	1.1	0.12	1
Bromodichloromethane	ND		ug/kg	1.1	0.25	1
trans-1,3-Dichloropropene	ND		ug/kg	1.1	0.13	1
cis-1,3-Dichloropropene	ND		ug/kg	1.1	0.14	1
1,1-Dichloropropene	ND		ug/kg	5.4	0.49	1
Bromoform	ND		ug/kg	4.3	0.45	1
1,1,2,2-Tetrachloroethane	ND		ug/kg	1.1	0.18	1
Benzene	ND		ug/kg	1.1	0.13	1
Toluene	ND		ug/kg	1.6	0.12	1
Ethylbenzene	ND		ug/kg	1.1	0.16	1
Chloromethane	ND		ug/kg	5.4	0.85	1
Bromomethane	ND		ug/kg	2.2	0.37	1
Vinyl chloride	ND		ug/kg	2.2	0.15	1
Chloroethane	ND		ug/kg	2.2	0.34	1
1,1-Dichloroethene	ND		ug/kg	1.1	0.22	1
trans-1,2-Dichloroethene	ND		ug/kg	1.6	0.23	1
Trichloroethene	ND		ug/kg	1.1	0.16	1
1,2-Dichlorobenzene	ND		ug/kg	5.4	0.20	1
1,3-Dichlorobenzene	ND		ug/kg	5.4	0.20	1
1,4-Dichlorobenzene	ND		ug/kg	5.4	0.26	1

SAMPLE RESULTS

Lab ID:	L1406459-06	Date Collected:	03/26/14 14:30
Client ID:	IB-5	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Methyl tert butyl ether	ND		ug/kg	2.2	0.11	1
p/m-Xylene	ND		ug/kg	2.2	0.35	1
o-Xylene	ND		ug/kg	2.2	0.29	1
cis-1,2-Dichloroethene	ND		ug/kg	1.1	0.16	1
Dibromomethane	ND		ug/kg	11	0.18	1
Styrene	ND		ug/kg	2.2	0.34	1
Dichlorodifluoromethane	ND		ug/kg	11	0.24	1
Acetone	ND		ug/kg	11	3.4	1
Carbon disulfide	ND		ug/kg	11	2.2	1
2-Butanone	ND		ug/kg	11	0.38	1
Vinyl acetate	ND		ug/kg	11	0.52	1
4-Methyl-2-pentanone	ND		ug/kg	11	0.26	1
1,2,3-Trichloropropane	ND		ug/kg	11	0.24	1
2-Hexanone	ND		ug/kg	11	0.20	1
Bromochloromethane	ND		ug/kg	5.4	0.21	1
2,2-Dichloropropane	ND		ug/kg	5.4	0.24	1
1,2-Dibromoethane	ND		ug/kg	4.3	0.19	1
1,3-Dichloropropane	ND		ug/kg	5.4	0.19	1
1,1,1,2-Tetrachloroethane	ND		ug/kg	1.1	0.34	1
Bromobenzene	ND		ug/kg	5.4	0.23	1
n-Butylbenzene	ND		ug/kg	1.1	0.21	1
sec-Butylbenzene	ND		ug/kg	1.1	0.22	1
tert-Butylbenzene	ND		ug/kg	5.4	0.61	1
o-Chlorotoluene	ND		ug/kg	5.4	0.17	1
p-Chlorotoluene	ND		ug/kg	5.4	0.17	1
1,2-Dibromo-3-chloropropane	ND		ug/kg	5.4	0.86	1
Hexachlorobutadiene	ND		ug/kg	5.4	0.46	1
Isopropylbenzene	ND		ug/kg	1.1	0.18	1
p-Isopropyltoluene	ND		ug/kg	1.1	0.21	1
Acrylonitrile	ND		ug/kg	11	0.26	1
n-Propylbenzene	ND		ug/kg	1.1	0.14	1
1,2,3-Trichlorobenzene	14		ug/kg	5.4	0.18	1
1,2,4-Trichlorobenzene	60		ug/kg	5.4	0.86	1
1,3,5-Trimethylbenzene	ND		ug/kg	5.4	0.16	1
1,2,4-Trimethylbenzene	ND		ug/kg	5.4	0.62	1
1,4-Dioxane	ND		ug/kg	110	19.	1
1,4-Diethylbenzene	0.57	J	ug/kg	4.3	0.17	1
4-Ethyltoluene	0.31	J	ug/kg	4.3	0.13	1
1,2,4,5-Tetramethylbenzene	0.52	J	ug/kg	4.3	0.14	1

SAMPLE RESULTS

Lab ID:	L1406459-06	Date Collected:	03/26/14 14:30
Client ID:	IB-5	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Volatile Organics by GC/MS - Westborough Lab						
Ethyl ether	ND		ug/kg	5.4	0.29	1
trans-1,4-Dichloro-2-butene	ND		ug/kg	5.4	0.48	1
Tentatively Identified Compounds						
Unknown	68	J	ug/kg			1
Unknown	110	J	ug/kg			1
Unknown	57	J	ug/kg			1
Unknown	100	J	ug/kg			1
Unknown Naphthalene	100	J	ug/kg			1
Unknown	52	J	ug/kg			1
Unknown	89	J	ug/kg			1
Unknown Naphthalene	140	J	ug/kg			1
Unknown	62	J	ug/kg			1
Unknown	64	J	ug/kg			1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	99		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	101		70-130
Dibromofluoromethane	98		70-130

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 03/31/14 08:37
Analyst: BN

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 04-06 Batch: WG679270-3					
Methylene chloride	ND		ug/kg	10	2.0
1,1-Dichloroethane	ND		ug/kg	1.5	0.18
Chloroform	ND		ug/kg	1.5	0.37
Carbon tetrachloride	ND		ug/kg	1.0	0.21
1,2-Dichloropropane	ND		ug/kg	3.5	0.23
Dibromochloromethane	ND		ug/kg	1.0	0.31
2-Chloroethylvinyl ether	ND		ug/kg	20	0.62
1,1,2-Trichloroethane	ND		ug/kg	1.5	0.30
Tetrachloroethene	ND		ug/kg	1.0	0.14
Chlorobenzene	ND		ug/kg	1.0	0.35
Trichlorofluoromethane	ND		ug/kg	5.0	0.12
1,2-Dichloroethane	ND		ug/kg	1.0	0.15
1,1,1-Trichloroethane	ND		ug/kg	1.0	0.11
Bromodichloromethane	ND		ug/kg	1.0	0.23
trans-1,3-Dichloropropene	ND		ug/kg	1.0	0.12
cis-1,3-Dichloropropene	ND		ug/kg	1.0	0.13
1,1-Dichloropropene	ND		ug/kg	5.0	0.46
Bromoform	ND		ug/kg	4.0	0.41
1,1,2,2-Tetrachloroethane	ND		ug/kg	1.0	0.17
Benzene	ND		ug/kg	1.0	0.12
Toluene	0.20	J	ug/kg	1.5	0.11
Ethylbenzene	ND		ug/kg	1.0	0.15
Chloromethane	ND		ug/kg	5.0	0.78
Bromomethane	ND		ug/kg	2.0	0.34
Vinyl chloride	ND		ug/kg	2.0	0.14
Chloroethane	ND		ug/kg	2.0	0.32
1,1-Dichloroethene	ND		ug/kg	1.0	0.20
trans-1,2-Dichloroethene	ND		ug/kg	1.5	0.21
Trichloroethene	ND		ug/kg	1.0	0.15
1,2-Dichlorobenzene	ND		ug/kg	5.0	0.18
1,3-Dichlorobenzene	ND		ug/kg	5.0	0.18

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 03/31/14 08:37
Analyst: BN

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 04-06 Batch: WG679270-3					
1,4-Dichlorobenzene	ND		ug/kg	5.0	0.24
Methyl tert butyl ether	ND		ug/kg	2.0	0.10
p/m-Xylene	ND		ug/kg	2.0	0.32
o-Xylene	ND		ug/kg	2.0	0.27
cis-1,2-Dichloroethene	ND		ug/kg	1.0	0.15
Dibromomethane	ND		ug/kg	10	0.16
Styrene	ND		ug/kg	2.0	0.31
Dichlorodifluoromethane	ND		ug/kg	10	0.22
Acetone	ND		ug/kg	10	3.1
Carbon disulfide	ND		ug/kg	10	2.0
2-Butanone	ND		ug/kg	10	0.36
Vinyl acetate	ND		ug/kg	10	0.48
4-Methyl-2-pentanone	ND		ug/kg	10	0.24
1,2,3-Trichloropropane	ND		ug/kg	10	0.22
2-Hexanone	ND		ug/kg	10	0.19
Bromochloromethane	ND		ug/kg	5.0	0.20
2,2-Dichloropropane	ND		ug/kg	5.0	0.22
1,2-Dibromoethane	ND		ug/kg	4.0	0.18
1,3-Dichloropropane	ND		ug/kg	5.0	0.17
1,1,1,2-Tetrachloroethane	ND		ug/kg	1.0	0.32
Bromobenzene	ND		ug/kg	5.0	0.21
n-Butylbenzene	ND		ug/kg	1.0	0.20
sec-Butylbenzene	ND		ug/kg	1.0	0.20
tert-Butylbenzene	ND		ug/kg	5.0	0.56
o-Chlorotoluene	ND		ug/kg	5.0	0.16
p-Chlorotoluene	ND		ug/kg	5.0	0.15
1,2-Dibromo-3-chloropropane	ND		ug/kg	5.0	0.79
Hexachlorobutadiene	ND		ug/kg	5.0	0.42
Isopropylbenzene	ND		ug/kg	1.0	0.17
p-Isopropyltoluene	ND		ug/kg	1.0	0.19
Naphthalene	ND		ug/kg	5.0	0.77

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 03/31/14 08:37
Analyst: BN

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 04-06 Batch: WG679270-3					
Acrylonitrile	ND		ug/kg	10	0.24
Isopropyl Ether	ND		ug/kg	4.0	0.14
tert-Butyl Alcohol	ND		ug/kg	60	0.91
n-Propylbenzene	ND		ug/kg	1.0	0.12
1,2,3-Trichlorobenzene	ND		ug/kg	5.0	0.17
1,2,4-Trichlorobenzene	ND		ug/kg	5.0	0.79
1,3,5-Trimethylbenzene	ND		ug/kg	5.0	0.14
1,2,4-Trimethylbenzene	ND		ug/kg	5.0	0.57
Methyl Acetate	ND		ug/kg	20	0.76
Ethyl Acetate	ND		ug/kg	20	0.82
Acrolein	ND		ug/kg	25	9.2
Cyclohexane	ND		ug/kg	20	1.1
1,4-Dioxane	ND		ug/kg	100	17.
1,1,2-Trichloro-1,2,2-Trifluoroethane	ND		ug/kg	20	0.27
1,4-Diethylbenzene	ND		ug/kg	4.0	0.16
4-Ethyltoluene	ND		ug/kg	4.0	0.12
1,2,4,5-Tetramethylbenzene	ND		ug/kg	4.0	0.13
Tetrahydrofuran	ND		ug/kg	20	0.38
Ethyl ether	ND		ug/kg	5.0	0.26
trans-1,4-Dichloro-2-butene	ND		ug/kg	5.0	0.45
Methyl cyclohexane	ND		ug/kg	4.0	1.3
Ethyl-Tert-Butyl-Ether	ND		ug/kg	4.0	0.42
Tertiary-Amyl Methyl Ether	ND		ug/kg	4.0	0.58

Tentatively Identified Compounds					
Unknown	2.6	J	ug/kg		

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8260C
Analytical Date: 03/31/14 08:37
Analyst: BN

Parameter	Result	Qualifier	Units	RL	MDL
Volatile Organics by GC/MS - Westborough Lab for sample(s): 04-06 Batch: WG679270-3					

Surrogate	%Recovery	Qualifier	Acceptance Criteria
1,2-Dichloroethane-d4	99		70-130
Toluene-d8	98		70-130
4-Bromofluorobenzene	99		70-130
Dibromofluoromethane	98		70-130

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 04-06 Batch: WG679270-1 WG679270-2

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Methylene chloride	100		99		70-130	1		30
1,1-Dichloroethane	101		97		70-130	4		30
Chloroform	100		98		70-130	2		30
Carbon tetrachloride	102		93		70-130	9		30
1,2-Dichloropropane	101		99		70-130	2		30
Dibromochloromethane	91		93		70-130	2		30
2-Chloroethylvinyl ether	96		100		70-130	4		30
1,1,2-Trichloroethane	95		98		70-130	3		30
Tetrachloroethene	93		88		70-130	6		30
Chlorobenzene	95		92		70-130	3		30
Trichlorofluoromethane	118		104		70-139	13		30
1,2-Dichloroethane	100		102		70-130	2		30
1,1,1-Trichloroethane	100		93		70-130	7		30
Bromodichloromethane	99		99		70-130	0		30
trans-1,3-Dichloropropene	94		96		70-130	2		30
cis-1,3-Dichloropropene	100		100		70-130	0		30
1,1-Dichloropropene	102		93		70-130	9		30
Bromoform	87		90		70-130	3		30
1,1,2,2-Tetrachloroethane	92		96		70-130	4		30
Benzene	100		97		70-130	3		30
Toluene	92		90		70-130	2		30

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE. **Lab Number:** L1406459
Project Number: 0294-013-001 **Report Date:** 04/14/14

Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 04-06 Batch: WG679270-1 WG679270-2

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Ethylbenzene	94		90		70-130	4		30
Chloromethane	105		93		52-130	12		30
Bromomethane	110		94		57-147	16		30
Vinyl chloride	114		102		67-130	11		30
Chloroethane	128		116		50-151	10		30
1,1-Dichloroethene	102		94		65-135	8		30
trans-1,2-Dichloroethene	99		93		70-130	6		30
Trichloroethene	101		95		70-130	6		30
1,2-Dichlorobenzene	92		92		70-130	0		30
1,3-Dichlorobenzene	92		91		70-130	1		30
1,4-Dichlorobenzene	93		91		70-130	2		30
Methyl tert butyl ether	98		100		66-130	2		30
p/m-Xylene	95		91		70-130	4		30
o-Xylene	94		92		70-130	2		30
cis-1,2-Dichloroethene	100		97		70-130	3		30
Dibromomethane	100		102		70-130	2		30
Styrene	92		92		70-130	0		30
Dichlorodifluoromethane	112		98		30-146	13		30
Acetone	94		109		54-140	15		30
Carbon disulfide	98		90		59-130	9		30
2-Butanone	94		95		70-130	1		30

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 04-06 Batch: WG679270-1 WG679270-2								
Vinyl acetate	97		99		70-130	2		30
4-Methyl-2-pentanone	94		101		70-130	7		30
1,2,3-Trichloropropane	95		98		68-130	3		30
2-Hexanone	84		90		70-130	7		30
Bromochloromethane	102		103		70-130	1		30
2,2-Dichloropropane	102		93		70-130	9		30
1,2-Dibromoethane	92		95		70-130	3		30
1,3-Dichloropropane	96		98		69-130	2		30
1,1,1,2-Tetrachloroethane	93		92		70-130	1		30
Bromobenzene	91		91		70-130	0		30
n-Butylbenzene	95		89		70-130	7		30
sec-Butylbenzene	94		88		70-130	7		30
tert-Butylbenzene	92		88		70-130	4		30
o-Chlorotoluene	101		99		70-130	2		30
p-Chlorotoluene	94		92		70-130	2		30
1,2-Dibromo-3-chloropropane	86		88		68-130	2		30
Hexachlorobutadiene	92		86		67-130	7		30
Isopropylbenzene	91		88		70-130	3		30
p-Isopropyltoluene	92		88		70-130	4		30
Naphthalene	89		92		70-130	3		30
Acrylonitrile	100		105		70-130	5		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 04-06 Batch: WG679270-1 WG679270-2								
Isopropyl Ether	100		99		66-130	1		30
tert-Butyl Alcohol	94		96		70-130	2		30
n-Propylbenzene	94		89		70-130	5		30
1,2,3-Trichlorobenzene	91		91		70-130	0		30
1,2,4-Trichlorobenzene	93		91		70-130	2		30
1,3,5-Trimethylbenzene	94		90		70-130	4		30
1,2,4-Trimethylbenzene	93		90		70-130	3		30
Methyl Acetate	99		103		51-146	4		30
Ethyl Acetate	98		102		70-130	4		30
Acrolein	94		97		70-130	3		30
Cyclohexane	107		96		59-142	11		30
1,4-Dioxane	103		110		65-136	7		30
1,1,2-Trichloro-1,2,2-Trifluoroethane	109		97		50-139	12		30
1,4-Diethylbenzene	92		88		70-130	4		30
4-Ethyltoluene	93		89		70-130	4		30
1,2,4,5-Tetramethylbenzene	92		89		70-130	3		30
Tetrahydrofuran	98		107		66-130	9		30
Ethyl ether	102		101		67-130	1		30
trans-1,4-Dichloro-2-butene	94		99		70-130	5		30
Methyl cyclohexane	107		95		70-130	12		30
Ethyl-Tert-Butyl-Ether	99		100		70-130	1		30

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.

Project Number: 0294-013-001

Lab Number: L1406459

Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Volatile Organics by GC/MS - Westborough Lab Associated sample(s): 04-06 Batch: WG679270-1 WG679270-2								
Tertiary-Amyl Methyl Ether	98		99		70-130	1		30

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
1,2-Dichloroethane-d4	99		99		70-130
Toluene-d8	96		98		70-130
4-Bromofluorobenzene	98		99		70-130
Dibromofluoromethane	99		99		70-130

SEMIVOLATILES

SAMPLE RESULTS

Lab ID:	L1406459-01	Date Collected:	03/26/14 09:05
Client ID:	TP-1 (2-3)	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	03/28/14 02:56
Analytical Date:	03/29/14 18:34		
Analyst:	JB		
Percent Solids:	81%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	97	J	ug/kg	160	42.	1
1,2,4-Trichlorobenzene	ND		ug/kg	200	67.	1
Hexachlorobenzene	ND		ug/kg	120	38.	1
Bis(2-chloroethyl)ether	ND		ug/kg	180	57.	1
2-Chloronaphthalene	ND		ug/kg	200	66.	1
1,2-Dichlorobenzene	ND		ug/kg	200	67.	1
1,3-Dichlorobenzene	ND		ug/kg	200	64.	1
1,4-Dichlorobenzene	ND		ug/kg	200	62.	1
3,3'-Dichlorobenzidine	ND		ug/kg	200	54.	1
2,4-Dinitrotoluene	ND		ug/kg	200	44.	1
2,6-Dinitrotoluene	ND		ug/kg	200	52.	1
Fluoranthene	1100		ug/kg	120	37.	1
4-Chlorophenyl phenyl ether	ND		ug/kg	200	62.	1
4-Bromophenyl phenyl ether	ND		ug/kg	200	47.	1
Bis(2-chloroisopropyl)ether	ND		ug/kg	240	72.	1
Bis(2-chloroethoxy)methane	ND		ug/kg	220	62.	1
Hexachlorobutadiene	ND		ug/kg	200	57.	1
Hexachlorocyclopentadiene	ND		ug/kg	580	130	1
Hexachloroethane	ND		ug/kg	160	37.	1
Isophorone	ND		ug/kg	180	54.	1
Naphthalene	160	J	ug/kg	200	68.	1
Nitrobenzene	ND		ug/kg	180	48.	1
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	160	43.	1
n-Nitrosodi-n-propylamine	ND		ug/kg	200	61.	1
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	200	53.	1
Butyl benzyl phthalate	ND		ug/kg	200	40.	1
Di-n-butylphthalate	ND		ug/kg	200	39.	1
Di-n-octylphthalate	ND		ug/kg	200	50.	1
Diethyl phthalate	ND		ug/kg	200	43.	1
Dimethyl phthalate	ND		ug/kg	200	52.	1
Benzo(a)anthracene	440		ug/kg	120	40.	1

SAMPLE RESULTS

Lab ID:	L1406459-01	Date Collected:	03/26/14 09:05
Client ID:	TP-1 (2-3)	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Benzo(a)pyrene	350		ug/kg	160	50.	1
Benzo(b)fluoranthene	410		ug/kg	120	41.	1
Benzo(k)fluoranthene	180		ug/kg	120	39.	1
Chrysene	390		ug/kg	120	40.	1
Acenaphthylene	ND		ug/kg	160	38.	1
Anthracene	240		ug/kg	120	34.	1
Benzo(ghi)perylene	190		ug/kg	160	42.	1
Fluorene	110	J	ug/kg	200	58.	1
Phenanthrene	1000		ug/kg	120	40.	1
Dibenzo(a,h)anthracene	49	J	ug/kg	120	39.	1
Indeno(1,2,3-cd)Pyrene	230		ug/kg	160	45.	1
Pyrene	830		ug/kg	120	40.	1
Biphenyl	ND		ug/kg	460	67.	1
4-Chloroaniline	ND		ug/kg	200	54.	1
2-Nitroaniline	ND		ug/kg	200	57.	1
3-Nitroaniline	ND		ug/kg	200	56.	1
4-Nitroaniline	ND		ug/kg	200	55.	1
Dibenzofuran	110	J	ug/kg	200	68.	1
2-Methylnaphthalene	240		ug/kg	240	65.	1
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	200	63.	1
Acetophenone	ND		ug/kg	200	63.	1
Benzyl Alcohol	ND		ug/kg	200	63.	1
Carbazole	98	J	ug/kg	200	44.	1
Benzaldehyde	ND		ug/kg	270	82.	1
Caprolactam	ND		ug/kg	200	56.	1
Atrazine	ND		ug/kg	160	46.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	66		23-120
2-Fluorobiphenyl	63		30-120
4-Terphenyl-d14	77		18-120

SAMPLE RESULTS

Lab ID:	L1406459-02	Date Collected:	03/26/14 13:41
Client ID:	IB-1	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	03/28/14 02:56
Analytical Date:	03/29/14 19:01		
Analyst:	JB		
Percent Solids:	83%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	160	41.	1
1,2,4-Trichlorobenzene	ND		ug/kg	200	65.	1
Hexachlorobenzene	ND		ug/kg	120	37.	1
Bis(2-chloroethyl)ether	ND		ug/kg	180	56.	1
2-Chloronaphthalene	ND		ug/kg	200	65.	1
1,2-Dichlorobenzene	ND		ug/kg	200	65.	1
1,3-Dichlorobenzene	ND		ug/kg	200	63.	1
1,4-Dichlorobenzene	ND		ug/kg	200	60.	1
3,3'-Dichlorobenzidine	ND		ug/kg	200	53.	1
2,4-Dinitrotoluene	ND		ug/kg	200	43.	1
2,6-Dinitrotoluene	ND		ug/kg	200	51.	1
Fluoranthene	ND		ug/kg	120	36.	1
4-Chlorophenyl phenyl ether	ND		ug/kg	200	60.	1
4-Bromophenyl phenyl ether	ND		ug/kg	200	46.	1
Bis(2-chloroisopropyl)ether	ND		ug/kg	240	70.	1
Bis(2-chloroethoxy)methane	ND		ug/kg	210	60.	1
Hexachlorobutadiene	ND		ug/kg	200	56.	1
Hexachlorocyclopentadiene	ND		ug/kg	570	130	1
Hexachloroethane	ND		ug/kg	160	36.	1
Isophorone	ND		ug/kg	180	53.	1
Naphthalene	ND		ug/kg	200	66.	1
Nitrobenzene	ND		ug/kg	180	47.	1
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	160	42.	1
n-Nitrosodi-n-propylamine	ND		ug/kg	200	59.	1
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	200	52.	1
Butyl benzyl phthalate	ND		ug/kg	200	39.	1
Di-n-butylphthalate	ND		ug/kg	200	38.	1
Di-n-octylphthalate	ND		ug/kg	200	49.	1
Diethyl phthalate	ND		ug/kg	200	42.	1
Dimethyl phthalate	ND		ug/kg	200	50.	1
Benzo(a)anthracene	ND		ug/kg	120	39.	1

SAMPLE RESULTS

Lab ID:	L1406459-02	Date Collected:	03/26/14 13:41
Client ID:	IB-1	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Benzo(a)pyrene	ND		ug/kg	160	49.	1
Benzo(b)fluoranthene	ND		ug/kg	120	40.	1
Benzo(k)fluoranthene	ND		ug/kg	120	38.	1
Chrysene	ND		ug/kg	120	39.	1
Acenaphthylene	ND		ug/kg	160	37.	1
Anthracene	ND		ug/kg	120	33.	1
Benzo(ghi)perylene	ND		ug/kg	160	41.	1
Fluorene	ND		ug/kg	200	57.	1
Phenanthrene	ND		ug/kg	120	39.	1
Dibenzo(a,h)anthracene	ND		ug/kg	120	38.	1
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	160	44.	1
Pyrene	ND		ug/kg	120	39.	1
Biphenyl	ND		ug/kg	450	66.	1
4-Chloroaniline	ND		ug/kg	200	52.	1
2-Nitroaniline	ND		ug/kg	200	56.	1
3-Nitroaniline	ND		ug/kg	200	55.	1
4-Nitroaniline	ND		ug/kg	200	54.	1
Dibenzofuran	ND		ug/kg	200	66.	1
2-Methylnaphthalene	ND		ug/kg	240	63.	1
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	200	62.	1
Acetophenone	ND		ug/kg	200	62.	1
Benzyl Alcohol	ND		ug/kg	200	61.	1
Carbazole	ND		ug/kg	200	43.	1
Benzaldehyde	ND		ug/kg	260	80.	1
Caprolactam	ND		ug/kg	200	55.	1
Atrazine	ND		ug/kg	160	45.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	67		23-120
2-Fluorobiphenyl	60		30-120
4-Terphenyl-d14	70		18-120

SAMPLE RESULTS

Lab ID: L1406459-03
Client ID: IB-2
Sample Location: 401 BUFFALO AVE.
Matrix: Soil
Analytical Method: 1,8270D
Analytical Date: 04/11/14 01:22
Analyst: RC
Percent Solids: 79%

Date Collected: 03/26/14 13:57
Date Received: 03/27/14
Field Prep: Not Specified
Extraction Method: EPA 3546
Extraction Date: 04/07/14 16:02

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	170	43.	1
1,2,4-Trichlorobenzene	ND		ug/kg	210	69.	1
Hexachlorobenzene	ND		ug/kg	130	39.	1
Bis(2-chloroethyl)ether	ND		ug/kg	190	59.	1
2-Chloronaphthalene	ND		ug/kg	210	68.	1
1,2-Dichlorobenzene	ND		ug/kg	210	69.	1
1,3-Dichlorobenzene	ND		ug/kg	210	66.	1
1,4-Dichlorobenzene	ND		ug/kg	210	64.	1
3,3'-Dichlorobenzidine	ND		ug/kg	210	56.	1
2,4-Dinitrotoluene	ND		ug/kg	210	45.	1
2,6-Dinitrotoluene	ND		ug/kg	210	54.	1
Fluoranthene	ND		ug/kg	130	38.	1
4-Chlorophenyl phenyl ether	ND		ug/kg	210	64.	1
4-Bromophenyl phenyl ether	ND		ug/kg	210	48.	1
Bis(2-chloroisopropyl)ether	ND		ug/kg	250	74.	1
Bis(2-chloroethoxy)methane	ND		ug/kg	230	64.	1
Hexachlorobutadiene	ND		ug/kg	210	59.	1
Hexachlorocyclopentadiene	ND		ug/kg	600	130	1
Hexachloroethane	ND		ug/kg	170	38.	1
Isophorone	ND		ug/kg	190	56.	1
Naphthalene	ND		ug/kg	210	70.	1
Nitrobenzene	ND		ug/kg	190	50.	1
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	170	44.	1
n-Nitrosodi-n-propylamine	ND		ug/kg	210	62.	1
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	210	55.	1
Butyl benzyl phthalate	ND		ug/kg	210	41.	1
Di-n-butylphthalate	ND		ug/kg	210	40.	1
Di-n-octylphthalate	ND		ug/kg	210	52.	1
Diethyl phthalate	ND		ug/kg	210	44.	1
Dimethyl phthalate	ND		ug/kg	210	53.	1
Benzo(a)anthracene	ND		ug/kg	130	41.	1

SAMPLE RESULTS

Lab ID:	L1406459-03	Date Collected:	03/26/14 13:57
Client ID:	IB-2	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Benzo(a)pyrene	ND		ug/kg	170	51.	1
Benzo(b)fluoranthene	ND		ug/kg	130	42.	1
Benzo(k)fluoranthene	ND		ug/kg	130	40.	1
Chrysene	ND		ug/kg	130	41.	1
Acenaphthylene	ND		ug/kg	170	39.	1
Anthracene	ND		ug/kg	130	35.	1
Benzo(ghi)perylene	ND		ug/kg	170	44.	1
Fluorene	ND		ug/kg	210	60.	1
Phenanthrene	ND		ug/kg	130	41.	1
Dibenzo(a,h)anthracene	ND		ug/kg	130	41.	1
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	170	47.	1
Pyrene	ND		ug/kg	130	41.	1
Biphenyl	ND		ug/kg	480	69.	1
4-Chloroaniline	ND		ug/kg	210	55.	1
2-Nitroaniline	ND		ug/kg	210	59.	1
3-Nitroaniline	ND		ug/kg	210	58.	1
4-Nitroaniline	ND		ug/kg	210	57.	1
Dibenzofuran	ND		ug/kg	210	70.	1
2-Methylnaphthalene	ND		ug/kg	250	67.	1
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	210	65.	1
Acetophenone	ND		ug/kg	210	65.	1
Benzyl Alcohol	ND		ug/kg	210	65.	1
Carbazole	ND		ug/kg	210	45.	1
Benzaldehyde	ND		ug/kg	280	85.	1
Caprolactam	ND		ug/kg	210	58.	1
Atrazine	ND		ug/kg	170	48.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	68		23-120
2-Fluorobiphenyl	66		30-120
4-Terphenyl-d14	76		18-120

SAMPLE RESULTS

Lab ID:	L1406459-04	Date Collected:	03/26/14 14:06
Client ID:	IB-3	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	03/28/14 02:56
Analytical Date:	03/29/14 19:28		
Analyst:	JB		
Percent Solids:	87%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	150	39.	1
1,2,4-Trichlorobenzene	ND		ug/kg	190	62.	1
Hexachlorobenzene	ND		ug/kg	110	36.	1
Bis(2-chloroethyl)ether	ND		ug/kg	170	53.	1
2-Chloronaphthalene	ND		ug/kg	190	62.	1
1,2-Dichlorobenzene	ND		ug/kg	190	62.	1
1,3-Dichlorobenzene	ND		ug/kg	190	60.	1
1,4-Dichlorobenzene	ND		ug/kg	190	58.	1
3,3'-Dichlorobenzidine	ND		ug/kg	190	51.	1
2,4-Dinitrotoluene	ND		ug/kg	190	41.	1
2,6-Dinitrotoluene	ND		ug/kg	190	49.	1
Fluoranthene	ND		ug/kg	110	35.	1
4-Chlorophenyl phenyl ether	ND		ug/kg	190	58.	1
4-Bromophenyl phenyl ether	ND		ug/kg	190	44.	1
Bis(2-chloroisopropyl)ether	ND		ug/kg	230	67.	1
Bis(2-chloroethoxy)methane	ND		ug/kg	200	58.	1
Hexachlorobutadiene	ND		ug/kg	190	54.	1
Hexachlorocyclopentadiene	ND		ug/kg	550	120	1
Hexachloroethane	ND		ug/kg	150	35.	1
Isophorone	ND		ug/kg	170	51.	1
Naphthalene	ND		ug/kg	190	63.	1
Nitrobenzene	ND		ug/kg	170	45.	1
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	150	40.	1
n-Nitrosodi-n-propylamine	ND		ug/kg	190	57.	1
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	190	50.	1
Butyl benzyl phthalate	ND		ug/kg	190	37.	1
Di-n-butylphthalate	ND		ug/kg	190	37.	1
Di-n-octylphthalate	ND		ug/kg	190	47.	1
Diethyl phthalate	ND		ug/kg	190	40.	1
Dimethyl phthalate	ND		ug/kg	190	48.	1
Benzo(a)anthracene	ND		ug/kg	110	37.	1

SAMPLE RESULTS

Lab ID:	L1406459-04	Date Collected:	03/26/14 14:06
Client ID:	IB-3	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Benzo(a)pyrene	ND		ug/kg	150	47.	1
Benzo(b)fluoranthene	ND		ug/kg	110	38.	1
Benzo(k)fluoranthene	ND		ug/kg	110	36.	1
Chrysene	ND		ug/kg	110	37.	1
Acenaphthylene	ND		ug/kg	150	36.	1
Anthracene	ND		ug/kg	110	32.	1
Benzo(ghi)perylene	ND		ug/kg	150	40.	1
Fluorene	ND		ug/kg	190	55.	1
Phenanthrene	ND		ug/kg	110	37.	1
Dibenzo(a,h)anthracene	ND		ug/kg	110	37.	1
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	150	42.	1
Pyrene	ND		ug/kg	110	37.	1
Biphenyl	ND		ug/kg	430	63.	1
4-Chloroaniline	ND		ug/kg	190	50.	1
2-Nitroaniline	ND		ug/kg	190	54.	1
3-Nitroaniline	ND		ug/kg	190	52.	1
4-Nitroaniline	ND		ug/kg	190	51.	1
Dibenzofuran	ND		ug/kg	190	64.	1
2-Methylnaphthalene	ND		ug/kg	230	61.	1
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	190	59.	1
Acetophenone	ND		ug/kg	190	59.	1
Benzyl Alcohol	ND		ug/kg	190	59.	1
Carbazole	ND		ug/kg	190	41.	1
Benzaldehyde	ND		ug/kg	250	77.	1
Caprolactam	ND		ug/kg	190	52.	1
Atrazine	ND		ug/kg	150	43.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	70		23-120
2-Fluorobiphenyl	62		30-120
4-Terphenyl-d14	83		18-120

SAMPLE RESULTS

Lab ID:	L1406459-05	Date Collected:	03/26/14 14:20
Client ID:	IB-4	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	03/28/14 02:56
Analytical Date:	03/29/14 19:55		
Analyst:	JB		
Percent Solids:	91%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	290	76.	2
1,2,4-Trichlorobenzene	ND		ug/kg	370	120	2
Hexachlorobenzene	ND		ug/kg	220	68.	2
Bis(2-chloroethyl)ether	ND		ug/kg	330	100	2
2-Chloronaphthalene	ND		ug/kg	370	120	2
1,2-Dichlorobenzene	ND		ug/kg	370	120	2
1,3-Dichlorobenzene	ND		ug/kg	370	120	2
1,4-Dichlorobenzene	ND		ug/kg	370	110	2
3,3'-Dichlorobenzidine	ND		ug/kg	370	98.	2
2,4-Dinitrotoluene	ND		ug/kg	370	79.	2
2,6-Dinitrotoluene	ND		ug/kg	370	94.	2
Fluoranthene	ND		ug/kg	220	67.	2
4-Chlorophenyl phenyl ether	ND		ug/kg	370	110	2
4-Bromophenyl phenyl ether	ND		ug/kg	370	84.	2
Bis(2-chloroisopropyl)ether	ND		ug/kg	440	130	2
Bis(2-chloroethoxy)methane	ND		ug/kg	400	110	2
Hexachlorobutadiene	ND		ug/kg	370	100	2
Hexachlorocyclopentadiene	ND		ug/kg	1000	240	2
Hexachloroethane	ND		ug/kg	290	67.	2
Isophorone	ND		ug/kg	330	98.	2
Naphthalene	ND		ug/kg	370	120	2
Nitrobenzene	ND		ug/kg	330	87.	2
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	290	77.	2
n-Nitrosodi-n-propylamine	ND		ug/kg	370	110	2
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	370	96.	2
Butyl benzyl phthalate	ND		ug/kg	370	72.	2
Di-n-butylphthalate	ND		ug/kg	370	71.	2
Di-n-octylphthalate	ND		ug/kg	370	90.	2
Diethyl phthalate	ND		ug/kg	370	78.	2
Dimethyl phthalate	ND		ug/kg	370	93.	2
Benzo(a)anthracene	ND		ug/kg	220	72.	2

SAMPLE RESULTS

Lab ID:	L1406459-05	Date Collected:	03/26/14 14:20
Client ID:	IB-4	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Benzo(a)pyrene	ND		ug/kg	290	90.	2
Benzo(b)fluoranthene	ND		ug/kg	220	74.	2
Benzo(k)fluoranthene	ND		ug/kg	220	70.	2
Chrysene	ND		ug/kg	220	72.	2
Acenaphthylene	ND		ug/kg	290	69.	2
Anthracene	ND		ug/kg	220	61.	2
Benzo(ghi)perylene	ND		ug/kg	290	76.	2
Fluorene	ND		ug/kg	370	100	2
Phenanthrene	ND		ug/kg	220	72.	2
Dibenzo(a,h)anthracene	ND		ug/kg	220	71.	2
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	290	82.	2
Pyrene	ND		ug/kg	220	71.	2
Biphenyl	ND		ug/kg	840	120	2
4-Chloroaniline	ND		ug/kg	370	97.	2
2-Nitroaniline	ND		ug/kg	370	100	2
3-Nitroaniline	ND		ug/kg	370	100	2
4-Nitroaniline	ND		ug/kg	370	99.	2
Dibenzofuran	ND		ug/kg	370	120	2
2-Methylnaphthalene	ND		ug/kg	440	120	2
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	370	110	2
Acetophenone	ND		ug/kg	370	110	2
Benzyl Alcohol	ND		ug/kg	370	110	2
Carbazole	ND		ug/kg	370	79.	2
Benzaldehyde	ND		ug/kg	480	150	2
Caprolactam	ND		ug/kg	370	100	2
Atrazine	ND		ug/kg	290	83.	2

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	91		23-120
2-Fluorobiphenyl	90		30-120
4-Terphenyl-d14	66		18-120

SAMPLE RESULTS

Lab ID: L1406459-06
Client ID: IB-5
Sample Location: 401 BUFFALO AVE.
Matrix: Soil
Analytical Method: 1,8270D
Analytical Date: 03/29/14 20:22
Analyst: JB
Percent Solids: 92%

Date Collected: 03/26/14 14:30
Date Received: 03/27/14
Field Prep: Not Specified
Extraction Method: EPA 3546
Extraction Date: 03/28/14 02:56

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	140	37.	1
1,2,4-Trichlorobenzene	67	J	ug/kg	180	59.	1
Hexachlorobenzene	ND		ug/kg	110	33.	1
Bis(2-chloroethyl)ether	ND		ug/kg	160	50.	1
2-Chloronaphthalene	ND		ug/kg	180	58.	1
1,2-Dichlorobenzene	ND		ug/kg	180	59.	1
1,3-Dichlorobenzene	ND		ug/kg	180	56.	1
1,4-Dichlorobenzene	ND		ug/kg	180	54.	1
3,3'-Dichlorobenzidine	ND		ug/kg	180	48.	1
2,4-Dinitrotoluene	ND		ug/kg	180	39.	1
2,6-Dinitrotoluene	ND		ug/kg	180	46.	1
Fluoranthene	ND		ug/kg	110	33.	1
4-Chlorophenyl phenyl ether	ND		ug/kg	180	54.	1
4-Bromophenyl phenyl ether	ND		ug/kg	180	41.	1
Bis(2-chloroisopropyl)ether	ND		ug/kg	220	63.	1
Bis(2-chloroethoxy)methane	ND		ug/kg	190	54.	1
Hexachlorobutadiene	ND		ug/kg	180	50.	1
Hexachlorocyclopentadiene	ND		ug/kg	510	120	1
Hexachloroethane	ND		ug/kg	140	33.	1
Isophorone	ND		ug/kg	160	48.	1
Naphthalene	ND		ug/kg	180	60.	1
Nitrobenzene	ND		ug/kg	160	43.	1
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	140	38.	1
n-Nitrosodi-n-propylamine	ND		ug/kg	180	53.	1
Bis(2-Ethylhexyl)phthalate	300		ug/kg	180	47.	1
Butyl benzyl phthalate	ND		ug/kg	180	35.	1
Di-n-butylphthalate	ND		ug/kg	180	35.	1
Di-n-octylphthalate	ND		ug/kg	180	44.	1
Diethyl phthalate	ND		ug/kg	180	38.	1
Dimethyl phthalate	ND		ug/kg	180	46.	1
Benzo(a)anthracene	ND		ug/kg	110	35.	1

SAMPLE RESULTS

Lab ID:	L1406459-06	Date Collected:	03/26/14 14:30
Client ID:	IB-5	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Benzo(a)pyrene	ND		ug/kg	140	44.	1
Benzo(b)fluoranthene	ND		ug/kg	110	36.	1
Benzo(k)fluoranthene	ND		ug/kg	110	34.	1
Chrysene	ND		ug/kg	110	35.	1
Acenaphthylene	ND		ug/kg	140	34.	1
Anthracene	ND		ug/kg	110	30.	1
Benzo(ghi)perylene	ND		ug/kg	140	37.	1
Fluorene	ND		ug/kg	180	51.	1
Phenanthrene	ND		ug/kg	110	35.	1
Dibenzo(a,h)anthracene	ND		ug/kg	110	35.	1
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	140	40.	1
Pyrene	ND		ug/kg	110	35.	1
Biphenyl	ND		ug/kg	410	59.	1
4-Chloroaniline	ND		ug/kg	180	47.	1
2-Nitroaniline	ND		ug/kg	180	50.	1
3-Nitroaniline	ND		ug/kg	180	49.	1
4-Nitroaniline	ND		ug/kg	180	48.	1
Dibenzofuran	ND		ug/kg	180	60.	1
2-Methylnaphthalene	ND		ug/kg	220	57.	1
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	180	56.	1
Acetophenone	ND		ug/kg	180	56.	1
Benzyl Alcohol	ND		ug/kg	180	55.	1
Carbazole	ND		ug/kg	180	38.	1
Benzaldehyde	ND		ug/kg	240	72.	1
Caprolactam	ND		ug/kg	180	49.	1
Atrazine	ND		ug/kg	140	41.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	78		23-120
2-Fluorobiphenyl	87		30-120
4-Terphenyl-d14	110		18-120

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 03/28/14 19:11
Analyst: JB

Extraction Method: EPA 3546
Extraction Date: 03/28/14 02:56

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-02,04-06 Batch: WG678534-1					
Acenaphthene	ND		ug/kg	130	34.
1,2,4-Trichlorobenzene	ND		ug/kg	170	54.
Hexachlorobenzene	ND		ug/kg	100	31.
Bis(2-chloroethyl)ether	ND		ug/kg	150	46.
2-Chloronaphthalene	ND		ug/kg	170	54.
1,2-Dichlorobenzene	ND		ug/kg	170	54.
1,3-Dichlorobenzene	ND		ug/kg	170	52.
1,4-Dichlorobenzene	ND		ug/kg	170	50.
3,3'-Dichlorobenzidine	ND		ug/kg	170	44.
2,4-Dinitrotoluene	ND		ug/kg	170	36.
2,6-Dinitrotoluene	ND		ug/kg	170	42.
Fluoranthene	ND		ug/kg	100	30.
4-Chlorophenyl phenyl ether	ND		ug/kg	170	50.
4-Bromophenyl phenyl ether	ND		ug/kg	170	38.
Bis(2-chloroisopropyl)ether	ND		ug/kg	200	58.
Bis(2-chloroethoxy)methane	ND		ug/kg	180	50.
Hexachlorobutadiene	ND		ug/kg	170	47.
Hexachlorocyclopentadiene	ND		ug/kg	480	110
Hexachloroethane	ND		ug/kg	130	30.
Isophorone	ND		ug/kg	150	44.
Naphthalene	ND		ug/kg	170	55.
Nitrobenzene	ND		ug/kg	150	40.
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	130	35.
n-Nitrosodi-n-propylamine	ND		ug/kg	170	49.
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	170	44.
Butyl benzyl phthalate	ND		ug/kg	170	32.
Di-n-butylphthalate	ND		ug/kg	170	32.
Di-n-octylphthalate	ND		ug/kg	170	41.
Diethyl phthalate	ND		ug/kg	170	35.
Dimethyl phthalate	ND		ug/kg	170	42.

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 03/28/14 19:11
Analyst: JB

Extraction Method: EPA 3546
Extraction Date: 03/28/14 02:56

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-02,04-06 Batch: WG678534-1					
Benzo(a)anthracene	ND		ug/kg	100	32.
Benzo(a)pyrene	ND		ug/kg	130	41.
Benzo(b)fluoranthene	ND		ug/kg	100	34.
Benzo(k)fluoranthene	ND		ug/kg	100	32.
Chrysene	ND		ug/kg	100	33.
Acenaphthylene	ND		ug/kg	130	31.
Anthracene	ND		ug/kg	100	28.
Benzo(ghi)perylene	ND		ug/kg	130	34.
Fluorene	ND		ug/kg	170	48.
Phenanthrene	ND		ug/kg	100	32.
Dibenzo(a,h)anthracene	ND		ug/kg	100	32.
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	130	37.
Pyrene	ND		ug/kg	100	32.
Biphenyl	ND		ug/kg	380	55.
4-Chloroaniline	ND		ug/kg	170	44.
2-Nitroaniline	ND		ug/kg	170	47.
3-Nitroaniline	ND		ug/kg	170	46.
4-Nitroaniline	ND		ug/kg	170	45.
Dibenzofuran	ND		ug/kg	170	55.
2-Methylnaphthalene	ND		ug/kg	200	53.
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	170	51.
Acetophenone	ND		ug/kg	170	51.
2,4,6-Trichlorophenol	ND		ug/kg	100	31.
P-Chloro-M-Cresol	ND		ug/kg	170	48.
2-Chlorophenol	ND		ug/kg	170	50.
2,4-Dichlorophenol	ND		ug/kg	150	54.
2,4-Dimethylphenol	ND		ug/kg	170	49.
2-Nitrophenol	ND		ug/kg	360	52.
4-Nitrophenol	ND		ug/kg	230	54.
2,4-Dinitrophenol	ND		ug/kg	800	230

Method Blank Analysis
Batch Quality Control

Analytical Method:	1,8270D	Extraction Method:	EPA 3546
Analytical Date:	03/28/14 19:11	Extraction Date:	03/28/14 02:56
Analyst:	JB		

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-02,04-06 Batch: WG678534-1					
4,6-Dinitro-o-cresol	ND		ug/kg	430	61.
Pentachlorophenol	ND		ug/kg	130	36.
Phenol	ND		ug/kg	170	49.
2-Methylphenol	ND		ug/kg	170	53.
3-Methylphenol/4-Methylphenol	ND		ug/kg	240	54.
2,4,5-Trichlorophenol	ND		ug/kg	170	54.
Benzoic Acid	ND		ug/kg	540	170
Benzyl Alcohol	ND		ug/kg	170	51.
Carbazole	ND		ug/kg	170	36.
Benzaldehyde	ND		ug/kg	220	67.
Caprolactam	ND		ug/kg	170	46.
Atrazine	ND		ug/kg	130	38.

Tentatively Identified Compounds		
No Tentatively Identified Compounds	ND	ug/kg

Surrogate	%Recovery	Qualifier	Acceptance Criteria
2-Fluorophenol	79		25-120
Phenol-d6	76		10-120
Nitrobenzene-d5	70		23-120
2-Fluorobiphenyl	80		30-120
2,4,6-Tribromophenol	62		0-136
4-Terphenyl-d14	99		18-120

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 04/10/14 20:42
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 04/07/14 16:02

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 03 Batch: WG680622-1					
Acenaphthene	ND		ug/kg	130	34.
1,2,4-Trichlorobenzene	ND		ug/kg	160	53.
Hexachlorobenzene	ND		ug/kg	98	30.
Bis(2-chloroethyl)ether	ND		ug/kg	150	46.
2-Chloronaphthalene	ND		ug/kg	160	53.
1,2-Dichlorobenzene	ND		ug/kg	160	54.
1,3-Dichlorobenzene	ND		ug/kg	160	51.
1,4-Dichlorobenzene	ND		ug/kg	160	50.
3,3'-Dichlorobenzidine	ND		ug/kg	160	43.
2,4-Dinitrotoluene	ND		ug/kg	160	35.
2,6-Dinitrotoluene	ND		ug/kg	160	42.
Fluoranthene	ND		ug/kg	98	30.
4-Chlorophenyl phenyl ether	ND		ug/kg	160	50.
4-Bromophenyl phenyl ether	ND		ug/kg	160	38.
Bis(2-chloroisopropyl)ether	ND		ug/kg	200	57.
Bis(2-chloroethoxy)methane	ND		ug/kg	180	49.
Hexachlorobutadiene	ND		ug/kg	160	46.
Hexachlorocyclopentadiene	ND		ug/kg	470	100
Hexachloroethane	ND		ug/kg	130	30.
Isophorone	ND		ug/kg	150	43.
Naphthalene	ND		ug/kg	160	54.
Nitrobenzene	ND		ug/kg	150	39.
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	130	34.
n-Nitrosodi-n-propylamine	ND		ug/kg	160	49.
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	160	43.
Butyl benzyl phthalate	ND		ug/kg	160	32.
Di-n-butylphthalate	ND		ug/kg	160	31.
Di-n-octylphthalate	ND		ug/kg	160	40.
Diethyl phthalate	ND		ug/kg	160	34.
Dimethyl phthalate	ND		ug/kg	160	41.
Benzo(a)anthracene	ND		ug/kg	98	32.

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 04/10/14 20:42
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 04/07/14 16:02

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 03 Batch: WG680622-1					
Benzo(a)pyrene	ND		ug/kg	130	40.
Benzo(b)fluoranthene	ND		ug/kg	98	33.
Benzo(k)fluoranthene	ND		ug/kg	98	31.
Chrysene	ND		ug/kg	98	32.
Acenaphthylene	ND		ug/kg	130	30.
Anthracene	ND		ug/kg	98	27.
Benzo(ghi)perylene	ND		ug/kg	130	34.
Fluorene	ND		ug/kg	160	47.
Phenanthrene	ND		ug/kg	98	32.
Dibenzo(a,h)anthracene	ND		ug/kg	98	32.
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	130	36.
Pyrene	ND		ug/kg	98	32.
Biphenyl	ND		ug/kg	370	54.
4-Chloroaniline	ND		ug/kg	160	43.
2-Nitroaniline	ND		ug/kg	160	46.
3-Nitroaniline	ND		ug/kg	160	45.
4-Nitroaniline	ND		ug/kg	160	44.
Dibenzofuran	ND		ug/kg	160	54.
2-Methylnaphthalene	ND		ug/kg	200	52.
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	160	50.
Acetophenone	ND		ug/kg	160	50.
2,4,6-Trichlorophenol	ND		ug/kg	98	31.
P-Chloro-M-Cresol	ND		ug/kg	160	47.
2-Chlorophenol	ND		ug/kg	160	49.
2,4-Dichlorophenol	ND		ug/kg	150	53.
2,4-Dimethylphenol	ND		ug/kg	160	49.
2-Nitrophenol	ND		ug/kg	350	51.
4-Nitrophenol	ND		ug/kg	230	53.
2,4-Dinitrophenol	ND		ug/kg	780	220
4,6-Dinitro-o-cresol	ND		ug/kg	420	60.
Pentachlorophenol	ND		ug/kg	130	35.

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 04/10/14 20:42
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 04/07/14 16:02

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 03 Batch: WG680622-1					
Phenol	ND		ug/kg	160	48.
2-Methylphenol	ND		ug/kg	160	52.
3-Methylphenol/4-Methylphenol	ND		ug/kg	230	54.
2,4,5-Trichlorophenol	ND		ug/kg	160	53.
Benzoic Acid	ND		ug/kg	530	160
Benzyl Alcohol	ND		ug/kg	160	50.
Carbazole	ND		ug/kg	160	35.
Benzaldehyde	ND		ug/kg	220	66.
Caprolactam	ND		ug/kg	160	45.
Atrazine	ND		ug/kg	130	37.
2,3,4,6-Tetrachlorophenol	ND		ug/kg	160	28.

Surrogate	%Recovery	Qualifier	Acceptance Criteria
2-Fluorophenol	73		25-120
Phenol-d6	70		10-120
Nitrobenzene-d5	68		23-120
2-Fluorobiphenyl	65		30-120
2,4,6-Tribromophenol	58		0-136
4-Terphenyl-d14	82		18-120

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02,04-06 Batch: WG678534-2 WG678534-3								
Acenaphthene	89		94		31-137	5		50
1,2,4-Trichlorobenzene	74		79		38-107	7		50
Hexachlorobenzene	96		100		40-140	4		50
Bis(2-chloroethyl)ether	68		70		40-140	3		50
2-Chloronaphthalene	82		83		40-140	1		50
1,2-Dichlorobenzene	74		77		40-140	4		50
1,3-Dichlorobenzene	71		74		40-140	4		50
1,4-Dichlorobenzene	72		75		28-104	4		50
3,3'-Dichlorobenzidine	53		55		40-140	4		50
2,4-Dinitrotoluene	**101**	Q	**104**	Q	28-89	3		50
2,6-Dinitrotoluene	96		94		40-140	2		50
Fluoranthene	100		101		40-140	1		50
4-Chlorophenyl phenyl ether	94		98		40-140	4		50
4-Bromophenyl phenyl ether	96		101		40-140	5		50
Bis(2-chloroisopropyl)ether	75		76		40-140	1		50
Bis(2-chloroethoxy)methane	78		78		40-117	0		50
Hexachlorobutadiene	76		82		40-140	8		50
Hexachlorocyclopentadiene	79		84		40-140	6		50
Hexachloroethane	70		72		40-140	3		50
Isophorone	79		79		40-140	0		50
Naphthalene	77		80		40-140	4		50

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.

Project Number: 0294-013-001

Lab Number: L1406459

Report Date: 04/14/14

Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02,04-06 Batch: WG678534-2 WG678534-3

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Nitrobenzene	79		84		40-140	6		50
NitrosoDiPhenylAmine(NDPA)/DPA	98		102			4		50
n-Nitrosodi-n-propylamine	76		76		32-121	0		50
Bis(2-Ethylhexyl)phthalate	102		107		40-140	5		50
Butyl benzyl phthalate	101		107		40-140	6		50
Di-n-butylphthalate	101		105		40-140	4		50
Di-n-octylphthalate	103		108		40-140	5		50
Diethyl phthalate	97		102		40-140	5		50
Dimethyl phthalate	96		102		40-140	6		50
Benzo(a)anthracene	101		105		40-140	4		50
Benzo(a)pyrene	103		108		40-140	5		50
Benzo(b)fluoranthene	98		101		40-140	3		50
Benzo(k)fluoranthene	101		107		40-140	6		50
Chrysene	91		97		40-140	6		50
Acenaphthylene	91		92		40-140	1		50
Anthracene	104		107		40-140	3		50
Benzo(ghi)perylene	100		106		40-140	6		50
Fluorene	96		101		40-140	5		50
Phenanthrene	101		104		40-140	3		50
Dibenzo(a,h)anthracene	103		107		40-140	4		50
Indeno(1,2,3-cd)Pyrene	101		107		40-140	6		50

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02,04-06 Batch: WG678534-2 WG678534-3								
Pyrene	98		101		35-142	3		50
Biphenyl	85		92			8		50
4-Chloroaniline	80		84		40-140	5		50
2-Nitroaniline	92		93		47-134	1		50
3-Nitroaniline	58		57		26-129	2		50
4-Nitroaniline	84		96		41-125	13		50
Dibenzofuran	92		96		40-140	4		50
2-Methylnaphthalene	82		83		40-140	1		50
1,2,4,5-Tetrachlorobenzene	80		87		40-117	8		50
Acetophenone	80		82		14-144	2		50
2,4,6-Trichlorophenol	90		92		30-130	2		50
P-Chloro-M-Cresol	98		99		26-103	1		50
2-Chlorophenol	77		76		25-102	1		50
2,4-Dichlorophenol	90		94		30-130	4		50
2,4-Dimethylphenol	87		88		30-130	1		50
2-Nitrophenol	74		74		30-130	0		50
4-Nitrophenol	93		98		11-114	5		50
2,4-Dinitrophenol	50		58		4-130	15		50
4,6-Dinitro-o-cresol	63		64		10-130	2		50
Pentachlorophenol	78		80		17-109	3		50
Phenol	77		75		26-90	3		50

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-02,04-06 Batch: WG678534-2 WG678534-3								
2-Methylphenol	84		86		30-130.	2		50
3-Methylphenol/4-Methylphenol	76		76		30-130	0		50
2,4,5-Trichlorophenol	93		95		30-130	2		50
Benzoic Acid	38		37			3		50
Benzyl Alcohol	80		81		40-140	1		50
Carbazole	100		103		54-128	3		50
Benzaldehyde	83		85			2		50
Caprolactam	96		98			2		50
Atrazine	107		112			5		50

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
2-Fluorophenol	80		80		25-120
Phenol-d6	78		77		10-120
Nitrobenzene-d5	78		76		23-120
2-Fluorobiphenyl	85		88		30-120
2,4,6-Tribromophenol	99		104		0-136
4-Terphenyl-d14	98		101		18-120

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Project Number: 0294-013-001

Lab Number: L1406459
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 03 Batch: WG680622-2 WG680622-3								
Acenaphthene	98		88		31-137	11		50
1,2,4-Trichlorobenzene	72		70		38-107	3		50
Hexachlorobenzene	106		92		40-140	14		50
Bis(2-chloroethyl)ether	76		78		40-140	3		50
2-Chloronaphthalene	92		89		40-140	3		50
1,2-Dichlorobenzene	69		68		40-140	1		50
1,3-Dichlorobenzene	67		65		40-140	3		50
1,4-Dichlorobenzene	68		68		28-104	0		50
3,3'-Dichlorobenzidine	56		52		40-140	7		50
2,4-Dinitrotoluene	**124**	Q	**108**	Q	28-89	14		50
2,6-Dinitrotoluene	110		105		40-140	5		50
Fluoranthene	118		102		40-140	15		50
4-Chlorophenyl phenyl ether	104		91		40-140	13		50
4-Bromophenyl phenyl ether	109		94		40-140	15		50
Bis(2-chloroisopropyl)ether	74		76		40-140	3		50
Bis(2-chloroethoxy)methane	79		84		40-117	6		50
Hexachlorobutadiene	69		68		40-140	1		50
Hexachlorocyclopentadiene	74		74		40-140	0		50
Hexachloroethane	67		66		40-140	2		50
Isophorone	85		87		40-140	2		50
Naphthalene	75		73		40-140	3		50

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Project Number: 0294-013-001

Lab Number: L1406459
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 03 Batch: WG680622-2 WG680622-3								
Nitrobenzene	84		81		40-140	4		50
NitrosoDiPhenylAmine(NDPA)/DPA	113		100			12		50
n-Nitrosodi-n-propylamine	80		84		32-121	5		50
Bis(2-Ethylhexyl)phthalate	120		109		40-140	10		50
Butyl benzyl phthalate	126		110		40-140	14		50
Di-n-butylphthalate	118		104		40-140	13		50
Di-n-octylphthalate	123		107		40-140	14		50
Diethyl phthalate	110		98		40-140	12		50
Dimethyl phthalate	106		96		40-140	10		50
Benzo(a)anthracene	112		98		40-140	13		50
Benzo(a)pyrene	112		97		40-140	14		50
Benzo(b)fluoranthene	107		96		40-140	11		50
Benzo(k)fluoranthene	105		93		40-140	12		50
Chrysene	110		96		40-140	14		50
Acenaphthylene	100		93		40-140	7		50
Anthracene	115		101		40-140	13		50
Benzo(ghi)perylene	113		93		40-140	19		50
Fluorene	105		94		40-140	11		50
Phenanthrene	111		98		40-140	12		50
Dibenzo(a,h)anthracene	114		96		40-140	17		50
Indeno(1,2,3-cd)Pyrene	113		94		40-140	18		50

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.

Project Number: 0294-013-001

Lab Number: L1406459

Report Date: 04/14/14

Parameter	*LCS %Recovery*	*Qual*	*LCSD %Recovery*	*Qual*	*%Recovery Limits*	*RPD*	*Qual*	*RPD Limits*
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 03 Batch: WG680622-2 WG680622-3								
Pyrene	117		103		35-142	13		50
Biphenyl	96		86			11		50
4-Chloroaniline	72		65		40-140	10		50
2-Nitroaniline	114		107		47-134	6		50
3-Nitroaniline	74		65		26-129	13		50
4-Nitroaniline	115		98		41-125	16		50
Dibenzofuran	104		91		40-140	13		50
2-Methylnaphthalene	82		82		40-140	0		50
1,2,4,5-Tetrachlorobenzene	84		75		40-117	11		50
Acetophenone	81		84		14-144	4		50
2,4,6-Trichlorophenol	103		97		30-130	6		50
P-Chloro-M-Cresol	**111**	Q	103		26-103	7		50
2-Chlorophenol	76		80		25-102	5		50
2,4-Dichlorophenol	93		90		30-130	3		50
2,4-Dimethylphenol	96		97		30-130	1		50
2-Nitrophenol	83		88		30-130	6		50
4-Nitrophenol	114		99		11-114	14		50
2,4-Dinitrophenol	85		81		4-130	5		50
4,6-Dinitro-o-cresol	101		91		10-130	10		50
Pentachlorophenol	105		92		17-109	13		50
Phenol	81		87		26-90	7		50

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 03 Batch: WG680622-2 WG680622-3								
2-Methylphenol	82		88		30-130.	7		50
3-Methylphenol/4-Methylphenol	90		96		30-130	6		50
2,4,5-Trichlorophenol	110		102		30-130	8		50
Benzoic Acid	44		40			10		50
Benzyl Alcohol	84		92		40-140	9		50
Carbazole	119		104		54-128	13		50
Benzaldehyde	48		52			8		50
Caprolactam	113		108			5		50
Atrazine	105		97			8		50
2,3,4,6-Tetrachlorophenol	109		95			14		50

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria
2-Fluorophenol	74		86		25-120
Phenol-d6	76		88		10-120
Nitrobenzene-d5	74		84		23-120
2-Fluorobiphenyl	81		85		30-120
2,4,6-Tribromophenol	96		94		0-136
4-Terphenyl-d14	103		100		18-120

PCBS

SAMPLE RESULTS

Lab ID:	L1406459-03	Date Collected:	03/26/14 13:57
Client ID:	IB-2	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8082A	Extraction Date:	04/07/14 18:16
Analytical Date:	04/09/14 12:01	Cleanup Method1:	EPA 3665A
Analyst:	JW	Cleanup Date1:	04/08/14
Percent Solids:	79%	Cleanup Method2:	EPA 3660B
		Cleanup Date2:	04/08/14

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	38.6	3.05	1	A
Aroclor 1221	ND		ug/kg	38.6	3.56	1	A
Aroclor 1232	ND		ug/kg	38.6	4.52	1	A
Aroclor 1242	ND		ug/kg	38.6	4.72	1	A
Aroclor 1248	ND		ug/kg	38.6	3.26	1	A
Aroclor 1254	ND		ug/kg	38.6	3.17	1	A
Aroclor 1260	ND		ug/kg	38.6	2.94	1	A
Aroclor 1262	ND		ug/kg	38.6	1.91	1	A
Aroclor 1268	ND		ug/kg	38.6	5.60	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	74		30-150	A
Decachlorobiphenyl	70		30-150	A
2,4,5,6-Tetrachloro-m-xylene	79		30-150	B
Decachlorobiphenyl	76		30-150	B

SAMPLE RESULTS

Lab ID:	L1406459-05	Date Collected:	03/26/14 14:20
Client ID:	IB-4	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8082A	Extraction Date:	03/28/14 20:01
Analytical Date:	03/29/14 19:17	Cleanup Method1:	EPA 3665A
Analyst:	JW	Cleanup Date1:	03/29/14
Percent Solids:	91%	Cleanup Method2:	EPA 3660B
		Cleanup Date2:	03/29/14

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**	**Column**
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	35.3	2.79	1	A
Aroclor 1221	ND		ug/kg	35.3	3.25	1	A
Aroclor 1232	ND		ug/kg	35.3	4.14	1	A
Aroclor 1242	ND		ug/kg	35.3	4.32	1	A
Aroclor 1248	367		ug/kg	35.3	2.98	1	B
Aroclor 1254	121		ug/kg	35.3	2.90	1	A
Aroclor 1260	ND		ug/kg	35.3	2.69	1	A
Aroclor 1262	ND		ug/kg	35.3	1.75	1	A
Aroclor 1268	ND		ug/kg	35.3	5.12	1	A

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**	**Column**
2,4,5,6-Tetrachloro-m-xylene	71		30-150	A
Decachlorobiphenyl	80		30-150	A
2,4,5,6-Tetrachloro-m-xylene	80		30-150	B
Decachlorobiphenyl	112		30-150	B

SAMPLE RESULTS

Lab ID:	L1406459-06	Date Collected:	03/26/14 14:30
Client ID:	IB-5	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8082A	Extraction Date:	03/28/14 20:01
Analytical Date:	03/29/14 19:31	Cleanup Method1:	EPA 3665A
Analyst:	JW	Cleanup Date1:	03/29/14
Percent Solids:	92%	Cleanup Method2:	EPA 3660B
		Cleanup Date2:	03/29/14

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Column
Polychlorinated Biphenyls by GC - Westborough Lab							
Aroclor 1016	ND		ug/kg	36.0	2.85	1	A
Aroclor 1221	ND		ug/kg	36.0	3.32	1	A
Aroclor 1232	ND		ug/kg	36.0	4.22	1	A
Aroclor 1242	ND		ug/kg	36.0	4.41	1	A
Aroclor 1248	ND		ug/kg	36.0	3.04	1	A
Aroclor 1254	ND		ug/kg	36.0	2.96	1	A
Aroclor 1260	128		ug/kg	36.0	2.74	1	B
Aroclor 1262	ND		ug/kg	36.0	1.79	1	A
Aroclor 1268	ND		ug/kg	36.0	5.22	1	A

Surrogate	% Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	76		30-150	A
Decachlorobiphenyl	92		30-150	A
2,4,5,6-Tetrachloro-m-xylene	83		30-150	B
Decachlorobiphenyl	115		30-150	B

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8082A
Analytical Date: 03/29/14 19:44
Analyst: JW

Extraction Method: EPA 3546
Extraction Date: 03/28/14 20:01
Cleanup Method1: EPA 3665A
Cleanup Date1: 03/29/14
Cleanup Method2: EPA 3660B
Cleanup Date2: 03/29/14

Parameter	Result	Qualifier	Units	RL	MDL	Column
Polychlorinated Biphenyls by GC - Westborough Lab for sample(s): 05-06 Batch: WG678794-1						
Aroclor 1016	ND		ug/kg	32.8	2.59	A
Aroclor 1221	ND		ug/kg	32.8	3.02	A
Aroclor 1232	ND		ug/kg	32.8	3.84	A
Aroclor 1242	ND		ug/kg	32.8	4.02	A
Aroclor 1248	ND		ug/kg	32.8	2.77	A
Aroclor 1254	ND		ug/kg	32.8	2.70	A
Aroclor 1260	ND		ug/kg	32.8	2.50	A
Aroclor 1262	ND		ug/kg	32.8	1.63	A
Aroclor 1268	ND		ug/kg	32.8	4.76	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	80		30-150	B
2,4,5,6-Tetrachloro-m-xylene	72		30-150	A
Decachlorobiphenyl	92		30-150	B
Decachlorobiphenyl	70		30-150	A

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8082A
Analytical Date: 04/09/14 12:13
Analyst: JW

Extraction Method: EPA 3546
Extraction Date: 04/07/14 18:16
Cleanup Method1: EPA 3665A
Cleanup Date1: 04/08/14
Cleanup Method2: EPA 3660B
Cleanup Date2: 04/08/14

Parameter	Result	Qualifier	Units	RL	MDL	Column
Polychlorinated Biphenyls by GC - Westborough Lab for sample(s): 03 Batch: WG680641-1						
Aroclor 1016	ND		ug/kg	32.6	2.58	A
Aroclor 1221	ND		ug/kg	32.6	3.01	A
Aroclor 1232	ND		ug/kg	32.6	3.83	A
Aroclor 1242	ND		ug/kg	32.6	4.00	A
Aroclor 1248	ND		ug/kg	32.6	2.76	A
Aroclor 1254	ND		ug/kg	32.6	2.68	A
Aroclor 1260	ND		ug/kg	32.6	2.49	A
Aroclor 1262	ND		ug/kg	32.6	1.62	A
Aroclor 1268	ND		ug/kg	32.6	4.74	A

Surrogate	%Recovery	Qualifier	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	84		30-150	B
2,4,5,6-Tetrachloro-m-xylene	77		30-150	A
Decachlorobiphenyl	83		30-150	B
Decachlorobiphenyl	74		30-150	A

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.

Project Number: 0294-013-001

Lab Number: L1406459

Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Polychlorinated Biphenyls by GC - Westborough Lab Associated sample(s): 05-06 Batch: WG678794-2 WG678794-3									
Aroclor 1016	89		96		40-140	8		50	A
Aroclor 1260	84		91		40-140	8		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	94		97		30-150	A
Decachlorobiphenyl	87		87		30-150	A
2,4,5,6-Tetrachloro-m-xylene	91		91		30-150	B
Decachlorobiphenyl	103		101		30-150	B

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits	Column
Polychlorinated Biphenyls by GC - Westborough Lab Associated sample(s): 03 Batch: WG680641-2 WG680641-3									
Aroclor 1016	78		76		40-140	3		50	A
Aroclor 1260	76		71		40-140	7		50	A

Surrogate	LCS %Recovery	Qual	LCSD %Recovery	Qual	Acceptance Criteria	Column
2,4,5,6-Tetrachloro-m-xylene	77		65		30-150	A
Decachlorobiphenyl	78		65		30-150	A
2,4,5,6-Tetrachloro-m-xylene	83		78		30-150	B
Decachlorobiphenyl	87		77		30-150	B

METALS

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

SAMPLE RESULTS

Lab ID:	L1406459-01	Date Collected:	03/26/14 09:05
Client ID:	TP-1 (2-3)	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	81%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	13		mg/kg	0.46	0.09	1	03/28/14 13:41	03/28/14 18:28	EPA 3050B	1,6010C	MG
Barium, Total	62		mg/kg	0.46	0.14	1	03/28/14 13:41	03/28/14 18:28	EPA 3050B	1,6010C	MG
Cadmium, Total	0.26	J	mg/kg	0.46	0.03	1	03/28/14 13:41	03/28/14 18:28	EPA 3050B	1,6010C	MG
Chromium, Total	10		mg/kg	0.46	0.09	1	03/28/14 13:41	03/28/14 18:28	EPA 3050B	1,6010C	MG
Lead, Total	210		mg/kg	2.3	0.09	1	03/28/14 13:41	03/28/14 18:28	EPA 3050B	1,6010C	MG
Mercury, Total	0.12		mg/kg	0.09	0.02	1	03/31/14 10:22	03/31/14 13:43	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.93	0.14	1	03/28/14 13:41	03/28/14 18:28	EPA 3050B	1,6010C	MG
Silver, Total	ND		mg/kg	0.46	0.09	1	03/28/14 13:41	03/28/14 18:28	EPA 3050B	1,6010C	MG

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

SAMPLE RESULTS

Lab ID:	L1406459-02	Date Collected:	03/26/14 13:41
Client ID:	IB-1	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	83%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	2.8		mg/kg	0.46	0.09	1	03/28/14 13:41	03/28/14 18:31	EPA 3050B	1,6010C	MG
Barium, Total	18		mg/kg	0.46	0.14	1	03/28/14 13:41	03/28/14 18:31	EPA 3050B	1,6010C	MG
Cadmium, Total	0.17	J	mg/kg	0.46	0.03	1	03/28/14 13:41	03/28/14 18:31	EPA 3050B	1,6010C	MG
Chromium, Total	7.5		mg/kg	0.46	0.09	1	03/28/14 13:41	03/28/14 18:31	EPA 3050B	1,6010C	MG
Lead, Total	12		mg/kg	2.3	0.09	1	03/28/14 13:41	03/28/14 18:31	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	0.10	0.02	1	03/31/14 10:22	03/31/14 13:45	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.93	0.14	1	03/28/14 13:41	03/28/14 18:31	EPA 3050B	1,6010C	MG
Silver, Total	0.59		mg/kg	0.46	0.09	1	03/28/14 13:41	03/28/14 18:31	EPA 3050B	1,6010C	MG

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

SAMPLE RESULTS

Lab ID:	L1406459-04	Date Collected:	03/26/14 14:06
Client ID:	IB-3	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	87%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	3.5		mg/kg	0.45	0.09	1	03/28/14 13:41	03/28/14 18:35	EPA 3050B	1,6010C	MG
Barium, Total	11		mg/kg	0.45	0.14	1	03/28/14 13:41	03/28/14 18:35	EPA 3050B	1,6010C	MG
Cadmium, Total	0.19	J	mg/kg	0.45	0.03	1	03/28/14 13:41	03/28/14 18:35	EPA 3050B	1,6010C	MG
Chromium, Total	6.3		mg/kg	0.45	0.09	1	03/28/14 13:41	03/28/14 18:35	EPA 3050B	1,6010C	MG
Lead, Total	9.2		mg/kg	2.2	0.09	1	03/28/14 13:41	03/28/14 18:35	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	0.09	0.02	1	03/31/14 10:22	03/31/14 13:50	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.90	0.14	1	03/28/14 13:41	03/28/14 18:35	EPA 3050B	1,6010C	MG
Silver, Total	ND		mg/kg	0.45	0.09	1	03/28/14 13:41	03/28/14 18:35	EPA 3050B	1,6010C	MG

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

SAMPLE RESULTS

Lab ID:	L1406459-05	Date Collected:	03/26/14 14:20
Client ID:	IB-4	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	91%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	2.1		mg/kg	0.42	0.08	1	03/28/14 13:41	03/28/14 18:47	EPA 3050B	1,6010C	MG
Barium, Total	3.1		mg/kg	0.42	0.13	1	03/28/14 13:41	03/28/14 18:47	EPA 3050B	1,6010C	MG
Cadmium, Total	1.7		mg/kg	0.42	0.03	1	03/28/14 13:41	03/28/14 18:47	EPA 3050B	1,6010C	MG
Chromium, Total	4.3		mg/kg	0.42	0.08	1	03/28/14 13:41	03/28/14 18:47	EPA 3050B	1,6010C	MG
Lead, Total	37		mg/kg	2.1	0.08	1	03/28/14 13:41	03/28/14 18:47	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	0.08	0.02	1	03/31/14 10:22	03/31/14 13:52	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.84	0.13	1	03/28/14 13:41	03/28/14 18:47	EPA 3050B	1,6010C	MG
Silver, Total	ND		mg/kg	0.42	0.08	1	03/28/14 13:41	03/28/14 18:47	EPA 3050B	1,6010C	MG

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

SAMPLE RESULTS

Lab ID:	L1406459-06	Date Collected:	03/26/14 14:30
Client ID:	IB-5	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	92%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	2.6		mg/kg	0.42	0.09	1	03/28/14 13:41	03/28/14 18:51	EPA 3050B	1,6010C	MG
Barium, Total	12		mg/kg	0.42	0.13	1	03/28/14 13:41	03/28/14 18:51	EPA 3050B	1,6010C	MG
Cadmium, Total	0.30	J	mg/kg	0.42	0.03	1	03/28/14 13:41	03/28/14 18:51	EPA 3050B	1,6010C	MG
Chromium, Total	5.4		mg/kg	0.42	0.09	1	03/28/14 13:41	03/28/14 18:51	EPA 3050B	1,6010C	MG
Lead, Total	14		mg/kg	2.1	0.09	1	03/28/14 13:41	03/28/14 18:51	EPA 3050B	1,6010C	MG
Mercury, Total	ND		mg/kg	0.09	0.02	1	03/31/14 10:22	03/31/14 13:54	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.85	0.13	1	03/28/14 13:41	03/28/14 18:51	EPA 3050B	1,6010C	MG
Silver, Total	0.47		mg/kg	0.42	0.09	1	03/28/14 13:41	03/28/14 18:51	EPA 3050B	1,6010C	MG

Project Name: 401 BUFFALO AVE.
Lab Number: L1406459
Project Number: 0294-013-001
Report Date: 04/14/14

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01-02,04-06 Batch: WG678691-1										
Arsenic, Total	ND		mg/kg	0.40	0.08	1	03/28/14 13:41	03/28/14 17:16	1,6010C	MG
Barium, Total	ND		mg/kg	0.40	0.12	1	03/28/14 13:41	03/28/14 17:16	1,6010C	MG
Cadmium, Total	ND		mg/kg	0.40	0.03	1	03/28/14 13:41	03/28/14 17:16	1,6010C	MG
Chromium, Total	ND		mg/kg	0.40	0.08	1	03/28/14 13:41	03/28/14 17:16	1,6010C	MG
Lead, Total	ND		mg/kg	2.0	0.08	1	03/28/14 13:41	03/28/14 17:16	1,6010C	MG
Selenium, Total	ND		mg/kg	0.80	0.12	1	03/28/14 13:41	03/28/14 17:16	1,6010C	MG
Silver, Total	ND		mg/kg	0.40	0.08	1	03/28/14 13:41	03/28/14 17:16	1,6010C	MG

Prep Information

Digestion Method: EPA 3050B

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01-02,04-06 Batch: WG678754-1										
Mercury, Total	ND		mg/kg	0.08	0.02	1	03/31/14 10:22	03/31/14 13:04	1,7471B	MC

Prep Information

Digestion Method: EPA 7471B

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.

Project Number: 0294-013-001

Lab Number: L1406459

Report Date: 04/14/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-02,04-06 Batch: WG678691-2 SRM Lot Number: 0518-10-02								
Arsenic, Total	114		-		81-119	-		
Barium, Total	96		-		83-118	-		
Cadmium, Total	106		-		82-117	-		
Chromium, Total	97		-		80-119	-		
Lead, Total	105		-		80-120	-		
Selenium, Total	109		-		80-120	-		
Silver, Total	108		-		66-134	-		
Total Metals - Westborough Lab Associated sample(s): 01-02,04-06 Batch: WG678754-2 SRM Lot Number: 0518-10-02								
Mercury, Total	95		-		67-133	-		

Matrix Spike Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Project Number: 0294-013-001

Lab Number: L1406459
Report Date: 04/14/14

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-02,04-06 QC Batch ID: WG678691-4 QC Sample: L1406379-01 Client ID: MS Sample												
Arsenic, Total	3.6	11.4	14	91		-	-		75-125	-		20
Barium, Total	96.	189	240	76		-	-		75-125	-		20
Cadmium, Total	0.09J	4.83	4.0	83		-	-		75-125	-		20
Chromium, Total	24.	18.9	38	**74**	Q	-	-		75-125	-		20
Lead, Total	21.	48.3	60	81		-	-		75-125	-		20
Selenium, Total	ND	11.4	8.7	76		-	-		75-125	-		20
Silver, Total	ND	28.4	24	84		-	-		75-125	-		20
Total Metals - Westborough Lab Associated sample(s): 01-02,04-06 QC Batch ID: WG678754-4 QC Sample: L1406335-01 Client ID: MS Sample												
Mercury, Total	4.0	0.159	6.0	**1260**	Q	-	-		80-120	-		35

Lab Duplicate Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVE.

Project Number: 0294-013-001

Lab Number: L1406459

Report Date: 04/14/14

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-02,04-06 QC Batch ID: WG678691-3 QC Sample: L1406379-01 Client ID: DUP Sample						
Arsenic, Total	3.6	3.8	mg/kg	5		20
Lead, Total	21.	21	mg/kg	0		20
Total Metals - Westborough Lab Associated sample(s): 01-02,04-06 QC Batch ID: WG678754-3 QC Sample: L1406335-01 Client ID: DUP Sample						
Mercury, Total	4.0	3.4	mg/kg	16		35

INORGANICS
&
MISCELLANEOUS

SAMPLE RESULTS

Lab ID: L1406459-01
Client ID: TP-1 (2-3)
Sample Location: 401 BUFFALO AVE.
Matrix: Soil

Date Collected: 03/26/14 09:05
Date Received: 03/27/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	81.3		%	0.100	NA	1	-	03/28/14 00:04	30,2540G	AT

SAMPLE RESULTS

Lab ID:	L1406459-02	Date Collected:	03/26/14 13:41
Client ID:	IB-1	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	82.8		%	0.100	NA	1	-	03/28/14 00:04	30,2540G	AT

SAMPLE RESULTS

Lab ID:	L1406459-03	Date Collected:	03/26/14 13:57
Client ID:	IB-2	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	78.8		%	0.100	NA	1	-	04/07/14 19:16	30,2540G	RT

Project Name:	401 BUFFALO AVE.	**Lab Number:**	L1406459
Project Number:	0294-013-001	**Report Date:**	04/14/14

SAMPLE RESULTS

Lab ID:	L1406459-04	Date Collected:	03/26/14 14:06
Client ID:	IB-3	Date Received:	03/27/14
Sample Location:	401 BUFFALO AVE.	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	87.3		%	0.100	NA	1	-	03/28/14 00:04	30,2540G	AT

SAMPLE RESULTS

Lab ID: L1406459-05
Client ID: IB-4
Sample Location: 401 BUFFALO AVE.
Matrix: Soil

Date Collected: 03/26/14 14:20
Date Received: 03/27/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	90.5		%	0.100	NA	1	-	03/28/14 00:04	30,2540G	AT

SAMPLE RESULTS

Lab ID: L1406459-06
Client ID: IB-5
Sample Location: 401 BUFFALO AVE.
Matrix: Soil

Date Collected: 03/26/14 14:30
Date Received: 03/27/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	92.2		%	0.100	NA	1	-	03/28/14 00:04	30,2540G	AT

Lab Duplicate Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVE.
Project Number: 0294-013-001

Lab Number: L1406459
Report Date: 04/14/14

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-02,04-06 QC Batch ID: WG678521-1 QC Sample: L1406443-01 Client ID: DUP Sample						
Solids, Total	88.9	89.8	%	1		20
General Chemistry - Westborough Lab Associated sample(s): 03 QC Batch ID: WG680643-1 QC Sample: L1406459-03 Client ID: IB-2						
Solids, Total	78.8	76.4	%	3		20

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information **Cooler**	**Custody Seal**
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1406459-01A	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-01B	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-01C	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-02A	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-02B	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-02C	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-02D	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-03A	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8082(14)
L1406459-03B	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),TS(7),NYTCL-8082(14)
L1406459-03C	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),TS(7),NYTCL-8082(14)

*Values in parentheses indicate holding time in days

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1406459-03D	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),TS(7),NYTCL-8082(14)
L1406459-04A	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-04B	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-04C	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1406459-04D	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8260(14)
L1406459-05A	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1406459-05B	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1406459-05C	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1406459-05D	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8260(14)
L1406459-06A	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1406459-06B	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1406459-06C	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),NYTCL-8082(14),CD-TI(180)
L1406459-06D	Amber 120ml unpreserved	A	N/A	2.7	Y	Absent	NYTCL-8260(14)

*Values in parentheses indicate holding time in days

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL	- Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).
EPA	- Environmental Protection Agency.
LCS	- Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
LCSD	- Laboratory Control Sample Duplicate: Refer to LCS.
LFB	- Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.
MDL	- Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
MS	- Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.
MSD	- Matrix Spike Sample Duplicate: Refer to MS.
NA	- Not Applicable.
NC	- Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.
NI	- Not Ignitable.
RL	- Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.
RPD	- Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.
SRM	- Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1	- The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A	- Spectra identified as "Aldol Condensation Product".
B	- The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit.
C	- Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.
D	- Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.
E	- Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.
G	- The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.
H	- The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
I	- The lower value for the two columns has been reported due to obvious interference.

Report Format: DU Report with 'J' Qualifiers

Data Qualifiers

M	- Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
NJ	- Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
P	- The RPD between the results for the two columns exceeds the method-specified criteria.
Q	- The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
S	- Analytical results are from modified screening analysis.
J	- Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
ND	- Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

Report Format: DU Report with 'J' Qualifiers

REFERENCES

1	Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.
30	Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

LIMITATION OF LIABILITIES

Alpha Analytical performs services with reasonable care and diligence normal to the analytical testing laboratory industry. In the event of an error, the sole and exclusive responsibility of Alpha Analytical shall be to re-perform the work at it's own expense. In no event shall Alpha Analytical be held liable for any incidental, consequential or special damages, including but not limited to, damages in any way connected with the use of, interpretation of, information or analysis provided by Alpha Analytical.

We strongly urge our clients to comply with EPA protocol regarding sample volume, preservation, cooling, containers, sampling procedures, holding time and splitting of samples in the field.

Certification Information

Last revised December 11, 2013

The following analytes are not included in our NELAP Scope of Accreditation:

Westborough Facility
EPA 524.2: Acetone, 2-Butanone (Methyl ethyl ketone (MEK)), Tert-butyl alcohol, 2-Hexanone, Tetrahydrofuran, 1,3,5-Trichlorobenzene, 4-Methyl-2-pentanone (MIBK), Carbon disulfide, Diethyl ether.
EPA 8260C: 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene, Iodomethane (methyl iodide), Methyl methacrylate, Azobenzene.
EPA 8330A/B: PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT.
EPA 8270D: 1-Methylnaphthalene, Dimethylnaphthalene,1,4-Diphenylhydrazine.
EPA 625: 4-Chloroaniline, 4-Methylphenol.
SM4500: Soil: Total Phosphorus, TKN, NO2, NO3.
EPA 9071: Total Petroleum Hydrocarbons, Oil & Grease.

Mansfield Facility
EPA 8270D: Biphenyl.
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water
EPA 200.8: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl; **EPA 200.7**: Ba,Be,Ca,Cd,Cr,Cu,Na; **EPA 245.1:** Mercury;
EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.**

Non-Potable Water
EPA 200.8: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn;
EPA 200.7: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn;
EPA 245.1, SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **SM4500NO3-F, EPA 353.2**: Nitrate-N**, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**
EPA 624: Volatile Halocarbons & Aromatics,
EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF**.

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

CHAIN OF CUSTODY

PAGE 1 OF 1

Date Rec'd in Lab: 3/27/14

ALPHA Job #: L1406459

ALPHA ANALYTICAL

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

Client Information

Client: Turnkey

Address: 2558 Hamburg Turnpike
Buffalo NY 14218

Phone: 716-856-0599

Fax: 716-856-0583

Email:

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: 401 Buffalo Ave

Project Location: "

Project #: 0294-013-001

Project Manager: Mike Lesakowski

ALPHA Quote #:

Turn-Around Time

☒ Standard ☐ RUSH *(only confirmed if pre-approved!)*

Date Due: 4/3/14 Time:

Report Information - Data Deliverables

☐ FAX ☐ EMAIL

☒ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program	Criteria

Other Project Specific Requirements/Comments/Detection Limits:

SAMPLE HANDLING

*Filtration*_________
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	ANALYSIS: BN only SVOC 8270	VOC 8260	PCB	Total ~~Metal~~ RCRA Metals									Sample Specific Comments	TOTAL # BOTTLES
06459-01	TP-1 (2-3)	3-26-14	905	Soil	PWW	X			X										~~4~~ 3
02	IB-1	↓	1341	↓	↓	X			X										4
03	IB-2	↓	1357	↓	↓	X			X									Hold	4
04	IB-3	↓	1406	↓	↓	X	X		X										4
05	IB-4	↓	1420	↓	↓	X	X	X	X										4
06	IB-5	↓	1430	↓	↓	X	X	X	X										4

Container Type	
Preservative	

Relinquished By:	Date/Time	Received By:	Date/Time
	3-26-14 1730	J. Hooven	3/27/14 11:00
J Hooven	3/27/14 14:47		3/27/14 14:47
	3-27-14 1710		3-27-14 17:10
	3-27-14 2000	Jim Corley	3-27-14 2000

Relinquish
Jim Corley 3/27/14 2230
Willie McClure 3/27/14 2230

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)

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Strong Advocates, Effective Solutions, Integrated Implementation

TurnKey
Environmental
Restoration, LLC

September 4, 2014

Mr. Craig Slater, Esq.
The Slater Law Firm, PLLC
26 Mississippi Street, Suite 400
Buffalo NY 14203

Re: 401 Buffalo Avenue – Supplemental Investigation
Niagara Falls, New York

Dear Mr. Slater:

TurnKey Environmental Restoration, LLC (TurnKey) conducted a Supplemental Investigation on behalf of The Slater Law Firm at the 401 Buffalo Avenue, Niagara Falls, New York (Site; see Figure 1) on August 26, 2014. The Supplemental Investigation was completed to further investigate and assess potential environmental impacts on-Site.

During a recent Site visit with the New York State Department of Environmental Conservation (NYSDEC) related to Spill No. 1312160, the Department requested additional investigation related to the spill and suggested completion of radiological screening prior to future demolition and/or redevelopment activities.

PREVIOUS INVESTIGATION FINDINGS

Previous investigations completed on-Site identified recognized environmental conditions (RECs) including:

- NYSDEC Spill No. 1312160 was assigned to the Site related to the vandalism/destruction of three transformers and spilling of approximately 120-gallons of potential PCB-containing transformer oil. The spill is currently open.
- Identification of "black-stained" fill material on-Site;
- Leaking oil-containing equipment and oil-contaminated floors, walls, and equipment were noted in the Boiler Room, Maintenance Room, and both elevator control rooms.

- Improper storage and handling of hazardous chemicals, including corrosive boiler chemicals, solvents, lubricants, degreasers, paints, thinners, hydraulic oils and maintenance equipment fuels, pesticides and herbicides, pool and water treatment chemicals;
- Sumps, floor drains and vent stacks noted in basement with staining noted proximate to several floor drains;
- Numerous ASTs of unknown contents in the basement;
- Illegal dumping and vandalism; and,
- Universal and e-waste throughout the building.

SCOPE OF WORK

The supplemental investigation included the excavation of test pits, interior subslab fill assessment and completion of a field radiological screening. Prior to the supplemental investigation, underground utilizes DigSafeNY was notified and cleared for intrusive activities.

Supplemental Investigation

A total of ten (10) sample locations were assessed across the Site during the August 2014 Supplemental Investigation (see Figure 1). Subsurface investigation activities were limited along Holly Place and 4th Street due to the presence of subgrade utilities. TurnKey mobilized a track-mounted mini-excavator to the Site and excavated test pits to assess the building backfill material. Test pits were inspected for the presence of slag fill material and scanned for total volatile organic vapors with a photoionization detector (PID) equipped with a 10.6 eV lamp. No elevated PID readings were detected. Test pit contents were screened by Greater Radiological Dimensions, Inc. (GRD), a licensed NYSDOH Radioactive Material Contractor, prior to backfilling test pits with spoils. Details of the laboratory analysis and radiological screening are provided below.

The subsurface soil/fill was typically characterized as asphalt and sub-base gravel fill, some including slag, overlying native sandy clay. Evidence of a black fill material with brick fragments was noted between 1-3 feet below ground surface in Island Test Pit (see Figure 2).

The supplemental investigation included the inspection and assessment of the south trench, west trench and pool test pit areas as described above.

TurnKey personnel utilized a concrete saw to remove an approximate 3-foot by 6-foot section of the concrete slab to assess underlying backfill material. Interior test pit (ITP-1) was completed in the lowest level of the 2-story section of the building planned for demolition and redevelopment. No visual, olfactory or elevated PID readings were detected under the building slab at this location. Accessibility and concrete thickness limited areas available for assessment. Radiological screening results are described below.

Analytical Sampling and Results

Samples were collected from the Island Test Pit, Pool Test Pit, West Trench and South Trench sample locations (see Figure 1). Samples were collected and placed in pre-cleaned, laboratory provided sample bottles using dedicated stainless steel sampling tools, and cooled to 4° C in the field. The samples were transported under chain-of-custody command to the analytical laboratory for analysis of polycyclic aromatic hydrocarbons (PAHs) and Resource Conservation and Recovery Act (RCRA) metals. Analytical results are presented on Table 1. Laboratory analytical package is attached electronically in Attachment 2.

Elevated PAHs above Part 375 Unrestricted, Restricted-Residential and/or Commercial Use SCOs, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, benzo(k)flouranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected in West Trench and South Trench sample locations (see Table 1).

Elevated metals above Part 375 Unrestricted, Restricted Residential, and/or Commercial Use SCOs were detected on-Site, including arsenic, cadmium, chromium, lead, and mercury were detected at West trench, South Trench, and Island Test Pit locations (see Table 1).

Radiological Assessment

Based on the location of the Site within an area of Niagara Falls, NY that is recently known to contain historic slag material which exhibits elevated levels of naturally-occurring radioactive material (NORM) and technologically-enhanced, naturally-occurring radioactive material (TENORM), radiological field screening was completed during the August 2014

Supplemental Investigation. Radiological screening was completed by GRD on the excavated test pits along the building foundation, accessible areas within the lowest floor of the existing building, including subslab ITP-1 location, paved areas (e.g., asphalt and concrete) and the entire perimeter of the vacant building. Background radiological readings were recorded between 4,000-7,000 counts per minute (cpm). Radiological screening field logs are provided in Appendix 1.

As shown on Figure 2, six (6) distinct areas of elevated radiological material ranging from twice to 10 times above background were detected on-Site. Specifically, four (4) areas of elevated radiological material, associated with the building foundation (2 areas up to 11,000 cpm) and subslab backfill material (one area up to 11,000 cpm), and the pool area with readings as high as 40,000 cpm. An area of elevated radiological material was detected in the parking lot island (up to 12,000 cpm) including the area of the Island Test Pit location. Another area of elevated radiological material was detected along the western portion of the Site with readings up to 12,000 cpm.

It should also be noted, that radiological screening values are typically muted by the presence of impervious surface cover (i.e., asphalt and concrete) and the likely radiological levels will be higher than the initial screening results once the material is disturbed during redevelopment activities. Based on the findings of the field screening, GRD recommended additional radiological investigation and assessment prior to any future demolition or redevelopment activities.

Summary of Results

- Elevated PAHs above Part 375 Unrestricted, Restricted-Residential and/or Commercial Use SCOs were detected on-Site, including benzo(a)anthracene, benzo(a)pyrene, benzo(b)flouranthene, benzo(k)flouranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

- Elevated metals above Part 375 Unrestricted, Restricted Residential, and/or Commercial Use SCOs were detected on-Site, including arsenic, cadmium, chromium, lead, and mercury.

- Based on the radiological screening results, elevated levels of NORM/TENORM are present across the Site. GRD recommends additional radiological assessment prior to any intrusive activities.

Recommendations

- Based on the presence of elevated radiological material on-Site that directly impacts the planned demolition and redevelopment of the property, a radiological work plan detailing the regulated assessment and waste disposal requirements should be prepared and submitted to the NYSDEC for approval prior to intrusive activities.

- Though not directly part of this Supplemental Investigation, TurnKey recommends that oil or wipe sample(s) be collected from the spilled transformer oil area to determine if PCBs are present. Based on the results, a Corrective Action Plan should be prepared and submitted to the NYSDEC for review to address the open spill.

- Benchmark recommends providing this report to the NYSDEC with a request to reconsider the New York Brownfield Cleanup Program (BCP) eligibility determination for the 401 Buffalo Avenue parcel prior to completion of additional investigation and Site remedial and/or redevelopment activities.

Please contact us if you have any questions.

Sincerely,
TurnKey Environmental Restoration, LLC

Nathan T. Munley
Project Manager

Michael A. Lesakowski
Sr. Project Manager

ec: F. Merani (Merani Hospitality)

File: 0271-013-001

TABLE

TABLE 1

SUMMARY OF SOIL ANALYTICAL RESULTS

401 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

Parameter[1]	Unrestricted Use SCOs[2]	Restricted Residential Use SCOs[2]	Commercial Use SCOs[2]	WEST TRENCH	SOUTH TRENCH	ISLAND TEST PIT	POOL TEST PIT
				8/26/2014			
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [3]							
Acenaphthene	**20**	**100**	**500**	ND	8.2	ND	ND
Anthracene	**100**	**100**	**500**	2.2 J	16	0.074 J	ND
Benzo(a)anthracene	**1**	**1**	**5.6**	**10**	**43**	0.32	ND
Benzo(a)pyrene	**1**	**1**	**1**	**12**	**43**	0.28	ND
Benzo(b)fluoranthene	**1**	**1**	**5.6**	**25**	**57**	0.32	ND
Benzo(g,h,i)perylene	**100**	**100**	**500**	14	29	0.15	ND
Benzo(k)fluoranthene	**0.8**	**3.9**	**56**	**9.3**	**24**	0.17	ND
Chrysene	**1**	**3.9**	**56**	**21**	**46**	0.34	ND
Dibenzo(a,h)anthracene	**0.33**	**0.33**	**0.56**	**2.3 J**	**7.3**	0.046 J	ND
Fluoranthene	**100**	**100**	**500**	31	99	0.48	ND
Fluorene	**30**	**100**	**500**	ND	7.3	ND	ND
Indeno(1,2,3-cd)pyrene	**0.5**	**0.5**	**5.6**	**14**	**32**	0.16	ND
Naphthalene	**12**	**100**	**500**	ND	3.7 J	ND	ND
Phenanthrene	**100**	**100**	**500**	13	66	0.18	ND
Pyrene	**100**	**100**	**500**	23	72	0.42	ND
Metals - mg/Kg							
Arsenic	**13**	**16**	**16**	7.1	4.7	**21**	3.6
Barium	**350**	**400**	**400**	160	150	84	25
Cadmium	**2.5**	**4.3**	**9.3**	**2.6**	**8.2**	0.24 J	0.42 J
Chromium	**30**	**180**	**1500**	**32**	**98**	9.7	7.6
Lead	**63**	**400**	**1000**	36	**150**	**540**	21
Selenium	**3.9**	**180**	**1500**	0.76 J	2 J	0.26 J	ND
Silver	**2**	**8.3**	**1500**	0.68 J	0.39 J	ND	ND
Mercury	**0.18**	**0.73**	**2.8**	0.18 J	**1**	**0.29**	0.03 J

Notes:

1. Only those parameters detected at a minimum of one sample location are presented in this table; all other compounds were reported as non-detect.
2. Values per 6NYCRR Part 375 Soil Cleanup Objectives (December 2006).
3. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparison to SCOs.

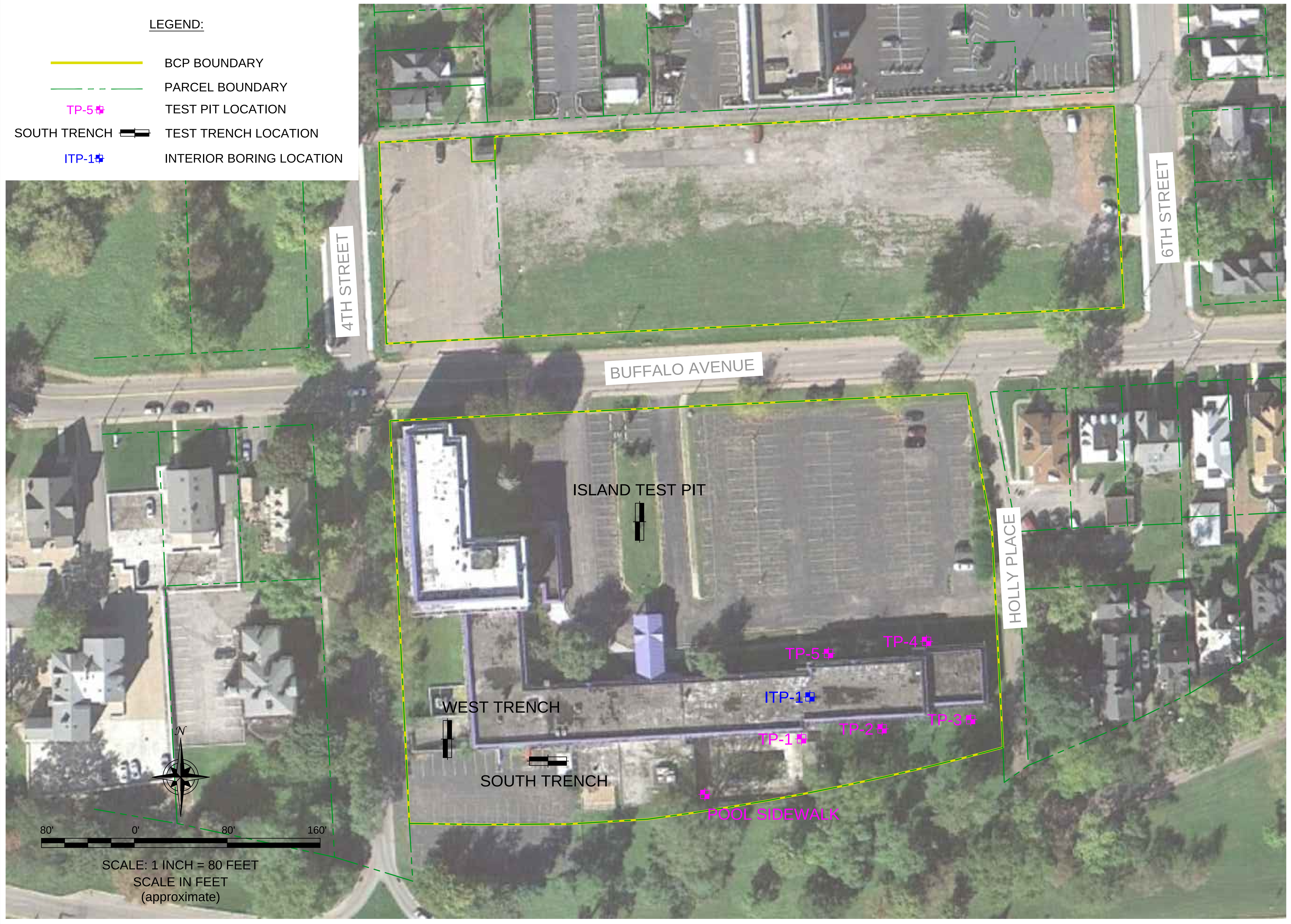
Definitions:

ND = Parameter not detected above laboratory detection limit.
"--" = No SCO available for the parameter.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.

BOLD = Result exceeds Part 375 Unrestricted Use SCOs.
BOLD = Result exceeds Part 375 Restricted Residential Use SCOs.
BOLD = Result exceeds Part 375 Commercial Use SCOs.

FIGURE

F:\CAD\TurnKey\Slater Law\401-430 Buffalo Ave\Supplemental Investigation August 2014\Figure 1; Sample Locations.dwg



DATE: AUGUST 2014
DRAFTED BY: BLR

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

TURNKEY ENVIRONMENTAL RESTORATION, LLC

JOB NO.: 0294-013-001

SAMPLE LOCATIONS

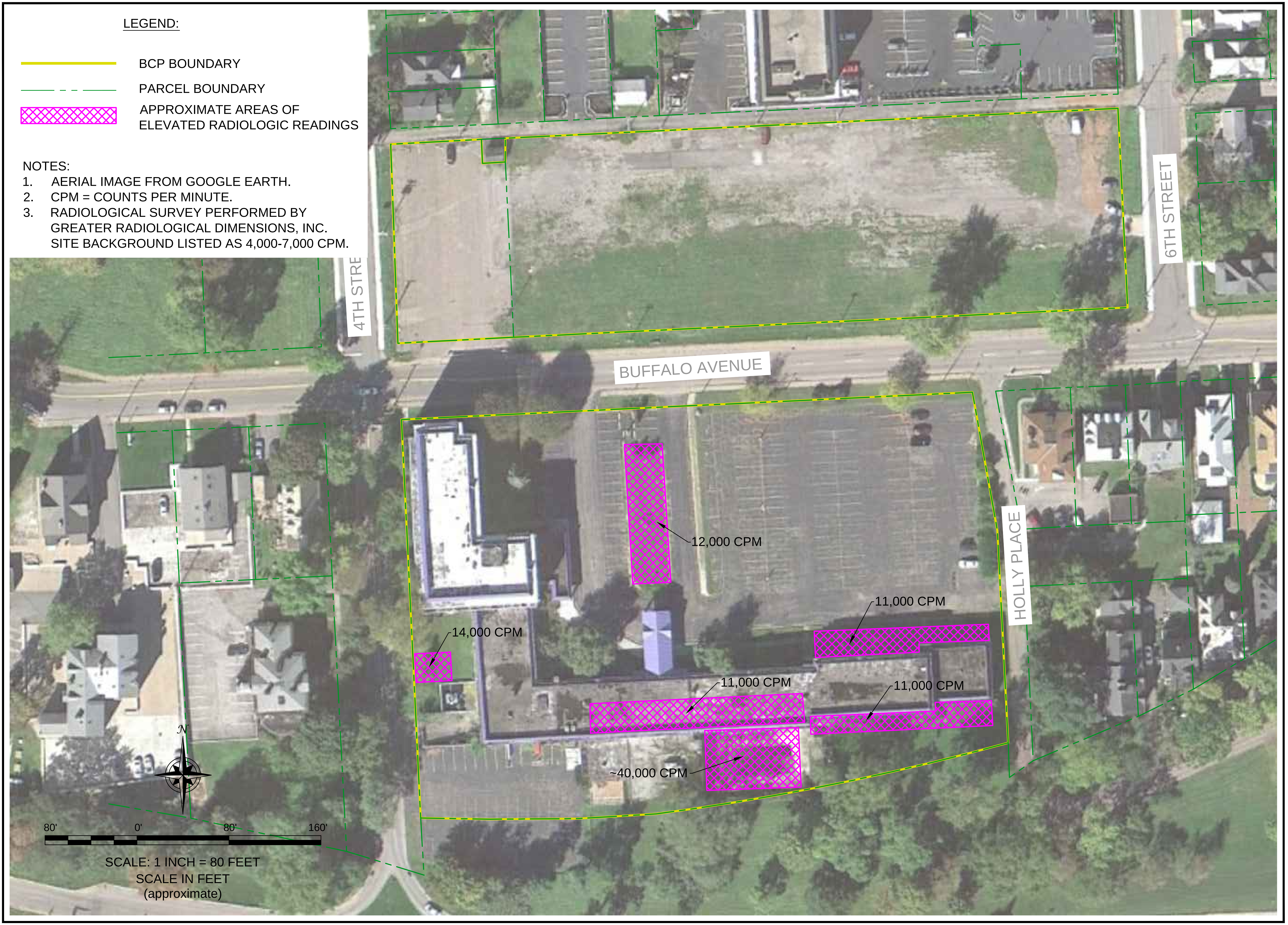
SUPPLEMENTAL INVESTIGATION

401 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK
PREPARED FOR
THE SLATER LAW FIRM, PLLC

FIGURE 1

DISCLAIMER:
PROPERTY OF TURNKEY ENV. REST., LLC. IMPORTANT: THIS DRAWING PRINT IS LOANED FOR MUTUAL ASSISTANCE AND AS SUCH IS SUBJECT TO RECALL AT ANY TIME. INFORMATION CONTAINED HEREON IS NOT TO BE DISCLOSED OR REPRODUCED IN ANY FORM FOR THE BENEFIT OF PARTIES OTHER THAN NECESSARY SUBCONTRACTORS & SUPPLIERS WITHOUT THE WRITTEN CONSENT OF TURNKEY ENV. REST., LLC.



LEGEND:

▬	BCP BOUNDARY
— - —	PARCEL BOUNDARY
▨	APPROXIMATE AREAS OF ELEVATED RADIOLOGIC READINGS

NOTES:
1. AERIAL IMAGE FROM GOOGLE EARTH.
2. CPM = COUNTS PER MINUTE.
3. RADIOLOGICAL SURVEY PERFORMED BY GREATER RADIOLOGICAL DIMENSIONS, INC. SITE BACKGROUND LISTED AS 4,000-7,000 CPM.

SCALE: 1 INCH = 80 FEET
SCALE IN FEET
(approximate)

DATE: AUGUST 2014
DRAFTED BY: BLR

TURNKEY ENVIRONMENTAL RESTORATION, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

JOB NO.: 0294-013-001

RADIATION SURVEY RESULTS

SUPPLEMENTAL INVESTIGATION
401 BUFFALO AVENUE SITE
NIAGARA FALLS, NEW YORK
PREPARED FOR
THE SLATER LAW FIRM, PLLC

FIGURE 2

DISCLAIMER:
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ATTACHMENT 1

RADIOLOGICAL SCREENING RESULTS
(GREATER RADIOLOGICAL DIMENSIONS, INC.)

RADIOLOGICAL SURVEY REPORT

Page 1 of 2

PROJECT: 401 Buffalo ave
PROJECT NO: Niagara Falls
AREA: ext / int. basement
SURVEY #: Buff ave 001
RWP #: NA
DATE: 8-26-14
TIME: 1200

JOB DESCRIPTION AND COMMENTS

☐ ROUTINE ☐ FOLLOW-UP ☐ NON-ROUTINE (Specify Below)

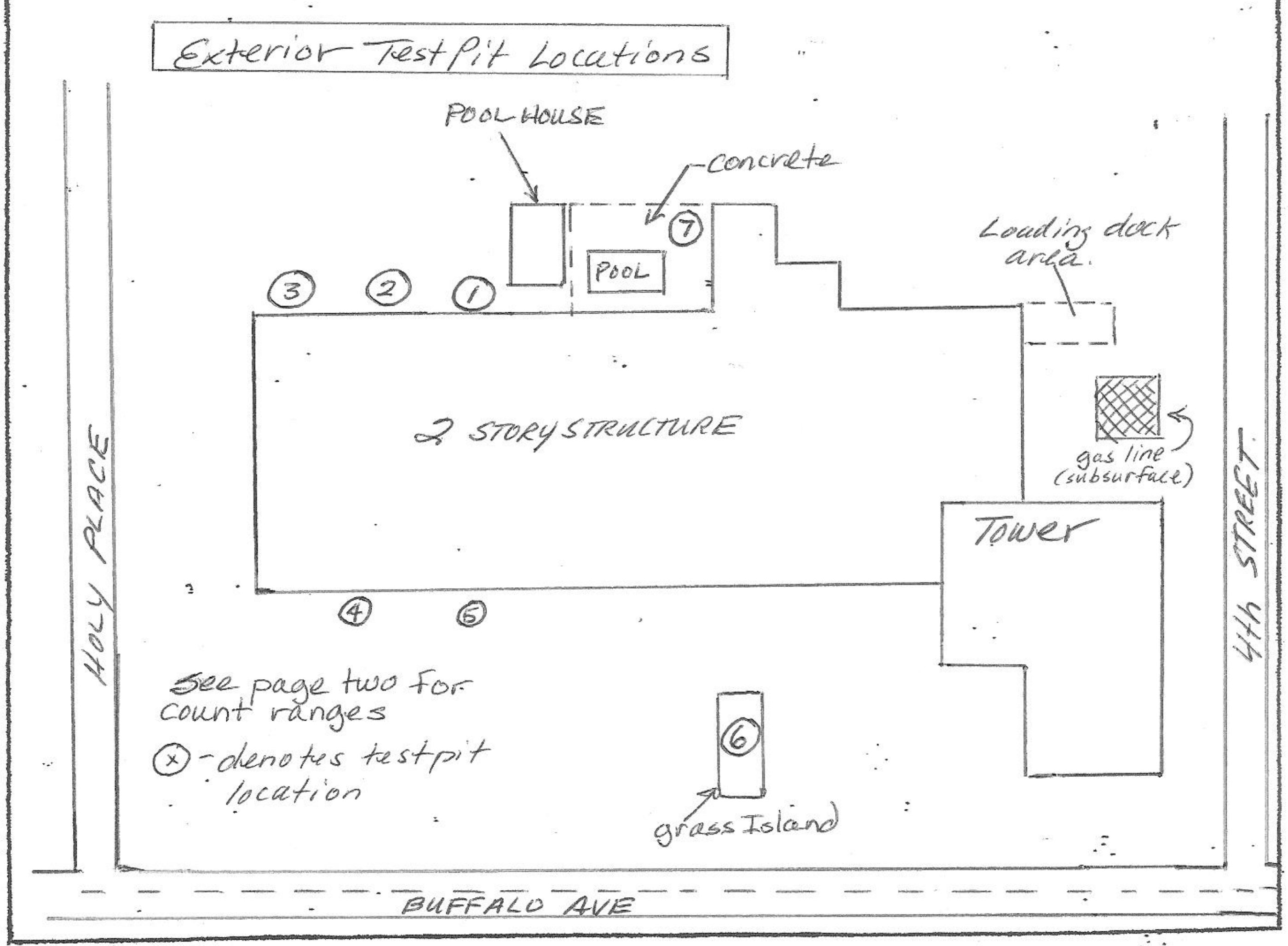
A preliminary GAMMA Walkover of the below described property was performed. On the exterior- 7 (seven) test pits were performed in addition to a surficial scane. On the interior one test pit was performed as well as a surficial walkover of accessible areas.

Performed by RCT: JAMES HULL
Performed by RCT: J. H. Hull
Print Name Signature

Performed by RCT: N/A
Performed by RCT: N/A
Print Name Signature

Reviewed by RCS: STUART PRYCE
Print Name
Signature
8.28.14.
Date

Exterior Test Pit Locations



See page two for count ranges

ⓧ - denotes testpit location

RADIOLOGICAL SURVEY REPORT

Page 1 of 2

PROJECT: 401 Buffalo ave Niagara falls
PROJECT NO:
AREA: ext/int
SURVEY #: Buffalo ave 001
RWP #: NA
DATE: 8.26.14
TIME: 1200

JOB DESCRIPTION AND COMMENTS

☐ ROUTINE ☐ FOLLOW-UP ☐ NON-ROUTINE (Specify Below)

survey instrument – Ludlum 2221 serial # 190170 paired w/a 44-10 probe. serial # PR242829 with a system cal due date of 8/../15, 1min waist high Backround on site 4800-7000 cpm

Performed by RCT: James Hull
Performed by RCT: J H Hull
Print Name / Signature

Performed by RCT: N/A
Performed by RCT: N/A
Print Name / Signature

Reviewed by RCS: STUART PRYCE / Stuart Pryce / 8.28.14
Print Name / Signature / Date

Exterior Test Pit
Count ranges. all counts in Cpm's

① 7K – 11K cpm
material consisted of clay, soil, and small amount of gravel/Rock.

② ③ ④ ⑤ same as #1
TP1-7 along base of structure

⑥ 7K - 12K cpm
material excavated consisted of clay, dirt, building debris, and a small amount of black ashe material.

TP6 located on grass Island in front parking lot.

⑦ elevated readings 8K-14K cpm thru the concrete in the pool area after concrete was removed readings were 18K – 40K cpm

Interior gamma readings (basement):

one cut was made in the basement floor of the two story portion of the building exposing the material beneath the concret floor readings range from 5K – 7500 cpm.

A Large amount of the basement was walked over where accessible due to debris.
The basement of the tower structure read 5K - 7K cpm
In the two story structure readings ranged from 7K – 11K cpm.

on the west side of the tower structure an area ▨ around a marked out subsurface gas line ranged from 10 - 14K cpm on surface - no test Pit was done.

* a sample of slag like material from TP 7 (POOL AREA) was secured and is being maintained for possible analysis.

ATTACHMENT 2

LABORATORY ANALYTICAL DATA PACKAGE

ANALYTICAL REPORT

Lab Number:	L1419647
Client:	Benchmark & Turnkey Companies 2558 Hamburg Turnpike Suite 300 Buffalo, NY 14218
ATTN:	Mike Lesakowski
Phone:	(716) 856-0599
Project Name:	401 BUFFALO AVENUE
Project Number:	0294-013-001
Report Date:	08/29/14

Certifications & Approvals: MA (M-MA086), NY (11148), CT (PH-0574), NH (2003), NJ NELAP (MA935), RI (LAO00065), ME (MA00086), PA (68-03671), USDA (Permit #P-330-11-00240), NC (666), TX (T104704476), DOD (L2217), US Army Corps of Engineers.

Eight Walkup Drive, Westborough, MA 01581-1019
508-898-9220 (Fax) 508-898-9193 800-624-9220 - www.alphalab.com

Project Name:	401 BUFFALO AVENUE	**Lab Number:**	L1419647
Project Number:	0294-013-001	**Report Date:**	08/29/14

Alpha Sample ID	Client ID	Matrix	Sample Location	Collection Date/Time	Receive Date
L1419647-01	WEST TRENCH DRAIN	SOIL	NIAGARA FALLS, NY	08/26/14 15:25	08/27/14
L1419647-02	SOUTH TRENCH DRAIN	SOIL	NIAGARA FALLS, NY	08/26/14 15:15	08/27/14
L1419647-03	ISLAND TEST PIT	SOIL	NIAGARA FALLS, NY	08/26/14 15:35	08/27/14
L1419647-04	POOL SIDEWALK	SOIL	NIAGARA FALLS, NY	08/26/14 15:00	08/27/14

Case Narrative

The samples were received in accordance with the Chain of Custody and no significant deviations were encountered during the preparation or analysis unless otherwise noted. Sample Receipt, Container Information, and the Chain of Custody are located at the back of the report.

Results contained within this report relate only to the samples submitted under this Alpha Lab Number and meet all of the requirements of NELAC, for all NELAC accredited parameters. The data presented in this report is organized by parameter (i.e. VOC, SVOC, etc.). Sample specific Quality Control data (i.e. Surrogate Spike Recovery) is reported at the end of the target analyte list for each individual sample, followed by the Laboratory Batch Quality Control at the end of each parameter. If a sample was re-analyzed or re-extracted due to a required quality control corrective action and if both sets of data are reported, the Laboratory ID of the re-analysis or re-extraction is designated with an "R" or "RE", respectively. When multiple Batch Quality Control elements are reported (e.g. more than one LCS), the associated samples for each element are noted in the grey shaded header line of each data table. Any Laboratory Batch, Sample Specific % recovery or RPD value that is outside the listed Acceptance Criteria is bolded in the report. Performance criteria for CAM and RCP methods allow for some LCS compound failures to occur and still be within method compliance. In these instances, the specific failures are not narrated but are noted in the associated QC table. This information is also incorporated in the Data Usability format for our Data Merger tool where it can be reviewed along with any associated usability implications. Soil/sediments, solids and tissues are reported on a dry weight basis unless otherwise noted. Definitions of all data qualifiers and acronyms used in this report are provided in the Glossary located at the back of the report.

In reference to questions H (CAM) or 4 (RCP) when "NO" is checked, the performance criteria for CAM and RCP methods allow for some quality control failures to occur and still be within method compliance. In these instances the specific failure is not narrated but noted in the associated QC table. The information is also incorporated in the Data Usability format of our Data Merger tool where it can be reviewed along with any associated usability implications.

Please see the associated ADEx data file for a comparison of laboratory reporting limits that were achieved with the regulatory Numerical Standards requested on the Chain of Custody.

HOLD POLICY
For samples submitted on hold, Alpha's policy is to hold samples (with the exception of Air canisters) free of charge for 21 calendar days from the date the project is completed. After 21 calendar days, we will dispose of all samples submitted including those put on hold unless you have contacted your Client Service Representative and made arrangements for Alpha to continue to hold the samples. Air canisters will be disposed after 3 business days from the date the project is completed.

Please contact Client Services at 800-624-9220 with any questions.

Case Narrative (continued)

Report Submission

All non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column.

Semivolatile Organics

L1419647-01 has elevated detection limits due to the dilution required by the matrix interferences encountered during the concentration of the sample and the analytical dilution required by the sample matrix.

I, the undersigned, attest under the pains and penalties of perjury that, to the best of my knowledge and belief and based upon my personal inquiry of those responsible for providing the information contained in this analytical report, such information is accurate and complete. This certificate of analysis is not complete unless this page accompanies any and all pages of this report.

Authorized Signature: Lisa Westerlind

Title: Technical Director/Representative

Date: 08/29/14

ORGANICS

SEMIVOLATILES

SAMPLE RESULTS

Lab ID: L1419647-01 D
Client ID: WEST TRENCH DRAIN
Sample Location: NIAGARA FALLS, NY
Matrix: Soil
Analytical Method: 1,8270D
Analytical Date: 08/29/14 02:12
Analyst: RC
Percent Solids: 30%

Date Collected: 08/26/14 15:25
Date Received: 08/27/14
Field Prep: Not Specified
Extraction Method: EPA 3546
Extraction Date: 08/28/14 03:42

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	4400	1100	10
2-Chloronaphthalene	ND		ug/kg	5500	1800	10
Fluoranthene	31000		ug/kg	3300	1000	10
Naphthalene	ND		ug/kg	5500	1800	10
Benzo(a)anthracene	10000		ug/kg	3300	1100	10
Benzo(a)pyrene	12000		ug/kg	4400	1300	10
Benzo(b)fluoranthene	25000		ug/kg	3300	1100	10
Benzo(k)fluoranthene	9300		ug/kg	3300	1000	10
Chrysene	21000		ug/kg	3300	1100	10
Acenaphthylene	ND		ug/kg	4400	1000	10
Anthracene	2200	J	ug/kg	3300	910	10
Benzo(ghi)perylene	14000		ug/kg	4400	1100	10
Fluorene	ND		ug/kg	5500	1600	10
Phenanthrene	13000		ug/kg	3300	1100	10
Dibenzo(a,h)anthracene	2300	J	ug/kg	3300	1100	10
Indeno(1,2,3-cd)Pyrene	14000		ug/kg	4400	1200	10
Pyrene	23000		ug/kg	3300	1100	10
2-Methylnaphthalene	ND		ug/kg	6600	1800	10

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**
Nitrobenzene-d5	109		23-120
2-Fluorobiphenyl	85		30-120
4-Terphenyl-d14	87		18-120

SAMPLE RESULTS

Lab ID:	L1419647-02 D	Date Collected:	08/26/14 15:15
Client ID:	SOUTH TRENCH DRAIN	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	08/28/14 03:42
Analytical Date:	08/29/14 13:00		
Analyst:	RC		
Percent Solids:	33%		

Parameter	**Result**	**Qualifier**	**Units**	**RL**	**MDL**	**Dilution Factor**
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	8200		ug/kg	4000	1000	10
2-Chloronaphthalene	ND		ug/kg	5000	1600	10
Fluoranthene	99000		ug/kg	3000	920	10
Naphthalene	3700	J	ug/kg	5000	1600	10
Benzo(a)anthracene	43000		ug/kg	3000	980	10
Benzo(a)pyrene	43000		ug/kg	4000	1200	10
Benzo(b)fluoranthene	57000		ug/kg	3000	1000	10
Benzo(k)fluoranthene	24000		ug/kg	3000	950	10
Chrysene	46000		ug/kg	3000	980	10
Acenaphthylene	ND		ug/kg	4000	930	10
Anthracene	16000		ug/kg	3000	830	10
Benzo(ghi)perylene	29000		ug/kg	4000	1000	10
Fluorene	7300		ug/kg	5000	1400	10
Phenanthrene	66000		ug/kg	3000	980	10
Dibenzo(a,h)anthracene	7300		ug/kg	3000	960	10
Indeno(1,2,3-cd)Pyrene	32000		ug/kg	4000	1100	10
Pyrene	72000		ug/kg	3000	970	10
2-Methylnaphthalene	ND		ug/kg	6000	1600	10

Surrogate	**% Recovery**	**Qualifier**	**Acceptance Criteria**
Nitrobenzene-d5	63		23-120
2-Fluorobiphenyl	64		30-120
4-Terphenyl-d14	59		18-120

SAMPLE RESULTS

Lab ID:	L1419647-03	Date Collected:	08/26/14 15:35
Client ID:	ISLAND TEST PIT	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	08/28/14 03:42
Analytical Date:	08/29/14 03:07		
Analyst:	RC		
Percent Solids:	88%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Semivolatile Organics by GC/MS - Westborough Lab						
Acenaphthene	ND		ug/kg	150	38.	1
2-Chloronaphthalene	ND		ug/kg	190	61.	1
Fluoranthene	480		ug/kg	110	34.	1
Naphthalene	ND		ug/kg	190	62.	1
Benzo(a)anthracene	320		ug/kg	110	36.	1
Benzo(a)pyrene	280		ug/kg	150	46.	1
Benzo(b)fluoranthene	320		ug/kg	110	38.	1
Benzo(k)fluoranthene	170		ug/kg	110	36.	1
Chrysene	340		ug/kg	110	37.	1
Acenaphthylene	ND		ug/kg	150	35.	1
Anthracene	74	J	ug/kg	110	31.	1
Benzo(ghi)perylene	150		ug/kg	150	39.	1
Fluorene	ND		ug/kg	190	54.	1
Phenanthrene	180		ug/kg	110	36.	1
Dibenzo(a,h)anthracene	46	J	ug/kg	110	36.	1
Indeno(1,2,3-cd)Pyrene	160		ug/kg	150	41.	1
Pyrene	420		ug/kg	110	36.	1
2-Methylnaphthalene	ND		ug/kg	220	60.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	86		23-120
2-Fluorobiphenyl	72		30-120
4-Terphenyl-d14	84		18-120

SAMPLE RESULTS

Lab ID:	L1419647-04	Date Collected:	08/26/14 15:00
Client ID:	POOL SIDEWALK	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil	Extraction Method:	EPA 3546
Analytical Method:	1,8270D	Extraction Date:	08/28/14 03:42
Analytical Date:	08/29/14 03:35		
Analyst:	RC		
Percent Solids:	89%		

Semivolatile Organics by GC/MS - Westborough Lab

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor
Acenaphthene	ND		ug/kg	150	38.	1
2-Chloronaphthalene	ND		ug/kg	190	61.	1
Fluoranthene	ND		ug/kg	110	34.	1
Naphthalene	ND		ug/kg	190	62.	1
Benzo(a)anthracene	ND		ug/kg	110	37.	1
Benzo(a)pyrene	ND		ug/kg	150	46.	1
Benzo(b)fluoranthene	ND		ug/kg	110	38.	1
Benzo(k)fluoranthene	ND		ug/kg	110	36.	1
Chrysene	ND		ug/kg	110	37.	1
Acenaphthylene	ND		ug/kg	150	35.	1
Anthracene	ND		ug/kg	110	31.	1
Benzo(ghi)perylene	ND		ug/kg	150	39.	1
Fluorene	ND		ug/kg	190	54.	1
Phenanthrene	ND		ug/kg	110	36.	1
Dibenzo(a,h)anthracene	ND		ug/kg	110	36.	1
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	150	42.	1
Pyrene	ND		ug/kg	110	36.	1
2-Methylnaphthalene	ND		ug/kg	220	60.	1

Surrogate	% Recovery	Qualifier	Acceptance Criteria
Nitrobenzene-d5	89		23-120
2-Fluorobiphenyl	63		30-120
4-Terphenyl-d14	73		18-120

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 08/28/14 09:01
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 08/27/14 23:09

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-04 Batch: WG717449-1					
Acenaphthene	ND		ug/kg	130	33.
1,2,4-Trichlorobenzene	ND		ug/kg	160	53.
Hexachlorobenzene	ND		ug/kg	97	30.
Bis(2-chloroethyl)ether	ND		ug/kg	140	45.
2-Chloronaphthalene	ND		ug/kg	160	53.
1,2-Dichlorobenzene	ND		ug/kg	160	53.
1,3-Dichlorobenzene	ND		ug/kg	160	51.
1,4-Dichlorobenzene	ND		ug/kg	160	49.
3,3'-Dichlorobenzidine	ND		ug/kg	160	43.
2,4-Dinitrotoluene	ND		ug/kg	160	35.
2,6-Dinitrotoluene	ND		ug/kg	160	41.
Fluoranthene	ND		ug/kg	97	30.
4-Chlorophenyl phenyl ether	ND		ug/kg	160	49.
4-Bromophenyl phenyl ether	ND		ug/kg	160	37.
Bis(2-chloroisopropyl)ether	ND		ug/kg	190	57.
Bis(2-chloroethoxy)methane	ND		ug/kg	170	49.
Hexachlorobutadiene	ND		ug/kg	160	46.
Hexachlorocyclopentadiene	ND		ug/kg	460	100
Hexachloroethane	ND		ug/kg	130	29.
Isophorone	ND		ug/kg	140	43.
Naphthalene	ND		ug/kg	160	54.
Nitrobenzene	ND		ug/kg	140	38.
NitrosoDiPhenylAmine(NDPA)/DPA	ND		ug/kg	130	34.
n-Nitrosodi-n-propylamine	ND		ug/kg	160	48.
Bis(2-Ethylhexyl)phthalate	ND		ug/kg	160	42.
Butyl benzyl phthalate	ND		ug/kg	160	32.
Di-n-butylphthalate	ND		ug/kg	160	31.
Di-n-octylphthalate	ND		ug/kg	160	40.
Diethyl phthalate	ND		ug/kg	160	34.

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 08/28/14 09:01
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 08/27/14 23:09

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-04 Batch: WG717449-1					
Dimethyl phthalate	ND		ug/kg	160	41.
Benzo(a)anthracene	ND		ug/kg	97	32.
Benzo(a)pyrene	ND		ug/kg	130	40.
Benzo(b)fluoranthene	ND		ug/kg	97	33.
Benzo(k)fluoranthene	ND		ug/kg	97	31.
Chrysene	ND		ug/kg	97	32.
Acenaphthylene	ND		ug/kg	130	30.
Anthracene	ND		ug/kg	97	27.
Benzo(ghi)perylene	ND		ug/kg	130	34.
Fluorene	ND		ug/kg	160	46.
Phenanthrene	ND		ug/kg	97	32.
Dibenzo(a,h)anthracene	ND		ug/kg	97	31.
Indeno(1,2,3-cd)Pyrene	ND		ug/kg	130	36.
Pyrene	ND		ug/kg	97	31.
Biphenyl	ND		ug/kg	370	53.
4-Chloroaniline	ND		ug/kg	160	43.
2-Nitroaniline	ND		ug/kg	160	46.
3-Nitroaniline	ND		ug/kg	160	45.
4-Nitroaniline	ND		ug/kg	160	44.
Dibenzofuran	ND		ug/kg	160	54.
2-Methylnaphthalene	ND		ug/kg	190	52.
1,2,4,5-Tetrachlorobenzene	ND		ug/kg	160	50.
Acetophenone	ND		ug/kg	160	50.
2,4,6-Trichlorophenol	ND		ug/kg	97	30.
P-Chloro-M-Cresol	ND		ug/kg	160	47.
2-Chlorophenol	ND		ug/kg	160	49.
2,4-Dichlorophenol	ND		ug/kg	140	52.
2,4-Dimethylphenol	ND		ug/kg	160	48.
2-Nitrophenol	ND		ug/kg	350	50.

Method Blank Analysis
Batch Quality Control

Analytical Method: 1,8270D
Analytical Date: 08/28/14 09:01
Analyst: RC

Extraction Method: EPA 3546
Extraction Date: 08/27/14 23:09

Parameter	Result	Qualifier	Units	RL	MDL
Semivolatile Organics by GC/MS - Westborough Lab for sample(s): 01-04 Batch: WG717449-1					
4-Nitrophenol	ND		ug/kg	230	52.
2,4-Dinitrophenol	ND		ug/kg	780	220
4,6-Dinitro-o-cresol	ND		ug/kg	420	59.
Pentachlorophenol	ND		ug/kg	130	35.
Phenol	ND		ug/kg	160	48.
2-Methylphenol	ND		ug/kg	160	52.
3-Methylphenol/4-Methylphenol	ND		ug/kg	230	53.
2,4,5-Trichlorophenol	ND		ug/kg	160	52.
Benzoic Acid	ND		ug/kg	520	160
Benzyl Alcohol	ND		ug/kg	160	50.
Carbazole	ND		ug/kg	160	35.

Surrogate	%Recovery	Qualifier	Acceptance Criteria
2-Fluorophenol	62		25-120
Phenol-d6	59		10-120
Nitrobenzene-d5	56		23-120
2-Fluorobiphenyl	53		30-120
2,4,6-Tribromophenol	52		0-136
4-Terphenyl-d14	52		18-120

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVENUE

Lab Number: L1419647

Project Number: 0294-013-001

Report Date: 08/29/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-04 Batch: WG717449-2 WG717449-3								
Acenaphthene	58		78		31-137	29		50
1,2,4-Trichlorobenzene	56		68		38-107	19		50
Hexachlorobenzene	57		76		40-140	29		50
Bis(2-chloroethyl)ether	60		71		40-140	17		50
2-Chloronaphthalene	62		77		40-140	22		50
1,2-Dichlorobenzene	58		68		40-140	16		50
1,3-Dichlorobenzene	56		66		40-140	16		50
1,4-Dichlorobenzene	55		66		28-104	18		50
3,3'-Dichlorobenzidine	41		51		40-140	22		50
2,4-Dinitrotoluene	63		84		28-89	29		50
2,6-Dinitrotoluene	67		82		40-140	20		50
Fluoranthene	56		80		40-140	35		50
4-Chlorophenyl phenyl ether	60		80		40-140	29		50
4-Bromophenyl phenyl ether	60		79		40-140	27		50
Bis(2-chloroisopropyl)ether	61		75		40-140	21		50
Bis(2-chloroethoxy)methane	63		77		40-117	20		50
Hexachlorobutadiene	60		74		40-140	21		50
Hexachlorocyclopentadiene	66		78		40-140	17		50
Hexachloroethane	60		71		40-140	17		50
Isophorone	65		79		40-140	19		50
Naphthalene	58		74		40-140	24		50

Lab Control Sample Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVENUE
Lab Number: L1419647
Project Number: 0294-013-001
Report Date: 08/29/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-04 Batch: WG717449-2 WG717449-3								
Nitrobenzene	60		76		40-140	24		50
NitrosoDiPhenylAmine(NDPA)/DPA	60		80			29		50
n-Nitrosodi-n-propylamine	60		74		32-121	21		50
Bis(2-Ethylhexyl)phthalate	62		92		40-140	39		50
Butyl benzyl phthalate	59		86		40-140	37		50
Di-n-butylphthalate	60		86		40-140	36		50
Di-n-octylphthalate	62		94		40-140	41		50
Diethyl phthalate	62		81		40-140	27		50
Dimethyl phthalate	62		81		40-140	27		50
Benzo(a)anthracene	56		82		40-140	38		50
Benzo(a)pyrene	56		81		40-140	36		50
Benzo(b)fluoranthene	56		80		40-140	35		50
Benzo(k)fluoranthene	57		85		40-140	39		50
Chrysene	58		83		40-140	35		50
Acenaphthylene	64		80		40-140	22		50
Anthracene	58		85		40-140	38		50
Benzo(ghi)perylene	55		80		40-140	37		50
Fluorene	59		78		40-140	28		50
Phenanthrene	56		81		40-140	36		50
Dibenzo(a,h)anthracene	53		80		40-140	41		50
Indeno(1,2,3-cd)Pyrene	55		81		40-140	38		50

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVENUE

Project Number: 0294-013-001

Lab Number: L1419647

Report Date: 08/29/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-04 Batch: WG717449-2 WG717449-3								
Pyrene	55		79		35-142	36		50
Biphenyl	61		85			33		50
4-Chloroaniline	59		46		40-140	25		50
2-Nitroaniline	67		80		47-134	18		50
3-Nitroaniline	49		58		26-129	17		50
4-Nitroaniline	58		77		41-125	28		50
Dibenzofuran	56		76		40-140	30		50
2-Methylnaphthalene	57		73		40-140	25		50
1,2,4,5-Tetrachlorobenzene	59		81		40-117	31		50
Acetophenone	64		78		14-144	20		50
2,4,6-Trichlorophenol	68		85		30-130	22		50
P-Chloro-M-Cresol	65		82		26-103	23		50
2-Chlorophenol	57		68		25-102	18		50
2,4-Dichlorophenol	60		77		30-130	25		50
2,4-Dimethylphenol	65		82		30-130	23		50
2-Nitrophenol	59		70		30-130	17		50
4-Nitrophenol	62		86		11-114	32		50
2,4-Dinitrophenol	46		63		4-130	31		50
4,6-Dinitro-o-cresol	57		75		10-130	27		50
Pentachlorophenol	55		78		17-109	35		50
Phenol	59		70		26-90	17		50

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVENUE
Lab Number: L1419647
Project Number: 0294-013-001
Report Date: 08/29/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Semivolatile Organics by GC/MS - Westborough Lab Associated sample(s): 01-04 Batch: WG717449-2 WG717449-3								
2-Methylphenol	61		74		30-130.	19		50
3-Methylphenol/4-Methylphenol	60		74		30-130	21		50
2,4,5-Trichlorophenol	68		83		30-130	20		50
Benzoic Acid	42		51			19		50
Benzyl Alcohol	62		75		40-140	19		50
Carbazole	56		78		54-128	33		50

Surrogate	*LCS %Recovery*	*Qual*	*LCSD %Recovery*	*Qual*	*Acceptance Criteria*
2-Fluorophenol	61		73		25-120
Phenol-d6	62		74		10-120
Nitrobenzene-d5	58		71		23-120
2-Fluorobiphenyl	59		74		30-120
2,4,6-Tribromophenol	59		83		0-136
4-Terphenyl-d14	53		75		18-120

METALS

Project Name:	401 BUFFALO AVENUE	**Lab Number:**	L1419647
Project Number:	0294-013-001	**Report Date:**	08/29/14

SAMPLE RESULTS

Lab ID:	L1419647-01	Date Collected:	08/26/14 15:25
Client ID:	WEST TRENCH DRAIN	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	30%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	7.1		mg/kg	1.3	0.26	1	08/28/14 15:20	08/28/14 19:27	EPA 3050B	1,6010C	TT
Barium, Total	160		mg/kg	1.3	0.38	1	08/28/14 15:20	08/28/14 19:27	EPA 3050B	1,6010C	TT
Cadmium, Total	2.6		mg/kg	1.3	0.09	1	08/28/14 15:20	08/28/14 19:27	EPA 3050B	1,6010C	TT
Chromium, Total	32		mg/kg	1.3	0.26	1	08/28/14 15:20	08/28/14 19:27	EPA 3050B	1,6010C	TT
Lead, Total	36		mg/kg	6.4	0.26	1	08/28/14 15:20	08/28/14 19:27	EPA 3050B	1,6010C	TT
Mercury, Total	0.18	J	mg/kg	0.21	0.05	1	08/28/14 07:55	08/28/14 11:09	EPA 7471B	1,7471B	MC
Selenium, Total	0.76	J	mg/kg	2.6	0.38	1	08/28/14 15:20	08/28/14 19:27	EPA 3050B	1,6010C	TT
Silver, Total	0.68	J	mg/kg	1.3	0.26	1	08/28/14 15:20	08/28/14 19:27	EPA 3050B	1,6010C	TT

Project Name:	401 BUFFALO AVENUE	**Lab Number:**	L1419647
Project Number:	0294-013-001	**Report Date:**	08/29/14

SAMPLE RESULTS

Lab ID:	L1419647-02	Date Collected:	08/26/14 15:15
Client ID:	SOUTH TRENCH DRAIN	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	33%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	4.7		mg/kg	1.2	0.24	1	08/28/14 15:20	08/28/14 19:31	EPA 3050B	1,6010C	TT
Barium, Total	150		mg/kg	1.2	0.36	1	08/28/14 15:20	08/28/14 19:31	EPA 3050B	1,6010C	TT
Cadmium, Total	8.2		mg/kg	1.2	0.09	1	08/28/14 15:20	08/28/14 19:31	EPA 3050B	1,6010C	TT
Chromium, Total	98		mg/kg	1.2	0.24	1	08/28/14 15:20	08/28/14 19:31	EPA 3050B	1,6010C	TT
Lead, Total	150		mg/kg	6.1	0.24	1	08/28/14 15:20	08/28/14 19:31	EPA 3050B	1,6010C	TT
Mercury, Total	1.0		mg/kg	0.20	0.04	1	08/28/14 07:55	08/28/14 11:11	EPA 7471B	1,7471B	MC
Selenium, Total	2.0	J	mg/kg	2.4	0.36	1	08/28/14 15:20	08/28/14 19:31	EPA 3050B	1,6010C	TT
Silver, Total	0.39	J	mg/kg	1.2	0.24	1	08/28/14 15:20	08/28/14 19:31	EPA 3050B	1,6010C	TT

Project Name:	401 BUFFALO AVENUE	**Lab Number:**	L1419647
Project Number:	0294-013-001	**Report Date:**	08/29/14

SAMPLE RESULTS

Lab ID:	L1419647-03	Date Collected:	08/26/14 15:35
Client ID:	ISLAND TEST PIT	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil		
Percent Solids:	88%		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	21		mg/kg	0.43	0.09	1	08/28/14 15:20	08/28/14 19:34	EPA 3050B	1,6010C	TT
Barium, Total	84		mg/kg	0.43	0.13	1	08/28/14 15:20	08/28/14 19:34	EPA 3050B	1,6010C	TT
Cadmium, Total	0.24	J	mg/kg	0.43	0.03	1	08/28/14 15:20	08/28/14 19:34	EPA 3050B	1,6010C	TT
Chromium, Total	9.7		mg/kg	0.43	0.09	1	08/28/14 15:20	08/28/14 19:34	EPA 3050B	1,6010C	TT
Lead, Total	540		mg/kg	2.2	0.09	1	08/28/14 15:20	08/28/14 19:34	EPA 3050B	1,6010C	TT
Mercury, Total	0.29		mg/kg	0.08	0.02	1	08/28/14 07:55	08/28/14 11:13	EPA 7471B	1,7471B	MC
Selenium, Total	0.26	J	mg/kg	0.86	0.13	1	08/28/14 15:20	08/28/14 19:34	EPA 3050B	1,6010C	TT
Silver, Total	ND		mg/kg	0.43	0.09	1	08/28/14 15:20	08/28/14 19:34	EPA 3050B	1,6010C	TT

Project Name: 401 BUFFALO AVENUE
Lab Number: L1419647
Project Number: 0294-013-001
Report Date: 08/29/14

SAMPLE RESULTS

Lab ID: L1419647-04
Client ID: POOL SIDEWALK
Sample Location: NIAGARA FALLS, NY
Matrix: Soil
Percent Solids: 89%
Date Collected: 08/26/14 15:00
Date Received: 08/27/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Prep Method	Analytical Method	Analyst
Total Metals - Westborough Lab											
Arsenic, Total	3.6		mg/kg	0.43	0.09	1	08/28/14 15:20	08/28/14 19:38	EPA 3050B	1,6010C	TT
Barium, Total	25		mg/kg	0.43	0.13	1	08/28/14 15:20	08/28/14 19:38	EPA 3050B	1,6010C	TT
Cadmium, Total	0.42	J	mg/kg	0.43	0.03	1	08/28/14 15:20	08/28/14 19:38	EPA 3050B	1,6010C	TT
Chromium, Total	7.6		mg/kg	0.43	0.09	1	08/28/14 15:20	08/28/14 19:38	EPA 3050B	1,6010C	TT
Lead, Total	21		mg/kg	2.2	0.09	1	08/28/14 15:20	08/28/14 19:38	EPA 3050B	1,6010C	TT
Mercury, Total	0.03	J	mg/kg	0.07	0.02	1	08/28/14 07:55	08/28/14 11:14	EPA 7471B	1,7471B	MC
Selenium, Total	ND		mg/kg	0.87	0.13	1	08/28/14 15:20	08/28/14 19:38	EPA 3050B	1,6010C	TT
Silver, Total	ND		mg/kg	0.43	0.09	1	08/28/14 15:20	08/28/14 19:38	EPA 3050B	1,6010C	TT

Method Blank Analysis
Batch Quality Control

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01-04 Batch: WG717491-1										
Mercury, Total	ND		mg/kg	0.08	0.02	1	08/28/14 07:55	08/28/14 10:21	1,7471B	MC

Prep Information

Digestion Method: EPA 7471B

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
Total Metals - Westborough Lab for sample(s): 01-04 Batch: WG717723-1										
Arsenic, Total	ND		mg/kg	0.40	0.08	1	08/28/14 15:20	08/28/14 18:34	1,6010C	TT
Barium, Total	ND		mg/kg	0.40	0.12	1	08/28/14 15:20	08/28/14 18:34	1,6010C	TT
Cadmium, Total	ND		mg/kg	0.40	0.03	1	08/28/14 15:20	08/28/14 18:34	1,6010C	TT
Chromium, Total	ND		mg/kg	0.40	0.08	1	08/28/14 15:20	08/28/14 18:34	1,6010C	TT
Lead, Total	ND		mg/kg	2.0	0.08	1	08/28/14 15:20	08/28/14 18:34	1,6010C	TT
Selenium, Total	ND		mg/kg	0.80	0.12	1	08/28/14 15:20	08/28/14 18:34	1,6010C	TT
Silver, Total	ND		mg/kg	0.40	0.08	1	08/28/14 15:20	08/28/14 18:34	1,6010C	TT

Prep Information

Digestion Method: EPA 3050B

Lab Control Sample Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVENUE

Project Number: 0294-013-001

Lab Number: L1419647

Report Date: 08/29/14

Parameter	LCS %Recovery	Qual	LCSD %Recovery	Qual	%Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-04 Batch: WG717491-2 SRM Lot Number: D083-540								
Mercury, Total	121		-		75-126	-		
Total Metals - Westborough Lab Associated sample(s): 01-04 Batch: WG717723-2 SRM Lot Number: D083-540								
Arsenic, Total	106		-		78-122	-		
Barium, Total	108		-		82-117	-		
Cadmium, Total	98		-		82-118	-		
Chromium, Total	98		-		79-121	-		
Lead, Total	93		-		81-119	-		
Selenium, Total	102		-		78-123	-		
Silver, Total	102		-		74-125	-		

Matrix Spike Analysis
Batch Quality Control

Parameter	Native Sample	MS Added	MS Found	MS %Recovery	Qual	MSD Found	MSD %Recovery	Qual	Recovery Limits	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG717491-4 QC Sample: L1419491-01 Client ID: MS Sample												
Mercury, Total	0.06J	0.191	0.32	**167**	Q	-	-		80-120	-		20
Total Metals - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG717723-4 QC Sample: L1419502-01 Client ID: MS Sample												
Arsenic, Total	2.2	10.9	12	90		-	-		75-125	-		20
Barium, Total	25.	182	190	90		-	-		75-125	-		20
Cadmium, Total	ND	4.65	3.8	82		-	-		75-125	-		20
Chromium, Total	18.	18.2	54	**197**	Q	-	-		75-125	-		20
Lead, Total	7.0	46.5	44	80		-	-		75-125	-		20
Selenium, Total	0.79J	10.9	9.5	87		-	-		75-125	-		20
Silver, Total	ND	27.4	25	91		-	-		75-125	-		20

Lab Duplicate Analysis

Batch Quality Control

Project Name: 401 BUFFALO AVENUE
Project Number: 0294-013-001

Lab Number: L1419647
Report Date: 08/29/14

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
Total Metals - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG717491-3 QC Sample: L1419491-01 Client ID: DUP Sample						
Mercury, Total	0.06J	0.05J	mg/kg	NC		20
Total Metals - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG717723-3 QC Sample: L1419502-01 Client ID: DUP Sample						
Arsenic, Total	2.2	3.0	mg/kg	**31**	Q	20
Barium, Total	25.	24	mg/kg	4		20
Cadmium, Total	ND	ND	mg/kg	NC		20
Chromium, Total	18.	23	mg/kg	**24**	Q	20
Lead, Total	7.0	6.2	mg/kg	12		20
Selenium, Total	0.79J	0.91J	mg/kg	NC		20
Silver, Total	ND	ND	mg/kg	NC		20

INORGANICS
&
MISCELLANEOUS

SAMPLE RESULTS

Lab ID:	L1419647-01	Date Collected:	08/26/14 15:25
Client ID:	WEST TRENCH DRAIN	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	29.8		%	0.100	NA	1	-	08/28/14 02:04	30,2540G	RT

SAMPLE RESULTS

Lab ID: L1419647-02
Client ID: SOUTH TRENCH DRAIN
Sample Location: NIAGARA FALLS, NY
Matrix: Soil

Date Collected: 08/26/14 15:15
Date Received: 08/27/14
Field Prep: Not Specified

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	32.7		%	0.100	NA	1	-	08/28/14 02:04	30,2540G	RT

Project Name:	401 BUFFALO AVENUE	**Lab Number:**	L1419647
Project Number:	0294-013-001	**Report Date:**	08/29/14

SAMPLE RESULTS

Lab ID:	L1419647-03	Date Collected:	08/26/14 15:35
Client ID:	ISLAND TEST PIT	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	88.4		%	0.100	NA	1	-	08/28/14 02:04	30,2540G	RT

SAMPLE RESULTS

Lab ID:	L1419647-04	Date Collected:	08/26/14 15:00
Client ID:	POOL SIDEWALK	Date Received:	08/27/14
Sample Location:	NIAGARA FALLS, NY	Field Prep:	Not Specified
Matrix:	Soil		

Parameter	Result	Qualifier	Units	RL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Analytical Method	Analyst
General Chemistry - Westborough Lab										
Solids, Total	88.6		%	0.100	NA	1	-	08/28/14 02:04	30,2540G	RT

Lab Duplicate Analysis
Batch Quality Control

Project Name: 401 BUFFALO AVENUE
Project Number: 0294-013-001

Lab Number: L1419647
Report Date: 08/29/14

Parameter	Native Sample	Duplicate Sample	Units	RPD	Qual	RPD Limits
General Chemistry - Westborough Lab Associated sample(s): 01-04 QC Batch ID: WG717482-1 QC Sample: L1419644-01 Client ID: DUP Sample						
Solids, Total	88.7	88.7	%	0		20

Sample Receipt and Container Information

Were project specific reporting limits specified? YES

Reagent H2O Preserved Vials Frozen on: NA

Cooler Information Cooler	**Custody Seal**
A	Absent

Container Information

Container ID	Container Type	Cooler	pH	Temp deg C	Pres	Seal	Analysis(*)
L1419647-01A	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1419647-01B	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1419647-02A	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1419647-02B	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1419647-03A	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1419647-03B	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1419647-04A	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)
L1419647-04B	Amber 120ml unpreserved	A	N/A	4.2	Y	Absent	NYTCL-8270(14),AS-TI(180),BA-TI(180),AG-TI(180),CR-TI(180),TS(7),PB-TI(180),SE-TI(180),HG-T(28),CD-TI(180)

*Values in parentheses indicate holding time in days

GLOSSARY

Acronyms

EDL - Estimated Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The EDL includes any adjustments from dilutions, concentrations or moisture content, where applicable. The use of EDLs is specific to the analysis of PAHs using Solid-Phase Microextraction (SPME).

EPA - Environmental Protection Agency.

LCS - Laboratory Control Sample: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

LCSD - Laboratory Control Sample Duplicate: Refer to LCS.

LFB - Laboratory Fortified Blank: A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes.

MDL - Method Detection Limit: This value represents the level to which target analyte concentrations are reported as estimated values, when those target analyte concentrations are quantified below the reporting limit (RL). The MDL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

MS - Matrix Spike Sample: A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available.

MSD - Matrix Spike Sample Duplicate: Refer to MS.

NA - Not Applicable.

NC - Not Calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit.

NI - Not Ignitable.

RL - Reporting Limit: The value at which an instrument can accurately measure an analyte at a specific concentration. The RL includes any adjustments from dilutions, concentrations or moisture content, where applicable.

RPD - Relative Percent Difference: The results from matrix and/or matrix spike duplicates are primarily designed to assess the precision of analytical results in a given matrix and are expressed as relative percent difference (RPD). Values which are less than five times the reporting limit for any individual parameter are evaluated by utilizing the absolute difference between the values; although the RPD value will be provided in the report.

SRM - Standard Reference Material: A reference sample of a known or certified value that is of the same or similar matrix as the associated field samples.

Footnotes

1 - The reference for this analyte should be considered modified since this analyte is absent from the target analyte list of the original method.

Terms

Total: With respect to Organic analyses, a 'Total' result is defined as the summation of results for individual isomers or Aroclors. If a 'Total' result is requested, the results of its individual components will also be reported. This is applicable to 'Total' results for methods 8260, 8081 and 8082.

Analytical Method: Both the document from which the method originates and the analytical reference method. (Example: EPA 8260B is shown as 1,8260B.) The codes for the reference method documents are provided in the References section of the Addendum.

Data Qualifiers

A - Spectra identified as "Aldol Condensation Product".

B - The analyte was detected above the reporting limit in the associated method blank. Flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For MCP-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank. For DOD-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte at less than ten times (10x) the concentration found in the blank AND the analyte was detected above one-half the reporting limit (or above the reporting limit for common lab contaminants) in the associated method blank. For NJ-Air-related projects, flag only applies to associated field samples that have detectable concentrations of the analyte above the reporting limit.

C - Co-elution: The target analyte co-elutes with a known lab standard (i.e. surrogate, internal standards, etc.) for co-extracted analyses.

D - Concentration of analyte was quantified from diluted analysis. Flag only applies to field samples that have detectable concentrations of the analyte.

E - Concentration of analyte exceeds the range of the calibration curve and/or linear range of the instrument.

G - The concentration may be biased high due to matrix interferences (i.e, co-elution) with non-target compound(s). The result should be considered estimated.

Data Qualifiers

H	- The analysis of pH was performed beyond the regulatory-required holding time of 15 minutes from the time of sample collection.
I	- The lower value for the two columns has been reported due to obvious interference.
M	- Reporting Limit (RL) exceeds the MCP CAM Reporting Limit for this analyte.
NJ	- Presumptive evidence of compound. This represents an estimated concentration for Tentatively Identified Compounds (TICs), where the identification is based on a mass spectral library search.
P	- The RPD between the results for the two columns exceeds the method-specified criteria.
Q	- The quality control sample exceeds the associated acceptance criteria. For DOD-related projects, LCS and/or Continuing Calibration Standard exceedences are also qualified on all associated sample results. Note: This flag is not applicable for matrix spike recoveries when the sample concentration is greater than 4x the spike added or for batch duplicate RPD when the sample concentrations are less than 5x the RL. (Metals only.)
R	- Analytical results are from sample re-analysis.
RE	- Analytical results are from sample re-extraction.
S	- Analytical results are from modified screening analysis.
J	- Estimated value. The Target analyte concentration is below the quantitation limit (RL), but above the Method Detection Limit (MDL) or Estimated Detection Limit (EDL) for SPME-related analyses. This represents an estimated concentration for Tentatively Identified Compounds (TICs).
ND	- Not detected at the method detection limit (MDL) for the sample, or estimated detection limit (EDL) for SPME-related analyses.

Report Format: DU Report with 'J' Qualifiers

REFERENCES

1 Test Methods for Evaluating Solid Waste: Physical/Chemical Methods. EPA SW-846. Third Edition. Updates I - IV, 2007.

30 Standard Methods for the Examination of Water and Wastewater. APHA-AWWA-WPCF. 18th Edition. 1992.

LIMITATION OF LIABILITIES

Certification Information

Last revised April 15, 2014

The following analytes are not included in our NELAP Scope of Accreditation:

Westborough Facility
EPA 524.2: Acetone, 2-Butanone (Methyl ethyl ketone (MEK)), Tert-butyl alcohol, 2-Hexanone, Tetrahydrofuran, 1,3,5-Trichlorobenzene, 4-Methyl-2-pentanone (MIBK), Carbon disulfide, Diethyl ether.
EPA 8260C: 1,2,4,5-Tetramethylbenzene, 4-Ethyltoluene, Iodomethane (methyl iodide), Methyl methacrylate, Azobenzene.
EPA 8330A/B: PETN, Picric Acid, Nitroglycerine, 2,6-DANT, 2,4-DANT.
EPA 8270D: 1-Methylnaphthalene, Dimethylnaphthalene,1,4-Diphenylhydrazine.
EPA 625: 4-Chloroaniline, 4-Methylphenol.
SM4500: Soil: Total Phosphorus, TKN, NO2, NO3.
EPA 9071: Total Petroleum Hydrocarbons, Oil & Grease.

Mansfield Facility
EPA 8270D: Biphenyl.
EPA 2540D: TSS
EPA TO-15: Halothane, 2,4,4-Trimethyl-2-pentene, 2,4,4-Trimethyl-1-pentene, Thiophene, 2-Methylthiophene, 3-Methylthiophene, 2-Ethylthiophene, 1,2,3-Trimethylbenzene, Indan, Indene, 1,2,4,5-Tetramethylbenzene, Benzothiophene, 1-Methylnaphthalene.

The following analytes are included in our Massachusetts DEP Scope of Accreditation, Westborough Facility:

Drinking Water
EPA 200.8: Sb,As,Ba,Be,Cd,Cr,Cu,Pb,Ni,Se,Tl; **EPA 200.7**: Ba,Be,Ca,Cd,Cr,Cu,Na; **EPA 245.1:** Mercury;
EPA 300.0: Nitrate-N, Fluoride, Sulfate; **EPA 353.2**: Nitrate-N, Nitrite-N; **SM4500NO3-F**: Nitrate-N, Nitrite-N; **SM4500F-C, SM4500CN-CE, EPA 180.1, SM2130B, SM4500Cl-D, SM2320B, SM2540C, SM4500H-B**
EPA 332: Perchlorate.
Microbiology: **SM9215B; SM9223-P/A, SM9223B-Colilert-QT, Enterolert-QT.**

Non-Potable Water
EPA 200.8: Al,Sb,As,Be,Cd,Cr,Cu,Pb,Mn,Ni,Se,Ag,Tl,Zn;
EPA 200.7: Al,Sb,As,Be,Cd,Ca,Cr,Co,Cu,Fe,Pb,Mg,Mn,Mo,Ni,K,Se,Ag,Na,Sr,Ti,Tl,V,Zn;
EPA 245.1, SM4500H,B, EPA 120.1, SM2510B, SM2540C, SM2340B, SM2320B, SM4500CL-E, SM4500F-BC, SM426C, SM4500NH3-BH, **EPA 350.1**: Ammonia-N, **LACHAT 10-107-06-1-B**: Ammonia-N, **SM4500NO3-F,**
EPA 353.2: Nitrate-N**, SM4500NH3-BC-NES, EPA 351.1, SM4500P-E, SM4500P-B, E, SM5220D, EPA 410.4, SM5210B, SM5310C, SM4500CL-D, EPA 1664, SM14 510AC, EPA 420.1, SM4500-CN-CE, SM2540D.**
EPA 624: Volatile Halocarbons & Aromatics,
EPA 608: Chlordane, Toxaphene, Aldrin, alpha-BHC, beta-BHC, gamma-BHC, delta-BHC, Dieldrin, DDD, DDE, DDT, Endosulfan I, Endosulfan II, Endosulfan sulfate, Endrin, Endrin Aldehyde, Heptachlor, Heptachlor Epoxide, PCBs
EPA 625: SVOC (Acid/Base/Neutral Extractables), **EPA 600/4-81-045**: PCB-Oil.
Microbiology: **SM9223B-Colilert-QT; Enterolert-QT, SM9222D-MF**.

For a complete listing of analytes and methods, please contact your Alpha Project Manager.

Serial_No:08291415:13

ALPHA ANALYTICAL

CHAIN OF CUSTODY

PAGE ______ OF ______

WESTBORO, MA
TEL: 508-898-9220
FAX: 508-898-9193

MANSFIELD, MA
TEL: 508-822-9300
FAX: 508-822-3288

Date Rec'd in Lab: 8/28/14

ALPHA Job #: L1419647

Client Information

Client: TurnKey Envmt Restoration
Address: 2558 Hamburg Trnpke
Lackawanna NY 14218
Phone: 716-856-0635
Fax: 716-856-0583
Email: mlesakowski@turnkeyllc.com

☐ These samples have been previously analyzed by Alpha

Project Information

Project Name: 401 Buffalo Avenue
Project Location: Niagara Falls, NY
Project #: 0294-013-001
Project Manager: Lesakowski / Munley
ALPHA Quote #:

Turn-Around Time

☐ Standard ☒ RUSH (only confirmed if pre-approved!)

Date Due: Aug 29, 2014 Time: 5 pm

Report Information - Data Deliverables

☐ FAX ☐ EMAIL
☐ ADEx ☐ Add'l Deliverables

Billing Information

☐ Same as Client info PO #:

Regulatory Requirements/Report Limits

State /Fed Program Criteria

Other Project Specific Requirements/Comments/Detection Limits:

ANALYSIS: RCRA Metals, PAHs

SAMPLE HANDLING

Filtration
☐ Done
☐ Not needed
☐ Lab to do
Preservation
☐ Lab to do
(Please specify below)

ALPHA Lab ID (Lab Use Only)	Sample ID	Collection Date	Collection Time	Sample Matrix	Sampler's Initials	RCRA Metals	PAHs	Sample Specific Comments	TOTAL # BOTTLES
19647-01	West Trench Drain	8/26	~~13~~ 15 28	S	JCT	2	2		
-02	South Trench Drain	8/26	~~13~~ 15 15	S	JCT	2	2		
-03	Island Test Pit	8/26	15 35	S	JCT	2	2		
-04	Pool Sidewalk	8/26	15 00	S	JCT	2	2		

Container Type	A	A
Preservative	A	A

Relinquished By:	Date/Time	Received By:	Date/Time
	8/27/14 1830	AAL	8/27/14 1830
	8/27/14 1730		8/27/14 1230
	8/27/14 2045	Jim Carly	8/27/14 2045
Jim Carly	8/28/14 00:45	SH	8/28/14 00:45

Please print clearly, legibly and completely. Samples can not be logged in and turnaround time clock will not start until any ambiguities are resolved. All samples submitted are subject to Alpha's Terms and Conditions. See reverse side.

FORM NO: 01-01 (rev. 14-OCT-07)

APPENDIX C

SITE-SPECIFIC HEALTH AND SAFETY PLAN

SITE HEALTH AND SAFETY PLAN
for
BROWNFIELD CLEANUP PROGRAM
RI/IRM ACTIVITIES

401, 402, and 430 BUFFALO AVENUE SITE
BCP SITE No. C932164

NIAGARA FALLS, NEW YORK

November 2014 0294-013-001

Prepared for:

MERANI HOSPITALITY, INC.

401, 402, AND 430 BUFFALO AVENUE SITE
HEALTH AND SAFETY PLAN FOR RI/IRM ACTIVITIES

ACKNOWLEDGEMENT

Plan Reviewed by (initial):

Corporate Health and Safety Director: Thomas H. Forbes, P.E.

Project Manager: Michael Lesakowski

Designated Site Safety and Health Officer: Bryan C. Hann

Acknowledgement:
I acknowledge that I have reviewed the information contained in this site-specific Health and Safety Plan, and understand the hazards associated with performance of the field activities described herein. I agree to comply with the requirements of this plan.

NAME (PRINT)	SIGNATURE	DATE

401, 402, AND 430 BUFFALO AVENUE SITE
HEALTH AND SAFETY PLAN FOR RI/IRM ACTIVITIES

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401, 402, AND 430 BUFFALO AVENUE SITE
HEALTH AND SAFETY PLAN FOR RI/IRM ACTIVITIES

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401, 402, AND 430 BUFFALO AVENUE SITE
HEALTH AND SAFETY PLAN FOR RI/IRM ACTIVITIES

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1.0 INTRODUCTION

1.1 General

In accordance with OSHA requirements contained in 29 CFR 1910.120, this Health and Safety Plan (HASP) describes the specific health and safety practices and procedures to be employed by TurnKey Environmental Restoration, LLC and Benchmark Environmental Engineering & Science, PLLC employees (referred to jointly hereafter as "TurnKey-Benchmark") during Remedial Investigation (RI) and Interim Remedial Measures (IRM) activities at the 401, 402, and 430 Buffalo Avenue Site (Site) located in the City of Niagara Falls, Niagara County, New York. This HASP presents procedures for TurnKey-Benchmark employees who will be involved with RI/IRM field activities; it does not cover the activities of other contractors, subcontractors or other individuals on the Site. These firms will be required to develop and enforce their own HASPs as discussed in Section 2.0. TurnKey-Benchmark accepts no responsibility for the health and safety of contractor, subcontractor or other personnel.

This HASP presents information on known Site health and safety hazards using available historical information, and identifies the equipment, materials and procedures that will be used to eliminate or control these hazards. Environmental monitoring will be performed during the course of field activities to provide real-time data for on-going assessment of potential hazards.

1.2 Background

The subject property (hereinafter, the "Project Site" or the "Site") subject to the Brownfield Cleanup Agreement (BCA) is comprised of three (3) adjoining parcels totaling 6.2 acres, located in a highly developed mixed use commercial and residential area of the City of Niagara Falls, Niagara County, New York (see Figures 1 and 2).

The Site is bound by 4th Street to the west, 6th Street and Holly Place to the east, a public alleyway from 4th Street the 6th Street to the north, and the Robert Moses State Parkway with the Niagara River beyond to the south. Buffalo Avenue intersects the property from east to west (see Figure 2). Land use surrounding the Site includes commercial and residential properties to the north, Robert Moses Parkway to the south with the Niagara beyond, residential properties to the east, and vacant and residential properties to the west.

The 401 Buffalo Avenue parcel is currently improved with a vacant municipally-condemned former hotel and conference center, parking areas and vegetated/landscaped areas.

The 402 and 430 Buffalo Avenue parcels are currently vacant, though historically were part of the manufacturing facility owned and operated by National Biscuit Co / Shredded Wheat Company. Manufacturing began on Site in at least 1914, and operations included underground storage tanks (USTs) noted as fuel oil. Baking ovens, likely utilizing the noted fuel oil, were located across the manufacturing facility (including both 402 and 430 Buffalo Avenue parcels) for drying raw materials, heating the various buildings and operations, and baking final products. Additional operations included paper box manufacturing and printing, material handling and shipping equipment, maintenance of manufacturing equipment and vehicles, and use and storage of paint, solvents, thinners, grease and lubricants common among former manufacturing operations. It is also likely that demolition debris from the former factory is located on the vacant Site.

1.3 Known and Suspected Environmental Conditions

Previous investigations completed on-Site identified recognized environmental conditions (RECs) including:

- NYSDEC Spill No. 1312160 was assigned to the Site related to the vandalism/destruction of three transformers and spilling of approximately 120-gallons of potential PCB-containing transformer oil. The spill is currently open.
- Elevated radiological material was identified in the vicinity of the pool area, with readings as high as 40,000 counts per minute (cpm).
- Leaking oil-containing equipment and oil-contaminated floors, walls, and equipment were noted in the Boiler Room, Maintenance Room, and both elevator control rooms.
- Improper storage and handling of hazardous chemicals, including corrosive boiler chemicals, solvents, lubricants, degreasers, paints, thinners, hydraulic oils and maintenance equipment fuels, pesticides and herbicides, pool and water treatment chemicals;
- Illegal dumping and vandalism; and,
- Universal and e-waste throughout the building.

The RI will be performed in support of the BCP to determine the nature and extent of impacts from these known and suspect environmental conditions on this parcel. As part of the RI, an IRM will be completed to immediately address known environmental impacts related to past use of the Site as a manufacturing facility. An IRM will quickly mitigate risks to public health and the environment attributable to petroleum contamination at the Site. Impacted soil will be removed and impacted groundwater (if encountered) will be extracted and treated during the IRM.

1.4 Parameters of Interest

Based on the previous investigations, constituents of potential concern (COPCs) in soil and, potentially groundwater, at the Site include:

- **Inorganic Compounds –** The inorganic COPCs potentially present at elevated concentrations are arsenic, barium, cadmium, chromium, lead, selenium, silver, and mercury.

- **Volatile Organic Compounds (VOCs)** – VOCs present at elevated concentration may include petroleum-related VOCs, such as 1,2,3-trichlorobenzene, 1,2,4,5-tetramethylbenzene, 1,2,4-trichlorobenzene, 1,4-diethylbenzene, 4-ethyltoluene, and acetone.

- **Semi-Volatile Organic Compounds (SVOCs) –** SVOCs present at elevated concentrations may include polycyclic aromatic hydrocarbons (PAHs), which are byproducts of incomplete combustion and impurities in petroleum products.

- **Polychlorinated Biphenyls (PCBs)** – PCBs present at elevated concentrations are Aroclors 1248, 1254, and 1260.

1.5 Overview of Demolition Activities

Engineering Survey and Chemical Walk-over

Prior to demolition of the 3-story portion of the existing buildings and interior portions of the 4-story structure, an OSHA required Engineering Survey and Chemical Walk-over will be completed by the demolition contractor. The walkover aims to identify universal wastes, undescribed asbestos containing material (ACM) and any abandoned chemicals that may be present and will require removal/abatement prior to building demolition. Accessible areas will also be visually inspected for areas of staining and/or potential petroleum contamination.

Asbestos Containing Material (ACM)

A pre-demolition asbestos survey has been completed, and friable and non-friable ACM has been identified on-Site. ACM abatement is planned to be completed by licensed-ACM subcontractor in the 4-story portion of the building. Based on the widespread uncontrolled release of ACM, likely caused by the extensive vandalism, the 3-story portion of the building is planned for controlled demolition. ACM abatement related to the removal of Universal Waste (UW), from the 3-story will be completed. All ACM abatement will be handled by licensed ACM subcontractor, and all ACM demolition material will be handled, recycled, and/or disposed off-site by licensed handlers and disposal/recycling facilities. Disposal documents will be provided to the Department.

Removal of Residual Chemicals, Maintenance Fluids, and Sumps

Prior to demolition activities, sumps, trenches and maintenance areas will be inspected and residual contents removed. Areas will also be inspected for residual chemicals and maintenance fluids, including paints, cleaners, solvents, hydraulic oils, and grease will be collected and consolidated into "lab-pack" or other approved disposal containers. Material will be characterized for off-site disposal and/or recycling.

Universal Waste

Universal Wastes (UWs), including bulbs, mercury-containing equipment (thermometers), and batteries will be identified during the pre-demolition survey, and removed during pre-demolition activities. Universal waste will be collected, handled and recycled/disposed in accordance with Title 40 Part 273 regulations. Recycling/disposal documents will be provided to the Department.

Transformer Room (Spill 1312160)

Prior to above grade demolition activities, polychlorinated biphenyl (PCB) wipe samples will be collected of the residual oil and/or oil-stained concrete floor within the transformer room. Based on the laboratory analytical results, any PCB-contaminated material will be segregated and disposed in accordance with PCB regulations. Transformer room contents, including former transformer housings will be removed and disposed/recycled.

Post Demolition Radiological Screening Activities:

Based on the findings of the pre-demolition Supplemental Investigation (September 2014), areas of potentially elevated radiological material may be present beneath the pool area and 3-story portion of the building.

After demolition of the above grade structure and removal of the slab, a licensed radiological subcontractor will complete a gamma walkover survey of accessible areas beneath the slab and exposed foundation to screen and evaluate potential elevated radiological material (e.g., slag) and delineate potential areas that will require additional assessment and/or remediation.

The radiological subcontractor will also collect radiological waste characterization samples in the pool area and any additional area(s) identified above the approved NYSDEC background levels that are planned to be excavated. All radiological material that is removed from the excavation will be field-screened and handled in accordance with the approved NYSDEC Radiological Material Work Plan, prepared by Greater Radiological Dimensions, Inc. (GRD), a licensed NYSDOH Radioactive Material contractor. Radiological material health and safety and handling protocols are more fully described in the Radiological Material Work Plan, included in Appendix C.

1.6 Overview of RI/IRM Activities

TurnKey-Benchmark personnel will be on-site to observe and perform RI and IRM activities. The field activities to be completed as part of the RI and IRM are described below.

Remedial Investigation Activities

1. **Surface Soil Sampling:** TurnKey-Benchmark will advance monitoring well borings and collect one surface soil sample from each boring from the upper 0-6 inches for the purpose of determining the nature and extent of potential COPC impacts in the surface soil/fill.

2. **Subsurface Soil Sampling:** TurnKey-Benchmark will advance soil borings, and/or test pits; and collect one subsurface soil sample from each location for the purpose of

determining the nature and extent of potential COPC impacts in the subsurface soil/fill.

3. **Monitoring Well Installation/Development and Sampling:** TurnKey-Benchmark will observe the installation of on-Site groundwater monitoring wells, develop the wells, and collect groundwater samples for the purpose of determining the nature and extent of potential COPC impacts.

4. **Subslab Vapor Sampling:** TurnKey-Benchmark will advance sample points into the sub-slab of the on-Site Building and collect subslab vapor, ambient indoor air, and ambient outdoor air samples for the purpose of determining the nature and extent of potential COPC impacts.

Potential IRM Activities

1. **Soil Excavation:** The remediation contractor would perform soil excavation activities.

2. **Verification Sampling:** The remediation contractor, in association with TurnKey-Benchmark, will collect soil samples from the sidewalls and bottom of the excavations using a backhoe to verify that cleanup objectives have been met.

3. **Backfilling:** The remediation contractor would coordinate and perform backfilling activities.

4. **Groundwater and Surface Management:** The remediation contractor would direct groundwater/surface water collection during soil excavation activities and coordinate disposal of the collected water.

2.0 ORGANIZATIONAL STRUCTURE

This section of the HASP describes the lines of authority, responsibility and communication as they pertain to health and safety functions at the Site. The purpose of this chapter is to identify the personnel who impact the development and implementation of the HASP and to describe their roles and responsibilities. This chapter also identifies other contractors and subcontractors involved in work operations and establish the lines of communications among them for health and safety matters. The organizational structure described in this chapter is consistent with the requirements of 29 CFR 1910.120(b)(2). This section will be reviewed by the Project Manager and updated as necessary to reflect the current organizational structure at this Site.

2.1 Roles and Responsibilities

All Turnkey-Benchmark personnel on the Site must comply with the minimum requirements of this HASP. The specific responsibilities and authority of management, safety and health, and other personnel on this Site are detailed in the following paragraphs.

2.1.1 Corporate Health and Safety Director

The TurnKey-Benchmark Corporate Health and Safety Director is ***Mr. Thomas H. Forbes, P.E.*** The Corporate Health and Safety Director responsible for developing and implementing the Health and Safety program and policies for Benchmark Environmental Engineering & Science, PLLC and TurnKey Environmental Restoration, LLC, and consulting with corporate management to ensure adequate resources are available to properly implement these programs and policies. The Corporate Health and Safety Director coordinates TurnKey-Benchmark's Health and Safety training and medical monitoring programs and assists project management and field staff in developing site-specific health and safety plans.

2.1.2 Project Manager

The Project Manager for this Site is ***Mr. Michael Lesakowski.*** The Project Manager has the responsibility and authority to direct all TurnKey-Benchmark work operations at the Site. The Project Manager coordinates safety and health functions with the Site Safety and Health Officer, and bears ultimate responsibility for proper implementation of this HASP.

He may delegate authority to expedite and facilitate any application of the program, including modifications to the overall project approach as necessary to circumvent unsafe work conditions. Specific duties of the Project Manager include:

- Preparing and coordinating the Site work plan.
- Providing TurnKey-Benchmark workers with work assignments and overseeing their performance.
- Coordinating health and safety efforts with the Site Safety and Health Officer (SSHO).
- Reviewing the emergency response coordination plan to assure its effectiveness.
- Serving as the primary liaison with Site contractors and the property owner.

2.1.3 Site Safety and Health Officer

The Site Safety and Health Officer (SSHO) for this Site is ***Mr. Bryan C. Hann***. The qualified alternate SSHO is ***Mr. Nathan Munley.*** The SSHO reports to the Project Manager. The SSHO is on-site or readily accessible to the Site during all work operations and has the authority to halt Site work if unsafe conditions are detected. The specific responsibilities of the SSHO are:

- Managing the safety and health functions for TurnKey-Benchmark personnel on the Site.
- Serving as the point of contact for safety and health matters.
- Ensuring that TurnKey-Benchmark field personnel working on the Site have received proper training (per 29 CFR Part 1910.120(e)), that they have obtained medical clearance to wear respiratory protection (per 29 CFR Part 1910.134), and that they are properly trained in the selection, use and maintenance of personal protective equipment, including qualitative respirator fit testing.
- Performing or overseeing Site monitoring as required by the HASP.
- Assisting in the preparation and review of the HASP.

- Maintaining site-specific safety and health records as described in this HASP.

- Coordinating with the Project Manager, Site Workers, and Contractor's SSHO as necessary for safety and health efforts.

2.1.4 Site Workers

Site workers are responsible for: complying with this HASP or a more stringent HASP, if appropriate (i.e., Contractor and Subcontractor's HASP); using proper PPE; reporting unsafe acts and conditions to the SSHO; and following the safety and health instructions of the Project Manager and SSHO.

2.1.5 Other Site Personnel

Other Site personnel who will have health and safety responsibilities will include the Drilling Contractor, who will be responsible for developing, implementing and enforcing a Health and Safety Plan equally stringent or more stringent than TurnKey-Benchmark's HASP. TurnKey-Benchmark assumes no responsibility for the health and safety of anyone outside its direct employ. Each Contractor's HASP shall cover all non-TurnKey/Benchmark Site personnel. Each Contractor shall assign a SSHO who will coordinate with TurnKey-Benchmark's SSHO as necessary to ensure effective lines of communication and consistency between contingency plans.

In addition to TurnKey-Benchmark and Contractor personnel, other individuals who may have responsibilities in the work zone include subcontractors and governmental agencies performing Site inspection work (i.e., the New York State Department of Environmental Conservation). The Contractor shall be responsible for ensuring that these individuals have received OSHA-required training (29 CFR 1910.120(e)), including initial, refresher and site-specific training, and shall be responsible for the safety and health of these individuals while they are on-site.

3.0 HAZARD EVALUATION

Due to the presence of certain contaminants at the Site, the possibility exists that workers will be exposed to hazardous substances during field activities. The principal points of exposure would be through direct contact with and incidental ingestion of soil, and through the inhalation of contaminated particles or vapors. Other points of exposure may include direct contact with groundwater. In addition, the use of drilling and/or medium to large-sized construction equipment (e.g., excavator) will also present conditions for potential physical injury to workers. Further, since work will be performed outdoors, the potential exists for heat/cold stress to impact workers, especially those wearing protective equipment and clothing. Adherence to the medical evaluations, worker training relative to chemical hazards, safe work practices, proper personal protection, environmental monitoring, establishment work zones and Site control, appropriate decontamination procedures and contingency planning outlined herein will reduce the potential for chemical exposures and physical injuries.

3.1 Chemical Hazards

As discussed in Section 1.3, historic activities have potentially resulted in impacts to Site soil and groundwater. Visual and olfactory observations, as well as elevated PID readings, indicate a potential VOC impact to Site soil. In addition to VOCs, soil and groundwater may be impacted by SVOCs (PAHs) due to historic use. Table 1 lists exposure limits for airborne concentrations of the COPCs identified in Section 1.4 of this HASP. Brief descriptions of the toxicology of the prevalent COPCs and related health and safety guidance and criteria are provided below.

- **1,2,3-Trichlorobenzene (CAS# 87-61-6)** is a white solid with a sharp chlorobenzene odor. Inhalation may cause irritation of respiratory tract. Irritating to the eyes and may redden skin on contact. Ingestion may cayuse liver damage.

- **1,2,4,5-Tetramethylbenzene (CAS# 95-93-2)** is known as an alkylbenzene and is one of the isomers of tetramethylbenzene. It is relatively toxic for an aromatic hydrocarbon. Ingestion and inhalation should be avoided. May cause redness and irritation if inhaled.

- **1,2,4-Trichlorobenzene (CAS# 120-82-1)** is a colorless liquid. It is used as a solvent and dielectric fluid and as a degreaser. Inhalation can lead to irritation of the lungs and dyspnea, which is shortness of breath.

- **Acetone (CAS# 67-64-1)** A colorless liquid used as a solvent and an antiseptic. It is one of the ketone bodies produced during ketoacidosis. Most commonly used as a laboratory solvent.

- **4-Ethyltoluene (CAS# 622-96-8)** may cause respiratory tract irritation. May cause central nervous system depression. May cause eye and skin irritation. May cause lung damage. Target Organs: Central nervous system, lungs.

- **Polycyclic Aromatic Hydrocarbons (PAHs)** are formed as a result of the pyrolysis and incomplete combustion of organic matter such as fossil fuel. PAH aerosols formed during the combustion process disperse throughout the atmosphere, resulting in the deposition of PAH condensate in soil, water and on vegetation. In addition, several products formed from petroleum processing operations (e.g., roofing materials and asphalt) also contain elevated levels of PAHs. Hence, these compounds are widely dispersed in the environment. PAHs are characterized by a molecular structure containing three or more fused, unsaturated carbon rings. Seven of the PAHs are classified by USEPA as probable human carcinogens (USEPA Class B2). These are: benzo(a)pyrene; benzo(a)anthracene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene; and indeno(1,2,3-cd)pyrene. The primary route of exposure to PAHs is through incidental ingestion and inhalation of contaminated particulates. PAHs are characterized by an organic odor, and exist as oily liquids in pure form. Acute exposure symptoms may include acne-type blemishes in areas of the skin exposed to sunlight.

- **Arsenic (CAS #7440-38-2)** is a naturally occurring element and is usually found combined with one or more elements, such as oxygen or sulfur. Inhalation is a more important exposure route than ingestion. First phase exposure symptoms include nausea, vomiting, diarrhea and pain in the stomach. Prolonged contact is corrosive to the skin and mucus membranes. Arsenic is considered a Group A human carcinogen by the USEPA. Exposure via inhalation is associated with an increased risk of lung cancer. Exposure via the oral route is associated with an increased risk of skin cancer.

- **Barium (CAS #7440-39-3)** is a silver white metal, produced by the reduction of barium oxide. Local effects and symptoms of exposure to barium compounds, such as the hydroxide or carbonate, may include irritation of the eyes, throat, nose and skin. Systemic effects from ingestion include increased muscle contractility, reduction of heart rate/potential arrest, intestinal peristalsis, vascular constriction, and bladder contraction.

- **Cadmium** is a natural element and is usually combined with one or more elements, such as oxygen, chloride, or sulfur. Breathing high levels of cadmium severely damages the lungs and can cause death. Ingestion of high levels of cadmium severely irritates the stomach, leading to vomiting and diarrhea. Long term exposure to lower levels of cadmium leads to a buildup of this substance in the kidneys and possible kidney disease. Other potential long term effects are lung damage and fragile bones. Cadmium is suspected to be a human carcinogen.

- **Chromium (CAS #7440-47-3)** is used in the production of stainless steel, chrome plated metals, and batteries. Two forms of chromium, hexavalent (CR+6) and trivalent (CR+3) are toxic. Hexavalent chromium is an irritant and corrosive to the skin and mucus membranes. Chromium is a potential occupational carcinogen. Acute exposures to dust may cause coughing, wheezing, headaches, pain and fever.

- **Lead (CAS #7439-92-1)** can affect almost every organ and system in our bodies. The most sensitive is the central nervous system, particularly in children. Lead also damages kidneys and the immune system. The effects are the same whether it is breathed or swallowed. Lead may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect memory. Lead may cause anemia.

- **Selenium (CAS# 7782-49-2)** is not a very common naturally occuring mineral. Selenium is most commonly produced from selenide in many sulfide ores, such as those of copper, nickel, or lead. Selenium has historically been used in the electronics industry due to its physical and chemical properties. Selenium is toxic in high doses.

- **Silver (CAS# 7740-22-4)** has a number of uses including jewelry, coins, solar panels, water infiltration, and X-ray and photographic technology. Diluted silver nitrate solutions are used as disinfectants and microbiocides.

- **Mercury (CAS #7439-97-6)** is used in industrial applications for the production of caustic and chlorine, and in electrical control equipment and apparatus. Overexposure to mercury may cause coughing, chest pains, bronchitis, pneumonia, indecision, headaches, fatigue, and salivation. Mercury is a skin and eye irritant.

- **Polychlorinated Biphenyls (PCBS)** are synthetic organic chemical compounds which are composed of chlorine attached to biphenyl (molecule composed of two benzene rings). There are ~209 configurations of one to ten chlorine atoms attached to a biphenyl that comprise the PCB molecules. PCBs are historically known for their use as fluid used due to the commercial utility which was based largely on their chemical stability, including low flammability, and desirable physical properties, including electrical insulating properties. PCBS have been used in plasticisers, fire retardant fabric treatments, adhesives, and railroad ties. PCBs are known to cause health effects from exposure including; toxic and mutagenic effects by interfering with hormones in the body as well as cause certain types of cancers.

With respect to the anticipated RI/IRM activities discussed in Section 1.5, possible routes of exposure to the above-mentioned contaminants are presented in Table 2. The use of proper respiratory equipment, as outlined in Section 7.0 of this HASP, will minimize the potential for exposure to airborne contamination. Exposure to contaminants through dermal and other routes will also be minimized through the use of protective clothing (Section 7.0), safe work practices (Section 6.0), and proper decontamination procedures (Section 12.0).

3.2 Physical Hazards

RI/IRM field activities at the 401, 402, and 430 Buffalo Avenue Street Site may present the following physical hazards:

- The potential for physical injury during heavy construction equipment use, such as backhoes and excavators.
- The potential for heat/cold stress to employees during the summer/winter months (see Section 10.0).
- The potential for slip and fall injuries due to rough, uneven terrain and/or open excavations.

These hazards represent only some of the possible means of injury that may be present during RI/IRM operations and sampling activities at the Site. Since it is impossible to list all potential sources of injury, it shall be the responsibility of each individual to exercise proper care and caution during all phases of the work.

4.0 TRAINING

4.1 Site Workers

All personnel performing RI/IRM activities at the Site (such as, but not limited to, equipment operators, general laborers, and drillers) and who may be exposed to hazardous substances, health hazards, or safety hazards and their supervisors/managers responsible for the Site shall receive training in accordance with 29 CFR 1910.120(e) before they are permitted to engage in operations in the exclusion zone or contaminant reduction zone. This training includes an initial 40-hour Hazardous Waste Site Worker Protection Course, an 8-hour Annual Refresher Course subsequent to the initial 40-hour training, and 3 days of actual field experience under the direct supervision of a trained, experienced supervisor. Additional site-specific training shall also be provided by the SSHO prior to the start of field activities. A description of topics to be covered by this training is provided below.

4.1.1 Initial and Refresher Training

Initial and refresher training is conducted by a qualified instructor as specified under OSHA 29 CFR 1910.120(e)(5), and is specifically designed to meet the requirements of OSHA 29 CFR 1910.120(e)(3) and 1910.120(e)(8). The training covers, as a minimum, the following topics:

- OSHA HAZWOPER regulations.
- Site safety and hazard recognition, including chemical and physical hazards.
- Medical monitoring requirements.
- Air monitoring, permissible exposure limits, and respiratory protection level classifications.
- Appropriate use of personal protective equipment (PPE), including chemical compatibility and respiratory equipment selection and use.
- Work practices to minimize risk.
- Work zones and Site control.

- Safe use of engineering controls and equipment.
- Decontamination procedures.
- Emergency response and escape.
- Confined space entry procedures.
- Heat and cold stress monitoring.
- Elements of a Health and Safety Plan.
- Spill containment.

Initial training also incorporates workshops for PPE and respiratory equipment use (Levels A, B and C), and respirator fit testing. Records and certification received from the course instructor documenting each employee's successful completion of the training identified above are maintained on file at TurnKey-Benchmark's Buffalo, NY office. Contractors and Subcontractors are required to provide similar documentation of training for all their personnel who will be involved in on-site work activities.

Any employee who has not been certified as having received health and safety training in conformance with 29 CFR 1910.120(e) is prohibited from working in the exclusion and contamination reduction zones, or to engage in any on-site work activities that may involve exposure to hazardous substances or wastes.

4.1.2 Site Training

Site workers are given a copy of the HASP and provided a site-specific briefing prior to the commencement of work to ensure that employees are familiar with the HASP and the information and requirements it contains. The Site briefing shall be provided by the SSHO prior to initiating field activities and shall include:

- Names of personnel and alternates responsible for Site safety and health.
- Safety, health and other hazards present on the Site.
- The site lay-out including work zones and places of refuge.

- The emergency communications system and emergency evacuation procedures.
- Use of PPE.
- Work practices by which the employee can minimize risks from hazards.
- Safe use of engineering controls and equipment on the site.
- Medical surveillance, including recognition of symptoms and signs of over-exposure as described in Chapter 5 of this HASP.
- Decontamination procedures as detailed in Chapter 12 of this HASP.
- The emergency response plan as detailed in Chapter 15 of this HASP.
- Confined space entry procedures, if required, as detailed in Chapter 13 of this HASP.
- The spill containment program as detailed in Chapter 9 of this HASP.
- Site control as detailed in Chapter 11 of this HASP.

Supplemental health and safety briefings will also be conducted by the SSHO on an as-needed basis during the course of the work. Supplemental briefings are provided as necessary to notify employees of any changes to this HASP as a result of information gathered during ongoing Site characterization and analysis. Conditions for which the SSHO may schedule additional briefings include, but are not limited to: a change in Site conditions (e.g., based on monitoring results); changes in the work schedule/plan; newly discovered hazards; and safety incidents occurring during Site work.

4.2 Supervisor Training

On-site safety and health personnel who are directly responsible for or who supervise the safety and health of workers engaged in hazardous waste operations (i.e., SSHO) shall receive, in addition to the appropriate level of worker training described in Section 4.1, above, 8 additional hours of specialized supervisory training, in compliance with 29 CFR 1910.120(e)(4).

4.3 Emergency Response Training

Emergency response training is addressed in Appendix A of this HASP, Emergency Response Plan.

4.4 Site Visitors

Each Contractor's SSHO will provide a site-specific briefing to all Site visitors and other non-TurnKey/Benchmark personnel who enter the Site beyond the Site entry point. The site-specific briefing will provide information about Site hazards, the Site layout including work zones and places of refuge, the emergency communications system and emergency evacuation procedures, and other pertinent safety and health requirements as appropriate.

Site visitors will not be permitted to enter the exclusion zone or contaminant reduction zones unless they have received the level of training required for Site workers as described in Section 4.1.

5.0 MEDICAL MONITORING

Medical monitoring examinations are provided to TurnKey-Benchmark employees as stipulated under 29 CFR Part 1910.120(f). These exams include initial employment, annual and employment termination physicals for all TurnKey-Benchmark employees involved in hazardous waste site field operations. Post-exposure examinations are also provided for employees who may have been injured, received a health impairment, or developed signs or symptoms of over-exposure to hazardous substances or were accidentally exposed to substances at concentrations above the permissible exposure limits without necessary personal protective equipment. Such exams are performed as soon as possible following development of symptoms or the known exposure event.

Medical evaluations are performed by Health Works, an occupational health care provider under contract with TurnKey-Benchmark. Health Works is located in Seneca Square Plaza, 1900 Ridge Road, West Seneca, New York 14224. The facility can be reached at (716) 823-5050 to schedule routine appointments or post-exposure examinations.

Medical evaluations are conducted according to the TurnKey-Benchmark Medical Monitoring Program and include an evaluation of the workers' ability to use respiratory protective equipment. The examinations include:

- Occupational/medical history review.
- Physical exam, including vital sign measurement.
- Spirometry testing.
- Eyesight testing.
- Audio testing (minimum baseline and exit, annual for employees routinely exposed to greater than 85db).
- EKG (for employees >40 yrs age or as medical conditions dictate).
- Chest X-ray (baseline and exit, and every 5 years).
- Blood biochemistry (including blood count, white cell differential count, serum multiplastic screening).
- Medical certification of physical requirements (i.e., sight, musculoskeletal,

cardiovascular) for safe job performance and to wear respiratory protection equipment.

The purpose of the medical evaluation is to determine an employee's fitness for duty on hazardous waste sites; and to establish baseline medical data.

In conformance with OSHA regulations, TurnKey-Benchmark will maintain and preserve medical records for a period of 30 years following termination of employment. Employees are provided a copy of the physician's post-exam report, and have access to their medical records and analyses.

6.0 SAFE WORK PRACTICES

All TurnKey-Benchmark employees shall conform to the following safe work practices during all on-site work activities conducted within the exclusion and contamination reduction zones:

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth contact is strictly prohibited.

- The hands and face must be thoroughly washed upon leaving the work area and prior to engaging in any activity indicated above.

- Respiratory protective equipment and clothing must be worn by all personnel entering the Site as required by the HASP or as modified by the Site safety officer. Excessive facial hair (i.e., beards, long mustaches or sideburns) that interferes with the satisfactory respirator-to-face seal is prohibited.

- Contact with surfaces/materials either suspected or known to be contaminated will be avoided to minimize the potential for transfer to personnel, cross contamination and need for decontamination.

- Medicine and alcohol can synergize the effects of exposure to toxic chemicals. Due to possible contraindications, use of prescribed drugs should be reviewed with the TurnKey-Benchmark occupational physician. Alcoholic beverage and illegal drug intake are strictly forbidden during the workday.

- All personnel shall be familiar with standard operating safety procedures and additional instructions contained in this Health and Safety Plan.

- On-site personnel shall use the “buddy” system. No one may work alone (i.e., out of earshot or visual contact with other workers) in the exclusion zone.

- Personnel and equipment in the contaminated area shall be minimized, consistent with effective Site operations.

- All employees have the obligation to immediately report and if possible, correct unsafe work conditions.

- Use of contact lenses on-site will not be permitted. Spectacle kits for insertion into full-face respirators will be provided for TurnKey-Benchmark employees, as requested and required.

The recommended specific safety practices for working around the contractor's equipment (e.g., backhoes, bulldozers, excavators, drill rigs etc.) are as follows:

- Although the Contractor and subcontractors are responsible for their equipment and safe operation of the Site, TurnKey-Benchmark personnel are also responsible for their own safety.
- Subsurface work will not be initiated without first clearing underground utility services.
- Heavy equipment should not be operated within 20 feet of overhead wires. This distance may be increased if windy conditions are anticipated or if lines carry high voltage. The Site should also be sufficiently clear to ensure the project staff can move around the heavy machinery safely.
- Care should be taken to avoid overhead wires when moving heavy-equipment from location to location.
- Hard hats, safety boots and safety glasses should be worn at all times in the vicinity of heavy equipment. Hearing protection is also recommended.
- The work Site should be kept neat. This will prevent personnel from tripping and will allow for fast emergency exit from the Site.
- Proper lighting must be provided when working at night.
- Construction activities should be discontinued during an electrical storm or severe weather conditions.
- The presence of combustible gases should be checked before igniting any open flame.
- Personnel shall stand upwind of any construction operation when not immediately involved in sampling/logging/observing activities.
- Personnel will not approach the edge of an unsecured trench/excavation closer than 2 feet.

7.0 PERSONAL PROTECTIVE EQUIPMENT

7.1 Equipment Selection

Personal protective equipment (PPE) will be donned when work activities may result in exposure to physical or chemical hazards beyond acceptable limits, and when such exposure can be mitigated through appropriate PPE. The selection of PPE will be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the Site, the task-specific conditions and duration, and the hazards and potential hazards identified at the Site.

Equipment designed to protect the body against contact with known or suspect chemical hazards are grouped into four categories according to the degree of protection afforded. These categories designated A through D consistent with United States Environmental Protection Agency (USEPA) Level of Protection designation, are:

- **Level A:** Should be selected when the highest level of respiratory, skin and eye protection is needed.

- **Level B:** Should be selected when the highest level of respiratory protection is needed, but a lesser level of skin protection is required. Level B protection is the minimum level recommended on initial Site entries until the hazards have been further defined by on-site studies. Level B (or Level A) is also necessary for oxygen-deficient atmospheres.

- **Level C:** Should be selected when the types of airborne substances are known, the concentrations have been measured and the criteria for using air-purifying respirators are met. In atmospheres where no airborne contaminants are present, Level C provides dermal protection only.

- **Level D:** Should not be worn on any Site with elevated respiratory or skin hazards. This is generally a work uniform providing minimal protection.

OSHA requires the use of certain PPE under conditions where an immediate danger to life and health (IDLH) may be present. Specifically, OSHA 29 CFR 1910.120(g)(3)(iii) requires use of a positive pressure self-contained breathing apparatus, or positive pressure air-line respirator equipped with an escape air supply when chemical exposure levels present a substantial possibility of immediate serious injury, illness or death, or impair the ability to escape. Similarly, OSHA 29 CFR 1910.120(g)(3)(iv) requires donning totally-encapsulating chemical protective suits (with a protection level equivalent to Level A protection) in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate serious illness, injury or death, or impair the ability to escape.

In situations where the types of chemicals, concentrations, and possibilities of contact are unknown, the appropriate level of protection must be selected based on professional experience and judgment until the hazards can be further characterized. The individual components of clothing and equipment must be assembled into a full protective ensemble to protect the worker from site-specific hazards, while at the same time minimizing hazards and drawbacks of the personal protective gear itself. Ensemble components are detailed below for levels A/B, C, and D protection.

7.2 Protection Ensembles

7.2.1 Level A/B Protection Ensemble

Level A/B ensembles include similar respiratory protection, however Level A provides a higher degree of dermal protection than Level B. Use of Level A over Level B is determined by: comparing the concentrations of identified substances in the air with skin toxicity data, and assessing the effect of the substance (by its measured air concentrations or splash potential) on the small area of the head and neck unprotected by Level B clothing.

The recommended PPE for level A/B is:

- Pressure-demand, full-face piece self-contained breathing apparatus (MSHA/-NIOSH approved) or pressure-demand supplied-air respirator with escape self-contained breathing apparatus (SCBA).
- Chemical-resistant clothing. For Level A, clothing consists of totally-encapsulating chemical resistant suit. Level B incorporates hooded one-or two-piece chemical splash suit.
- Inner and outer chemical resistant gloves.
- Chemical-resistant safety boots/shoes.
- Hardhat.

7.2.2 Level C Protection Ensemble

Level C protection is distinguished from Level B by the equipment used to protect the respiratory system, assuming the same type of chemical-resistant clothing is used. The main selection criterion for Level C is that conditions permit wearing an air-purifying device. The device (when required) must be an air-purifying respirator (MSHA/NIOSH approved) equipped with filter cartridges. Cartridges must be able to remove the substances encountered. Respiratory protection will be used only with proper fitting, training and the approval of a qualified individual. In addition, an air-purifying respirator can be used only if: oxygen content of the atmosphere is at least 19.5% in volume; substances are identified and concentrations measured; substances have adequate warning properties; the individual passes a qualitative fit-test for the mask; and an appropriate cartridge/canister is used, and its service limit concentration is not exceeded.

Recommended PPE for Level C conditions includes:

- Full-face piece, air-purifying respirator equipped with MSHA and NIOSH approved organic vapor/acid gas/dust/mist combination cartridges or as designated by the SSHO.
- Chemical-resistant clothing (hooded, one or two-piece chemical splash suit or disposable chemical-resistant one-piece suit).
- Inner and outer chemical-resistant gloves.
- Chemical-resistant safety boots/shoes.
- Hardhat.

An air-monitoring program is part of all response operations when atmospheric contamination is known or suspected. It is particularly important that the air be monitored thoroughly when personnel are wearing air-purifying respirators. Continual surveillance using direct-reading instruments is needed to detect any changes in air quality necessitating a higher level of respiratory protection.

7.2.3 Level D Protection Ensemble

As indicated above, Level D protection is primarily a work uniform. It can be worn in areas where only boots can be contaminated, where there are no inhalable toxic substances and where the atmospheric contains at least 19.5% oxygen.

Recommended PPE for Level D includes:

- Coveralls.
- Safety boots/shoes.
- Safety glasses or chemical splash goggles.
- Hardhat.
- Optional gloves; escape mask; face shield.

7.2.4 Recommended Level of Protection for Site Tasks

Based upon current information regarding both the contaminants suspected to be present at the Site and the various tasks that are included in the remedial activities, the minimum required levels of protection for these tasks shall be as identified in Table 3.

8.0 EXPOSURE MONITORING

8.1 General

Based on the results of historic sample analysis and the nature of the proposed work activities at the Site, the possibility exist that organic vapors and/or particulates may be released to the air during intrusive construction activities. Ambient breathing zone concentrations may at times, exceed the permissible exposure limits (PELs) established by OSHA for the individual compounds (see Table 1), in which case respiratory protection will be required. Respiratory and dermal protection may be modified (upgraded or downgraded) by the SSHO based upon real-time field monitoring data.

8.1.1 On-Site Work Zone Monitoring

TurnKey-Benchmark personnel will conduct routine, real-time air monitoring during all intrusive construction phases such as excavation, backfilling, drilling, etc. The work area will be monitored at regular intervals using a photo-ionization detector (PID), combustible gas meter and a particulate meter. Observed values will be recorded and maintained as part of the permanent field record.

Additional air monitoring measurements may be made by TurnKey-Benchmark personnel to verify field conditions during subcontractor oversight activities. Monitoring instruments will be protected from surface contamination during use. Additional monitoring instruments may be added if the situations or conditions change. Monitoring instruments will be calibrated in accordance with manufacturer's instructions before use.

8.1.2 Off-Site Community Air Monitoring

In addition to on-site monitoring within the work zone(s), monitoring at the down-wind portion of the Site perimeter will be conducted. This will provide a real-time method for determination of vapor and/or particulate releases to the surrounding community as a result of ground intrusive investigation work.

Ground intrusive activities are defined in the Generic Community Air Monitoring Plan and attached as Appendix C. Ground intrusive activities include soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells. Non-intrusive activities include the collection of soil and sediment samples or the collection of groundwater samples from existing wells. Continuous monitoring is required for ground intrusive activities and periodic monitoring is required for non-intrusive activities. Periodic monitoring consists of taking a reading upon arrival at a sample location, monitoring while opening a well cap or overturning soil, monitoring while bailing a well, and taking a reading prior to leaving a sampling location. This may be upgraded to continuous if the sampling location is in close proximity to individuals not involved in the Site activity (i.e., on a curb of a busy street). The action levels below will be used during periodic monitoring.

8.2 Monitoring Action Levels

8.2.1 On-Site Work Zone Action Levels

The PID, or other appropriate instrument(s), will be used by TurnKey-Benchmark personnel to monitor organic vapor concentrations as specified in this HASP. Combustible gas will be monitored with the "combustible gas" option on the combustible gas meter or other appropriate instrument(s). In addition, fugitive dust/particulate concentrations will be monitored during major soil intrusion (viz., well/boring installation) using a real-time particulate monitor as specified in this plan. In the absence of such monitoring, appropriate respiratory protection for particulates shall be donned. Sustained readings obtained in the breathing zone may be interpreted (with regard to other Site conditions) as follows for TurnKey-Benchmark personnel:

- Total atmospheric concentrations of unidentified vapors or gases ranging from 0 to 1 ppm above background on the PID) - Continue operations under Level D (see Appendix A).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings from >1 ppm to 5 ppm above background on the PID (vapors not suspected of containing high levels of chemicals toxic to the skin) - Continue operations under Level C (see Appendix A).

- Total atmospheric concentrations of unidentified vapors or gases yielding sustained readings of >5 ppm to 50 ppm above background on the PID - Continue operations under Level B (see Attachment 1), re-evaluate and alter (if possible) construction methods to achieve lower vapor concentrations.

- Total atmospheric concentrations of unidentified vapors or gases above 50 ppm on the PID - Discontinue operations and exit the work zone immediately.

The particulate monitor will be used to monitor respirable dust concentrations during all intrusive activities and during handling of Site soil/fill. Action levels based on the instrument readings shall be as follows:

- Less than 50 mg/m^3 - Continue field operations.
- 50-150 mg/m^3 - Don dust/particulate mask or equivalent
- Greater than 150 mg/m^3 - Don dust/particulate mask or equivalent. Initiate engineering controls to reduce respirable dust concentration (viz., wetting of excavated soils or tools at discretion of Site Health and Safety Officer).

Readings from the field equipment will be recorded and documented on the appropriate Project Field Forms. All instruments will be calibrated before use on a daily basis and the procedure will be documented on the appropriate Project Field Forms.

8.2.2 Community Air Monitoring Action Levels

In addition to the action levels prescribed in Section 8.2.1 for TurnKey-Benchmark personnel on-site, the following criteria shall also be adhered to for the protection of downwind receptors consistent with NYSDOH requirements (Appendix C):

- **ORGANIC VAPOR PERIMETER MONITORING:**
  - If the sustained ambient air concentration of organic vapors at the downwind perimeter of the exclusion zone exceeds 5 ppm above background for the 15-minute average, work activities will be temporarily halted and monitoring continued. If the sustained organic vapor decreases below 5 ppm over background, work activities can resume with continued monitoring.
  - If the sustained ambient air concentration of organic vapors at the downwind perimeter of the exclusion zone are greater than 5 ppm over background but less than 25 ppm for the 15-minute average, activities can resume provided that: the organic vapor level 200 feet downwind of the working site or half the distance to the nearest off-site residential or commercial structure, whichever

is less, but in no case less than 20 feet, is below 5 ppm over background; and more frequent intervals of monitoring, as directed by the Site Health and Safety Officer, are conducted.

- If the <u>sustained</u> organic vapor level is <u>above 25 ppm</u> at the perimeter of the exclusion zone for the 15-minute average, the Site Health and Safety Officer must be notified and work activities shut down. The Site Health and Safety Officer will determine when re-entry of the exclusion zone is possible and will implement downwind air monitoring to ensure vapor emissions do not impact the nearest off-site residential or commercial structure at levels exceeding those specified in the ***Organic Vapor Contingency Monitoring Plan*** below. All readings will be recorded and will be available for New York State Department of Environmental Conservation (DEC) and Department of Health (DOH) personnel to review.

o **<u>ORGANIC VAPOR CONTINGENCY MONITORING PLAN:</u>**

- If the <u>sustained</u> organic vapor level is <u>greater than 5 ppm</u> over background 200 feet downwind from the work area or half the distance to the nearest off-site residential or commercial property, whichever is less, all work activities must be halted.

- If, following the cessation of the work activities or as the result of an emergency, <u>sustained</u> organic levels <u>persist above 5 ppm</u> above background 200 feet downwind or half the distance to the nearest off-site residential or commercial property from the work area, then the air quality must be monitored within 20 feet of the perimeter of the nearest off-site residential or commercial structure (20-foot zone).

- If efforts to abate the emission source are unsuccessful and if <u>sustained</u> organic vapor levels approach or exceed 5 ppm above background within the 20-foot zone for more than 30 minutes, or are sustained at levels greater than 10 ppm above background for longer than one minute, then the ***Major Vapor Emission Response Plan*** (see below) will automatically be placed into effect.

o **<u>MAJOR VAPOR EMISSION RESPONSE PLAN:</u>**

Upon activation, the following activities will be undertaken:

1. All Emergency Response Contacts as listed in this Health and Safety Plan and the Emergency Response Plan (Appendix A) will be advised.

2. The local police authorities will immediately be contacted by the Site Health and Safety Officer and advised of the situation.

3. Frequent air monitoring will be conducted at 30-minute intervals within the 20-foot zone. If two <u>sustained</u> successive readings below action levels are measured, air monitoring may be halted or modified by the Site Health and Safety Officer.

The following personnel are to be notified in the listed sequence in the event that a Major Vapor Emission Plan is activated:

Responsible Person	Contact	Phone Number
SSHO	Police	911
SSHO	State Emergency Response Hotline	(800) 457-7362

Additional emergency numbers are listed in the Emergency Response Plan included as Appendix A.

- <u>**EXPLOSIVE VAPORS:**</u>
  - <u>Sustained</u> atmospheric concentrations of greater than 10% LEL in the work area - Initiate combustible gas monitoring at the downwind portion of the Site perimeter.
  - <u>Sustained</u> atmospheric concentrations of greater than 10% LEL at the downwind Site perimeter – Halt work and contact local Fire Department.
- <u>**AIRBORNE PARTICULATE COMMUNITY AIR MONITORING**</u>

Respirable (PM-10) particulate monitoring will be performed on a continuous basis at the upwind and downwind perimeter of the exclusion zone. The monitoring will be performed using real-time monitoring equipment capable of measuring PM-10 and integrating over a period of 15-minutes for comparison to the airborne particulate action levels. The equipment will be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration will be visually assessed during all work activities. All readings will be recorded and will be available for NYSDEC and NYSDOH review. Readings will be interpreted as follows:

- If the downwind PM-10 particulate level is 100 micrograms per cubic meter (ug/m^3) greater than the background (upwind perimeter) reading 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 provided that the downwind PM-10 particulate levels do not exceed 150 ug/m^3 above the upwind level and that visible dust is not migrating from the work area.

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

Pertinent emergency response information including the telephone number of the Fire Department is included in the Emergency Response Plan (Appendix A).

9.0 SPILL RELEASE/RESPONSE

This chapter of the HASP describes the potential for and procedures related to spills or releases of known or suspected petroleum and/or hazardous substances on the Site. The purpose of this Section of the HASP is to plan appropriate response, control, countermeasures and reporting, consistent with OSHA requirements in 29 CFR 1910.120(b)(4)(ii)(J) and (j)(1)(viii). The spill containment program addresses the following elements:

- Potential hazardous material spills and available controls.
- Initial notification and evaluation.
- Spill response.
- Post-spill evaluation.

9.1 Potential Spills and Available Controls

An evaluation was conducted to determine the potential for hazardous material and oil/petroleum spills at this Site. For the purpose of this evaluation, hazardous materials posing a significant spill potential are considered to be:

- CERCLA Hazardous Substances as identified in 40 CFR Part 302, where such materials pose the potential for release in excess of their corresponding Reportable Quantity (RQ).

- Extremely Hazardous Substances as identified in 40 CFR Part 355, Appendix A, where such materials pose the potential for release in excess of their corresponding Reportable Quantity (RQ).

- Hazardous Chemicals as defined under Section 311(e) of the Emergency Planning and Community Right-To-Know Act of 1986, where such chemicals are present or will be stored in excess of 10,000 lbs.

- Toxic Chemicals as defined in 40 CFR Part 372, where such chemicals are present or will be stored in excess of 10,000 lbs.

- Chemicals regulated under 6NYCRR Part 597, where such materials pose the potential for release in excess of their corresponding Reportable Quantity (RQ).

Oil/petroleum products are considered to pose a significant spill potential whenever the following situations occur:

- The potential for a "harmful quantity" of oil (including petroleum and non-petroleum-based fuels and lubricants) to reach navigable waters of the U.S. exists (40 CFR Part 112.4). Harmful quantities are considered by USEPA to be volumes that could form a visible sheen on the water or violate applicable water quality standards.

- The potential for any amount of petroleum to reach any waters of NY State, including groundwater, exists. Petroleum, as defined by NY State in 6NYCRR Part 612, is a petroleum-based heat source, energy source, or engine lubricant/maintenance fluid.

- The potential for any release, to soil or water, of petroleum from a bulk storage facility regulated under 6NYCRR Part 612. A regulated petroleum storage facility is defined by NY State as a site having stationary tank(s) and intra-facility piping, fixtures and related equipment with an aggregate storage volume of 1,100 gallons or greater.

The evaluation indicates that, based on Site history and decommissioning records, a hazardous material spill and/or a petroleum product spill is not likely to occur during RI/IRM efforts.

9.2 Initial Spill Notification and Evaluation

Any worker who discovers a hazardous substance or oil/petroleum spill will immediately notify the Project Manager and SSHO. The worker will, to the best of his/her ability, report the material involved, the location of the spill, the estimated quantity of material spilled, the direction/flow of the spill material, related fire/explosion incidents, if any, and any associated injuries. The Emergency Response Plan presented in Attachment H2 of this HASP will immediately be implemented if an emergency release has occurred.

Following initial report of a spill, the Project Manager will make an evaluation as to whether the release exceeds RQ levels. If an RQ level is exceeded, the Project Manager will notify the Site owner and NYSDEC at 1-800-457-7362 within 2 hours of spill discovery. The Project Manager will also determine what additional agencies (e.g., USEPA) are to be contacted regarding the release, and will follow-up with written reports as required by the applicable regulations.

9.3 Spill Response

For all spill situations, the following general response guidelines will apply:

- Only those personnel involved in overseeing or performing containment operations will be allowed within the spill area. If necessary, the area will be roped, ribboned, or otherwise blocked off to prevent unauthorized access.
- Appropriate PPE, as specified by the SSHO, will be donned before entering the spill area.
- Ignition points will be extinguished/removed if fire or explosion hazards exist.
- Surrounding reactive materials will be removed.
- Drains or drainage in the spill area will be blocked to prevent inflow of spilled materials or applied materials.

For minor spills, the Contractor will maintain a Spill Control and Containment Kit in the Field Office or other readily accessible storage location. The kit will consist of, at a minimum, a 50 lb. bag of "speedy dry" granular absorbent material, absorbent pads, shovels, empty 5-gallon pails and an empty open-top 55-gallon drum. Spilled materials will be absorbed, and shoveled into a 55-gallon drum for proper disposal (NYSDEC approval will be secured for on-site treatment of the impacted soils/absorbent materials, if applicable). Impacted soils will be hand-excavated to the point that no visible signs of contamination remains, and will be drummed with the absorbent.

In the event of a major release or a release that threatens surface water, a spill response contractor will be called to the Site. The response contractor may use heavy equipment (e.g., excavator, backhoe, etc.) to berm the soils surrounding the spill Site or create diversion trenching to mitigate overland migration or release to navigable waters. Where feasible, pumps will be used to transfer free liquid to storage containers. Spill control/cleanup contractors in the Western New York area that may be contacted for assistance include:

- The Environmental Service Group of NY, Inc.: (716) 695-6720
- Environmental Products and Services, Inc.: (716) 447-4700
- Op-Tech: (716) 873-7680

9.4 Post-Spill Evaluation

If a reportable quantity of hazardous material or oil/petroleum is spilled as determined by the Project Manager, a written report will be prepared as indicated in Section 9.2. The report will identify the root cause of the spill, type and amount of material released, date/time of release, response actions, agencies notified and/or involved in cleanup, and procedures to be implemented to avoid repeat incidents. In addition, all re-useable spill cleanup and containment materials will be decontaminated, and spill kit supplies/disposable items will be replenished.

10.0 HEAT/COLD STRESS MONITORING

Since some of the work activities at the Site will be scheduled for both the summer and winter months, measures will be taken to minimize heat/cold stress to TurnKey-Benchmark employees. The Site Safety and Health Officer and/or his or her designee will be responsible for monitoring TurnKey-Benchmark field personnel for symptoms of heat/cold stress.

10.1 Heat Stress Monitoring

Personal protective equipment may place an employee at risk of developing heat stress, a common and potentially serious illnesses often encountered at construction, landfill, waste disposal, industrial or other unsheltered sites. The potential for heat stress is dependent on a number of factors, including environmental conditions, clothing, workload, physical conditioning and age. Personal protective equipment may severely reduce the body's normal ability to maintain temperature equilibrium (via evaporation and convection), and require increased energy expenditure due to its bulk and weight.

Proper training and preventive measures will mitigate the potential for serious illness. Heat stress prevention is particularly important because once a person suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat related illness. To avoid heat stress, the following steps should be taken:

- Adjust work schedules.
- Modify work/rest schedules according to monitoring requirements.
- Mandate work slowdowns as needed.
- Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide shelter (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain worker's body fluids at normal levels. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in sweat (i.e., eight fluid ounces must be ingested for approximately every 1 lb of weight lost). The normal thirst

mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost perspiration. When heavy sweating occurs, workers should be encouraged to drink more.

- Train workers to recognize the symptoms of heat related illness.

Heat-Related Illness - Symptoms:

- Heat rash may result from continuous exposure to heat or humid air.
- Heat cramps are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include: muscle spasms; pain in the hands, feet and abdomen.
- Heat exhaustion occurs from increased stress on various body organs including inadequate blood circulation due to cardiovascular insufficiency or dehydration. Signs and symptoms include: pale, cool, moist skin; heavy sweating; dizziness; nausea; fainting.
- Heat stroke is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are: red, hot, usually dry skin; lack of or reduced perspiration; nausea; dizziness and confusion; strong, rapid pulse; coma.

The monitoring of personnel wearing protective clothing should commence when the ambient temperature is 70 degrees Fahrenheit or above. For monitoring the body's recuperative ability to excess heat, one or more of the following techniques should be used as a screening mechanism.

- Heart rate may be measured by the radial pulse for 30 seconds as early as possible in the resting period. The rate at the beginning of the rest period should not exceed 100 beats per minute. If the rate is higher, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest periods stay the same, If the pulse rate is 100 beats per minute at the beginning of the nest rest period, the following work cycle should be further shortened by 33%.
- Body temperature may be measured orally with a clinical thermometer as early as possible in the resting period. Oral temperature at the beginning of the rest period

should not exceed 99.6 degrees Fahrenheit. If it does, the next work period should be shortened by 10 minutes (or 33%), while the length of the rest period remains the same. However, if the oral temperature exceeds 99.6 degrees Fahrenheit at the beginning of the next period, the work cycle may be further shortened by 33%. Oral temperature should be measured at the end of the rest period to make sure that it has dropped below 99.6 degrees Fahrenheit. No TurnKey-Benchmark employee will be permitted to continue wearing semi-permeable or impermeable garments when his/her oral temperature exceeds 100.6 degrees Fahrenheit.

10.2 Cold Stress Monitoring

Exposure to cold conditions may result in frostbite or hypothermia, each of which progresses in stages as shown below.

- **Frostbite** occurs when body tissue (usually on the extremities) begins to freeze. The three states of frostbite are:

  1) **Frost nip** - This is the first stage of the freezing process. It is characterized by a whitened area of skin, along with a slight burning or painful sensation. Treatment consists of removing the victim from the cold conditions, removal of boots and gloves, soaking the injured part in warm water (102 to 108 degrees Fahrenheit) and drinking a warm beverage. Do not rub skin to generate friction/ heat.

  2) **Superficial Frostbite** - This is the second stage of the freezing process. It is characterized by a whitish gray area of tissue, which will be firm to the touch but will yield little pain. The treatment is identical for Frost nip.

  3) **Deep Frostbite** - In this final stage of the freezing process the affected tissue will be cold, numb and hard and will yield little to no pain. Treatment is identical to that for Frost nip.

- **Hypothermia** is a serious cold stress condition occurring when the body loses heat at a rate faster than it is produced. If untreated, hypothermia may be fatal. The stages of hypothermia may not be clearly defined or visible at first, but generally include:

  1) Shivering
  2) Apathy (i.e., a change to an indifferent or uncaring mood)

3) Unconsciousness
4) Bodily freezing

Employees exhibiting signs of hypothermia should be treated by medical professionals. Steps that can be taken while awaiting help include:

1) Remove the victim from the cold environment and remove wet or frozen clothing. (Do this carefully as frostbite may have started.)

2) Perform active re-warming with hot liquids for drinking (Note: do not give the victim any liquid containing alcohol or caffeine) and a warm water bath (102 to 108 degrees Fahrenheit).

3) Perform passive re-warming with a blanket or jacket wrapped around the victim.

In any potential cold stress situation, it is the responsibility of the Site Health and Safety Officer to encourage the following:

- Education of workers to recognize the symptoms of frostbite and hypothermia.
- Workers should dress warmly, with more layers of thin clothing as opposed to one thick layer.
- Personnel should remain active and keep moving.
- Personnel should be allowed to take shelter in a heated areas, as necessary.
- Personnel should drink warm liquids (no caffeine or alcohol if hypothermia has set in).
- For monitoring the body's recuperation from excess cold, oral temperature recordings should occur:
  - At the Site Safety Technicians discretion when suspicion is based on changes in a worker's performance or mental status.
  - At a workers request.
  - As a screening measure, two times per shift, under unusually hazardous conditions (e.g., wind chill less than 20 degrees Fahrenheit or wind chill

less than 30 degrees Fahrenheit with precipitation).

- As a screening measure, whenever anyone worker on-site develops hypothermia.

Any person developing moderate hypothermia (a core body temperature of 92 degrees Fahrenheit) will not be allowed to return to work for 48 hours without the recommendation of a qualified medical doctor.

11.0 WORK ZONES AND SITE CONTROL

Work zones around the areas designated for construction activities will be established on a daily basis and communicated to all employees and other Site users by the SSHO. It shall be each Contractor's Site Safety and Health Officer's responsibility to ensure that all Site workers are aware of the work zone boundaries and to enforce proper procedures in each area. The zones will include:

- Exclusion Zone ("Hot Zone") - The area where contaminated materials may be exposed, excavated or handled and all areas where contaminated equipment or personnel may travel. Flagging tape will delineate the zone. All personnel entering the Exclusion Zone must wear the prescribed level of personal protective equipment identified in Section 7.

- Contamination Reduction Zone - The zone where decontamination of personnel and equipment takes place. Any potentially contaminated clothing, equipment and samples must remain in the Contamination Reduction Zone until decontaminated.

- Support Zone - The part of the site that is considered non-contaminated or "clean." Support equipment will be located in this zone, and personnel may wear normal work clothes within this zone.

In the absence of other task-specific work zone boundaries established by the SSHO, the following boundaries will apply to all investigation and construction activities involving disruption or handling of Site soils or groundwater:

- Exclusion Zone: 50 foot radius from the outer limit of the sampling/construction activity.

- Contaminant Reduction Zone: 100 foot radius from the outer limit of the sampling/construction activity.

- Support Zone: Areas outside the Contaminant Reduction Zone.

Access of non-essential personnel to the Exclusion and Contamination Reduction Zones will be strictly controlled by the SSHO. Only personnel who are essential to the completion of the task will be allowed access to these areas and only if they are wearing the prescribed level of protection. Entrance of all personnel must be approved by the SSHO.

The SSHO will maintain a Health and Safety Logbook containing the names of TurnKey-Benchmark workers and their level of protection. The zone boundaries may be changed by the SSHO as environmental conditions warrant, and to respond to the necessary changes in work locations on-site.

12.0 DECONTAMINATION

12.1 Decontamination for TurnKey-Benchmark Employees

The degree of decontamination required is a function of a particular task and the environment within which it occurs. The following decontamination procedure will remain flexible, thereby allowing the decontamination crew to respond appropriately to the changing environmental conditions that may arise at the Site. All TurnKey-Benchmark personnel on-site shall follow the procedure below, or the Contractor's procedure (if applicable), whichever is more stringent.

Station 1 - Equipment Drop: Deposit visibly contaminated (if any) re-useable equipment used in the contamination reduction and exclusion zones (tools, containers, monitoring instruments, radios, clipboards, etc.) on plastic sheeting.

Station 2 - Boots and Gloves Wash and Rinse: Scrub outer boots and outer gloves. Deposit tape and gloves in waste disposal container.

Station 3 - Tape, Outer Boot and Glove Removal: Remove tape, outer boots and gloves. Deposit tape and gloves in waste disposal container.

Station 4 - Canister or Mask Change: If worker leaves exclusive zone to change canister (or mask), this is the last step in the decontamination procedure. Worker's canister is exchanged, new outer gloves and boot cover donned, and worker returns to duty.

Station 5 - Outer Garment/Face Piece Removal: Protective suit removed and deposited in separate container provided by Contractor. Face piece or goggles are removed if used. Avoid touching face with fingers. Face piece and/or goggles deposited on plastic sheet. Hard hat removed and placed on plastic sheet.

Station 6 - Inner Glove Removal: Inner gloves are the last personal protective equipment to be removed. Avoid touching the outside of the gloves with bare fingers. Dispose of these gloves in waste disposal container.

Following PPE removal, personnel shall wash hands, face and forearms with absorbent wipes. If field activities proceed for duration of 6 consecutive months or longer, shower facilities will be provided for worker use in accordance with OSHA 29 CFR 1910.120(n).

12.2 Decontamination for Medical Emergencies

In the event of a minor, non-life threatening injury, personnel should follow the decontamination procedures as defined, and then administer first-aid.

In the event of a major injury or other serious medical concern (e.g., heat stroke), immediate first-aid is to be administered and the victim transported to the hospital in lieu of further decontamination efforts unless exposure to a Site contaminant would be considered "Immediately Dangerous to Life or Health."

12.3 Decontamination of Field Equipment

The Contractor in accordance with his approved Health and Safety Plan in the Contamination Reduction Zone will conduct decontamination of heavy equipment. As a minimum, this will include manually removing heavy soil contamination, followed by steam cleaning on an impermeable pad.

TurnKey-Benchmark personnel will conduct decontamination of all tools used for sample collection purposes. It is expected that all tools will be constructed of nonporous, nonabsorbent materials (i.e., metal), which will aid in the decontamination effort. Any tool or part of a tool made of porous, absorbent material (i.e., wood) will be placed into suitable containers and prepared for disposal.

Decontamination of bailers, split-spoons, spatula knives, and other tools used for environmental sampling and examination shall be as follows:

- Disassemble the equipment
- Water wash to remove all visible foreign matter.
- Wash with detergent.
- Rinse all parts with distilled-deionized water.
- Allow to air dry.
- Wrap all parts in aluminum foil or polyethylene.

13.0 CONFINED SPACE ENTRY

OSHA 29 CFR 1910.146 identifies a confined space as a space that is large enough and so configured that an employee can physically enter and do assigned work, has limited or restricted means for entry and exit, and is not intended for continuous employee occupancy. Confined spaces include, but are not limited to, trenches, storage tanks, process vessels, pits, sewers, tunnels, underground utility vaults, pipelines, sumps, wells, and excavations.

Confined space entry by TurnKey-Benchmark employees is not anticipated to be necessary to complete the RI/IRM activities identified in Section 2.0. In the event that the scope of work changes or confined space entry appears necessary, the Project Manager will be consulted to determine if feasible engineering alternatives to confined space entry can be implemented. If confined space entry by TurnKey-Benchmark employees cannot be avoided through reasonable engineering measures, task-specific confined space entry procedures will be developed and a confined-space entry permit will be issued through TurnKey-Benchmark's corporate Health and Safety Director. TurnKey-Benchmark employees shall not enter a confined space without these procedures and permits in place.

14.0 FIRE PREVENTION AND PROTECTION

14.1 General Approach

Recommended practices and standards of the National Fire Protection Association (NFPA) and other applicable regulations will be followed in the development and application of Project Fire Protection Programs. When required by regulatory authorities, the project management will prepare and submit a Fire Protection Plan for the approval of the contracting officers, authorized representative or other designated official. Essential considerations for the Fire Protection Plan will include:

- Proper Site preparation and safe storage of combustible and flammable materials.
- Availability of coordination with private and public fire authorities.
- Adequate job-site fire protection and inspections for fire prevention.
- Adequate indoctrination and training of employees.

14.2 Equipment and Requirements

Fire extinguishers will be provided by each Contractor and are required on all heavy equipment and in each field trailer. Fire extinguishers will be inspected, serviced, and maintained in accordance with the manufacturer's instructions. As a minimum, all extinguishers shall be checked monthly and weighed semi-annually, and recharged if necessary. Recharge or replacement shall be mandatory immediately after each use.

14.3 Flammable and Combustible Substances

All storage, handling or use of flammable and combustible substances will be under the supervision of qualified persons. All tanks, containers and pumping equipment, whether portable or stationary, used for the storage and handling of flammable and combustible liquids, will meet the recommendations of the National Fire Protection Association.

14.4 Hot Work

If the scope of work necessitates welding or blowtorch operation, the hot work permit presented in Appendix B will be completed by the SSHO and reviewed/issued by the Project Manager.

15.0 EMERGENCY INFORMATION

In accordance with OSHA 29 CFR Part 1910, an Emergency Response Plan is attached to this HASP as Appendix A. The hospital route map is presented within Appendix A as Figure 1.

16.0 REFERENCES

1. New York State Department of Environmental Conservation. *DER-10; Technical Guidance for Site Investigation and Remediation.* May 2010.

TABLES

TABLE 1

TOXICITY DATA FOR CONSTITUENTS OF POTENTIAL CONCERN

401, 402, and 430 Buffalo Avenue Site

Niagara Falls, New York

Parameter	Synonyms	CAS No.	Code	Concentration Limits [1]		
				PEL	TLV	IDLH
Volatile Organic Compounds (VOCs): ppm						
1,2,4-Trimethylbenzene	Pseudocumene	95-63-6	*none*	25	25	--
1,3,5-Trimethylbenzene	Mesitylene	108-67-8	*none*	25	25	--
Ethylbenzene	Ethylbenzol, Phenylethane	100-41-4	*none*	100	100	800
Isopropylbenzene	Cumene	98-82-8	*none*	50	50	900
n-Propylbenzene	Isocumene	103-65-1	*none*	50	50	--
Xylene, Total	o-, m-, p-isomers	1330-20-7	*none*	100	100	900
Semi-volatile Organic Compounds (SVOCs) [2] : ppm						
Anthracene	*none*	120-12-7	*none*	--	--	--
Benzo(a)anthracene	*none*	56-55-3	*none*	--	--	--
Benzo(a)pyrene	*none*	50-32-8	*none*	--	--	--
Benzo(b)fluoranthene	*none*	205-99-2	*none*	--	--	--
Benzo(k)fluoranthene	*none*	207-08-9	*none*	--	--	--
Chrysene	*none*	218 01 9	*none*	--	--	--
Dibenzo(a,h)anthracene	*none*	53-70-3	*none*	--	--	--
Fluoranthene	*none*	206-44-0	*none*	--	--	--
Fluorene	*none*	86-73-7	*none*	--	--	--
Indeno(1,2,3-cd)pyrene	*none*	193-39-5	*none*	--	--	--
Naphthalene	Naphthalin, Tar camphor, White tar	91-20-3	*none*	10	10	250
Phenanthrene	*none*	85-01-8	*none*	--	--	--
Pyrene	*none*	129-00-0	*none*	--	--	--
Inorganic Compounds: mg/m ^{2}						
Arsenic	*none*	7440-38-2	*Ca*	0.01	0.01	5
Barium	*none*	7440-39-3	*none*	0.5	0.5	50
Cadmium	*none*	7440-43-9	*Ca*	0.005	0.01	9
Chromium	*none*	7440-47-3	*none*	1	0.5	250
Copper	*none*	7440-50-8	*none*	0.1	0.2	200
Lead	*none*	7439-92-1	*none*	0.05	0.15	100
Mercury	*none*	7439-97-6	C-0.1	0.1	0.05	10
Selenium	*none*	7782-49-2	*none*	0.2	0.2	1
Silver	*none*	7440-28-0	*none*	0.01	0.1	10
Zinc	*none*	7440-66-6	*none*	--	--	--

Notes:

1. Concentration limits as reported by NIOSH Pocket Guide to Chemical Hazards, February 2004 (NIOSH Publication No. 97-140, fourth printing with chages and updates.
2. " -- " = concentration limit not available; exposure should be minimized to the extent feasible through appropriate engineering controls & PPE.

Explanation:

Ca = NIOSH considers constituent to be a potential occupational carcinogen.
C-## = Ceiling Level equals the maximum exposure concentration allowable during the work day.
IDLH = Immediately Dangerous to Life or Health.
ND indicates that an IDLH has not as yet been determined.
TLV = Threshold Limit Value, established by American Conference of Industrial Hygienists (ACGIH), equals the maximum exposure concentration allowable for 8 hours/day @ 40 ho
TLVs are the amounts of chemicals in the air that almost all healthy adult workers are predicted to be able to tolerate without adverse effects. There are three types.
TLV-TWA (TLV-Time-Weighted Average) which is averaged over the normal eight-hour day/forty-hour work week. (Most TLVs.)
TLV-C or Ceiling limits are the concentration that should not be exceeded during any part of the working exposure.
Unless the initials "STEL" or "C" appear in the Code column, the TLV value should be considered to be the eight-hour TLV-TWA.
PEL = Permissible Exposure Limit, established by OSHA, equals the maximium exposure conconcentration allowable for 8 hours per day @ 40 hours per week

TABLE 2

POTENTIAL ROUTES OF EXPOSURE TO THE CONSTITUENTS OF POTENTIAL CONCERN

401, 402, and 430 Buffalo Avenue Site
Niagra Falls, New York

Activity [1]	Direct Contact with Soil/Fill	Inhalation of Vapors or Dust	Direct Contact with Groundwater
Remedial Investigation Tasks			
1. Subsurface Soil Sampling	**x**	**x**	
2. Monitoring Well Installation/Development and Sampling	**x**	**x**	**x**
3. Subslab Vapor Sampling	**x**	**x**	
Interim Remedial Measures Tasks			
1. Soil Excavation	x	x	
2. Backfilling	x	x	
3. Verification Sampling	x	x	
4. Groundwater and Surface Water Management	x		x

Notes:

1. Activity as described in Section 1.5 of the Health and Safety Plan.

TABLE 3

REQUIRED LEVELS OF PROTECTION FOR RI/IRM TASKS

401, 402, and 430 Buffalo Avenue Site
Niagara Falls, New York

Activity	Respiratory Protection[1]	Clothing	Gloves[2]	Boots[2, 3]	Other Required PPE/Modifications[2, 4]
Remedial Investigation Tasks					
1. Subsurface Soil Sampling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
2. Monitoring Well Installation/Development and Sampling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	SGSS
3. Subslab Vapor Sampling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
Interim Remedial Measures Tasks					
1. Soil Excavation	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
2. Backfilling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
3. Verification Sampling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
4. Groundwater and Surface Water Management	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS

Notes:

1. Respiratory equipment shall conform to guidelines presented in Section 7.0 of this HASP. The Level C requirement is an air-purifying respirator equiped with organic compound/acid gas/dust cartridge.
2. HH = hardhat; L= Latex; L/N = latex inner glove, nitrile outer glove; N = Nitrile; S = Saranex; SG = safety glasses; SGSS = safety glasses with sideshields; STSS = steel toe safety shoes.
3. Latex outer boot (or approved overboot) required whenever contact with contaminated materials may occur. SSHO may downgrade to STSS (steel-toed safety shoes) if contact will be limited to cover/replacement soils.
4. Dust masks shall be donned as directed by the SSHO (site safety and health officer) or site safety technician whenever potentially contaminated airborne particulates (i.e., dust) are present in significant amounts in the breathing zone. Goggles may be substituted with safety glasses w/side-shields whenever contact with contaminated liquids is not anticipated.

FIGURES

FIGURE 1

TurnKey Environmental Restoration, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

PROJECT NO.: 0294-013-001

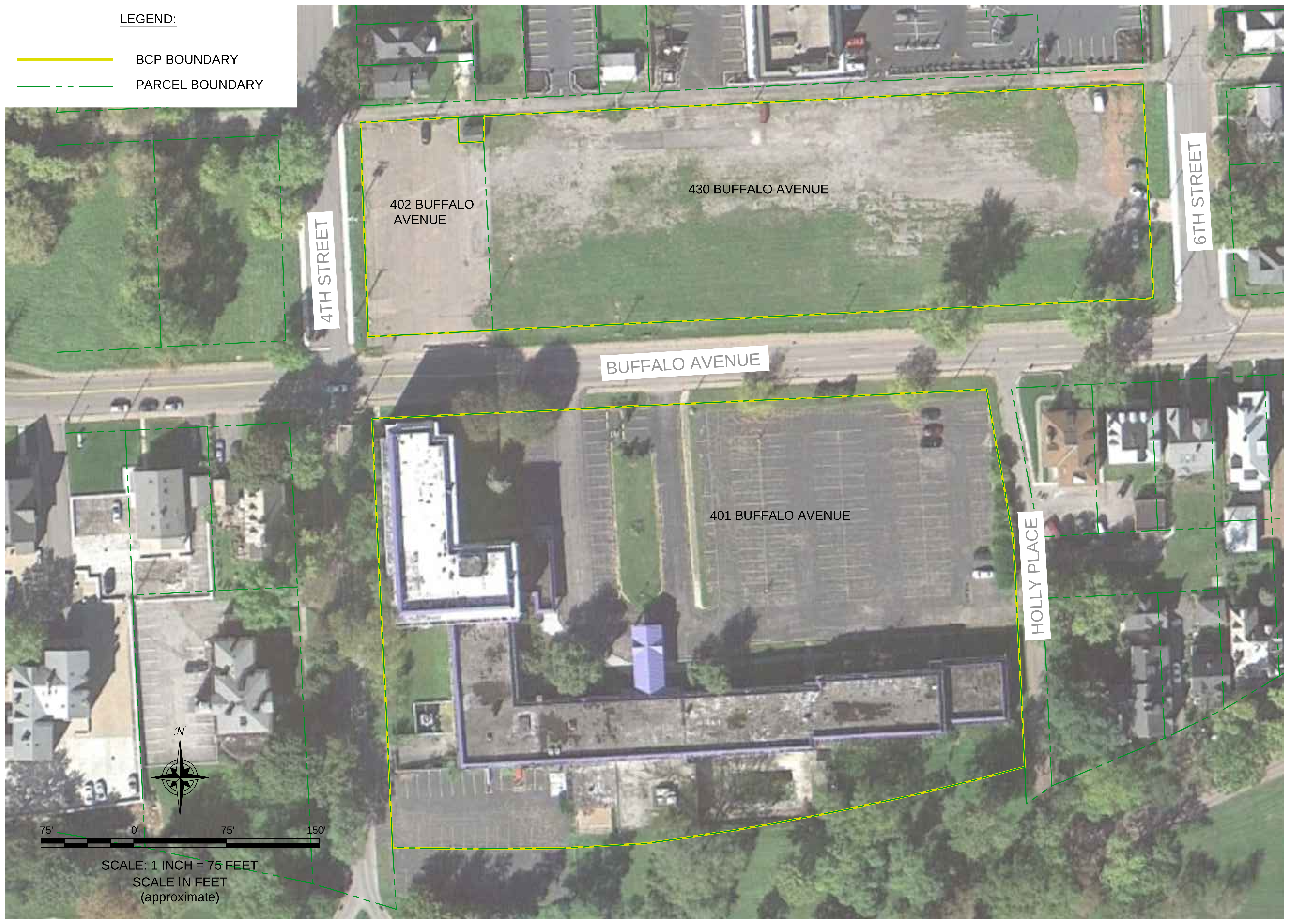
DATE: OCTOBER 2014

DRAFTED BY: BLR/NTM

SITE LOCATION AND VICINITY MAP

INTERIM REMEDIAL MEASURES WORK PLAN

401, 402, & 430 BUFFALO AVENUE SITE
BCP SITE No. C932164
NIAGARA FALLS, NEW YORK
PREPARED FOR
MERANI HOSPITALITY, INC.



DATE: OCTOBER 2014
DRAFTED BY: BLR/NTM

SITE PLAN (AERIAL)

INTERIM REMEDIAL MEASURES WORK PLAN

401, 402, & 430 BUFFALO AVENUE SITE
BCP SITE No. C932164
NIAGARA FALLS, NEW YORK

PREPARED FOR
MERANI HOSPITALITY

TURNKEY ENVIRONMENTAL RESTORATION, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

JOB NO.: 0294-013-001

FIGURE 2

ATTACHMENT A

EMERGENCY RESPONSE PLAN

EMERGENCY RESPONSE PLAN
for
BROWNFIELD CLEANUP PROGRAM
RI/IRM ACTIVITIES

401, 402, and 430 BUFFALO AVENUE SITE
NIAGARA FALLS, NEW YORK

November 2014 0294-013-001

Prepared for:

MERANI HOSPITALITY, INC.

HEALTH AND SAFETY PLAN FOR RI/IRM ACTIVITIES
APPENDIX A: EMERGENCY RESPONSE PLAN
401, 402, AND 430 BUFFALO AVENUE SITE

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1.0 GENERAL

This report presents the site-specific Emergency Response Plan (ERP) referenced in the Site Health and Safety Plan (HASP) prepared for Remedial Investigation (RI) and Interim Remedial Measures (IRM) activities at the 401, 402, and 430 Buffalo Avenue Site in Niagara Falls, New York. This appendix of the HASP describes potential emergencies that may occur at the Site; procedures for responding to those emergencies; roles and responsibilities during emergency response; and training all workers must receive in order to follow emergency procedures. This ERP also describes the provisions this Site has made to coordinate its emergency response planning with other contractors on-site and with off-site emergency response organizations.

This ERP is consistent with the requirements of 29 CFR 1910.120(l) and provides the following site-specific information:

- Pre-emergency planning.
- Personnel roles, lines of authority, and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Evacuation routes and procedures.
- Decontamination procedures.
- Emergency medical treatment and first aid.
- Emergency alerting and response procedures.
- Critique of response and follow-up.
- Emergency personal protective equipment (PPE) and equipment.

2.0 PRE-EMERGENCY PLANNING

This Site has been evaluated for potential emergency occurrences, based on site hazards, the required work tasks, the site topography, and prevailing weather conditions. The results of that evaluation indicate the potential for the following site emergencies to occur at the locations indicated.

Type of Emergency:

1. Medical, due to physical injury

Source of Emergency:

1. Slip/trip/fall

Location of Source:

1. Non-specific

3.0 ON-SITE EMERGENCY RESPONSE EQUIPMENT

Emergency procedures may require specialized equipment to facilitate worker rescue, contamination control and reduction, or post-emergency clean up. Emergency response equipment available on the Site is listed below. The equipment inventory and storage locations are based on the potential emergencies described above. This equipment inventory is designed to meet on-site emergency response needs and any specialized equipment needs that off-site responders might require because of the hazards at this Site but not ordinarily stocked.

Any additional personal protective equipment (PPE) required and stocked for emergency response is also listed in below. During an emergency, the Emergency Response Coordinator (ERC) is responsible for specifying the level of PPE required for emergency response. At a minimum, PPE used by emergency responders will comply with Section 7.0, Personal Protective Equipment, of this HASP. Emergency response equipment is inspected at regular intervals and maintained in good working order. The equipment inventory is replenished as necessary to maintain response capabilities.

Emergency Equipment	Quantity	Location
First Aid Kit	1	Site Vehicle
Chemical Fire Extinguisher	2 (minimum)	All heavy equipment and Site Vehicle

Emergency PPE	Quantity	Location
Full-face respirator	1 for each worker	Site Vehicle
Chemical-resistant suits	4 (minimum)	Site Vehicle

4.0 EMERGENCY PLANNING MAPS

An area-specific map of the Site will be developed on a daily basis during performance of field activities. The map will be marked to identify critical on-site emergency planning information, including: emergency evacuation routes, a place of refuge, an assembly point, and the locations of key site emergency equipment. Site zone boundaries will be shown to alert responders to known areas of contamination. There are no major topographical features, however the direction of prevailing winds/weather conditions that could affect emergency response planning are also marked on the map. The map will be posted at site-designated place of refuge and inside the TurnKey personnel field vehicle.

5.0 EMERGENCY CONTACTS

The following identifies the emergency contacts for this ERP.

Emergency Telephone Numbers:

Project Manager: ***Michael Lesakowski***
Work: (716) 856-0599
Mobile: (716) 818-3954

Corporate Health and Safety Director: ***Thomas H. Forbes***
Work: (716) 856-0599
Mobile: (716) 864-1730

Site Safety and Health Officer (SSHO): ***Bryan C. Hann***
Work: (716) 856-0635
Mobile: (716) 870-1165

Alternate SSHO: ***Nathan Munley***
Work: (716) 856-0635
Mobile: (716) 289-1072

NIAGRA FALLS MEMORIAL MEDICAL CENTER (ER):	(716) 278-4000
FIRE:	911
AMBULANCE:	911
BUFFALO POLICE:	911
STATE EMERGENCY RESPONSE HOTLINE:	(800) 457-7362
NATIONAL RESPONSE HOTLINE:	(800) 424-8802
NYSDOH:	(716) 847-4385
NYSDEC:	(716) 851-7220
NYSDEC 24-HOUR SPILL HOTLINE:	(800) 457-7252

The Site location is:

401, 402, and 430 Buffalo Avenue
Niagara Falls, New York 14303
Site Phone Number: (Insert Cell Phone or Field Trailer): ___________________

6.0 EMERGENCY ALERTING & EVACUATION

Internal emergency communication systems are used to alert workers to danger, convey safety information, and maintain site control. Any effective system can be employed. Two-way radio headsets or field telephones are often used when work teams are far from the command post. Hand signals and air-horn blasts are also commonly used. Every system must have a backup. It shall be the responsibility of each contractor's Site Health and Safety Officer to ensure all personnel entering the site understand an adequate method of internal communication. Unless all personnel are otherwise informed, the following signals shall be used.

1) Emergency signals by portable air horn, siren, or whistle: two short blasts, personal injury; continuous blast, emergency requiring site excavation.

2) Visual signals: hand gripping throat, out of air/cannot breathe; hands on top of head, need assistance; thumbs up, affirmative/ everything is OK; thumbs down, no/negative; grip partner's wrist or waist, leave area immediately.

If evacuation notice is given, site workers leave the worksite with their respective buddies, if possible, by way of the nearest exit. Emergency decontamination procedures detailed in Section 12.0 of the HASP are followed to the extent practical without compromising the safety and health of site personnel. The evacuation routes and assembly area will be determined by conditions at the time of the evacuation based on wind direction, the location of the hazard source, and other factors as determined by rehearsals and inputs from emergency response organizations. Wind direction indicators are located so that workers can determine a safe up wind or cross wind evacuation route and assembly area if not informed by the emergency response coordinator at the time the evacuation alarm sounds. Since work conditions and work zones within the site may be changing on daily basis, it shall be the responsibility of the construction Site Health and Safety Officer to review evacuation routes and procedures as necessary and to inform all TurnKey-Benchmark workers of any changes.

Personnel exiting the site will gather at a designated assembly point. To determine that everyone has successfully exited the site, personnel will be accounted for at the assembly site. If any worker cannot be accounted for, notification is given to the SSHO (***Bryan Hann*** or ***Nathan Munley***) so that appropriate action can be initiated. Contractors and subcontractors on this site have coordinated their emergency response plans to ensure that these plans are compatible and that source(s) of potential emergencies are recognized, alarm systems are clearly understood, and evacuation routes are accessible to all personnel relying upon them.

7.0 EXTREME WEATHER CONDITIONS

In the event of adverse weather conditions, the Site Safety and Health Officer in conjunction with the Contractor's SSHO will determine if engineering operations can continue without sacrificing the health and safety of site personnel. Items to be considered prior to determining if work should continue include but are not limited to:

- Potential for heat/cold stress.
- Weather-related construction hazards (e.g., flooding or wet conditions producing undermining of structures or sheeting, high wind threats, etc).
- Limited visibility.
- Potential for electrical storms.
- Limited site access/egress (e.g., due to heavy snow)

8.0 EMERGENCY MEDICAL TREATMENT & FIRST AID

Personnel Exposure:

The following general guidelines will be employed in instances where health impacts threaten to occur acute exposure is realized:

- Skin Contact: Use copious amounts of soap and water. Wash/rinse affected area for at least 15 minutes. Decontaminate and provide medical attention. Eyewash stations will be provided on site. If necessary, transport to Buffalo General Hospital.
- Inhalation: Move to fresh air and, if necessary, transport to Hospital.
- Ingestion: Decontaminate and transport to Hospital.

Personal Injury:

Minor first-aid will be applied on-site as deemed necessary. In the event of a life threatening injury, the individual should be transported to Hospital via ambulance. The Site Health and Safety Officer will supply available chemical specific information to appropriate medical personnel as requested.

First aid kits will conform to Red Cross and other applicable good health standards, and shall consist of a weatherproof container with individually sealed packages for each type of item. First aid kits will be fully equipped before being sent out on each job and will be checked weekly by the SSHO to ensure that the expended items are replaced.

Directions to Niagara Falls Memorial Medical Center (see Figure 1):

The following directions describe the best route from the Site to Niagara Falls Memorial Medical Center:

- Head east on Buffalo Avenue toward Holly Place
- Turn right onto Robert Moses Parkway
- Keep right at the fork, follow signs for New York 384/New York 265/Tonawandas and merge onto LaSalle Expressway
- Turn left onto Williams Road
- Hospital on the left (6934 Williams Road)
(7.5 miles)

9.0 EMERGENCY RESPONSE CRITIQUE & RECORD KEEPING

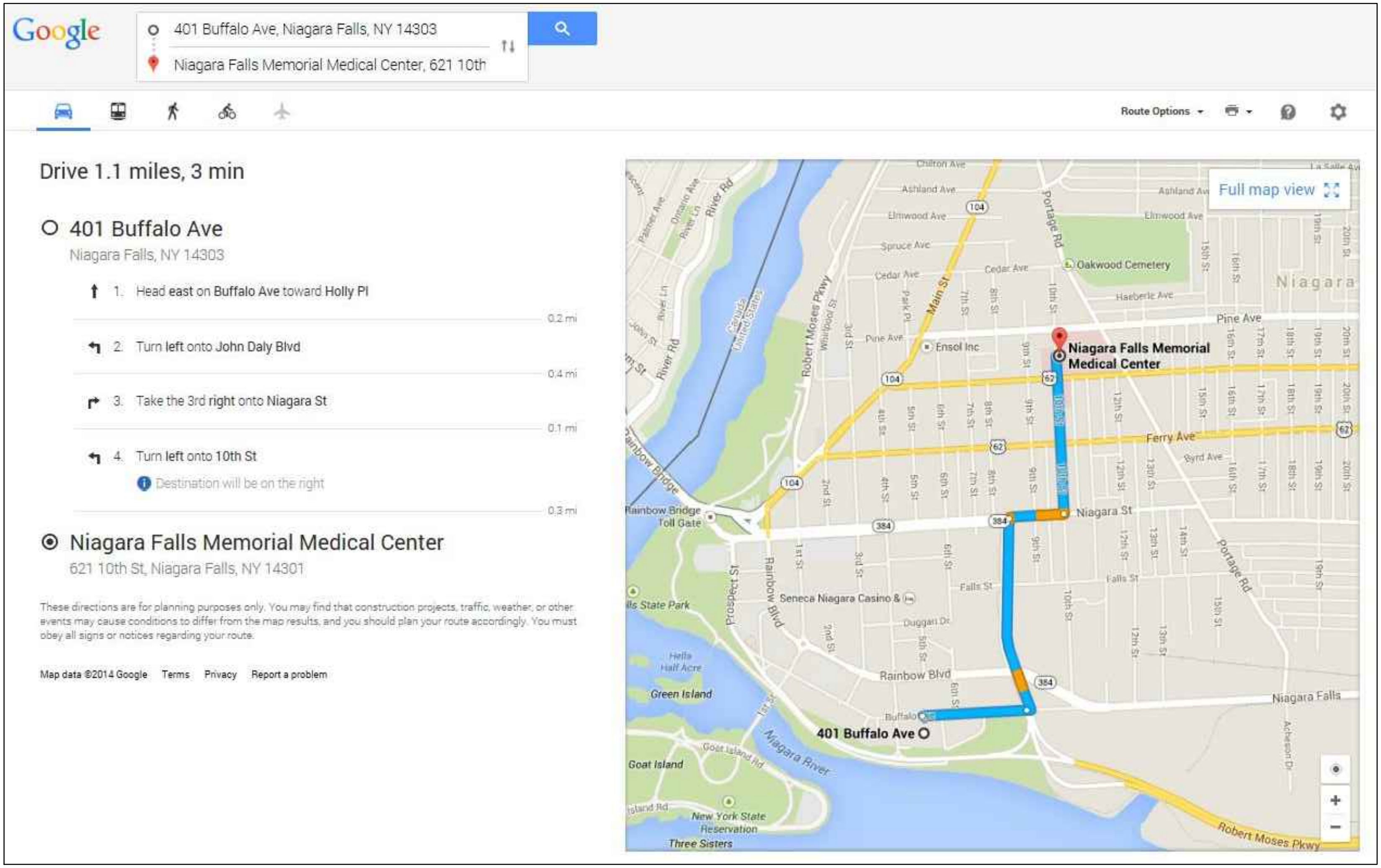
Following an emergency, the SSHO and Project Manager shall review the effectiveness of this Emergency Response Plan (ERP) in addressing notification, control and evacuation requirements. Updates and modifications to this ERP shall be made accordingly. It shall be the responsibility of each contractor to establish and assure adequate records of the following:

- Occupational injuries and illnesses.
- Accident investigations.
- Reports to insurance carrier or State compensation agencies.
- Reports required by the client.
- Records and reports required by local, state, federal and/or international agencies.
- Property or equipment damage.
- Third party injury or damage claims.
- Environmental testing logs.
- Explosive and hazardous substances inventories and records.
- Records of inspections and citations.
- Safety training.

10.0 EMERGENCY RESPONSE TRAINING

All persons who enter the worksite, including visitors, shall receive a site-specific briefing about anticipated emergency situations and the emergency procedures by the SSHO. Where this site relies on off-site organizations for emergency response, the training of personnel in those off-site organizations has been evaluated and is deemed adequate for response to this site.

FIGURES



Drive 1.1 miles, 3 min

○ 401 Buffalo Ave
Niagara Falls, NY 14303

1. Head east on Buffalo Ave toward Holly Pl — 0.2 mi
2. Turn left onto John Daly Blvd — 0.4 mi
3. Take the 3rd right onto Niagara St — 0.1 mi
4. Turn left onto 10th St
Destination will be on the right — 0.3 mi

◉ Niagara Falls Memorial Medical Center
621 10th St, Niagara Falls, NY 14301

These directions are for planning purposes only. You may find that construction projects, traffic, weather, or other events may cause conditions to differ from the map results, and you should plan your route accordingly. You must obey all signs or notices regarding your route.

Map data ©2014 Google Terms Privacy Report a problem

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TURNKEY ENVIRONMENTAL RESTORATION, LLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0635

PROJECT NO.: 0294-013-001

DATE: NOVEMBER 2014

DRAFTED BY: NTM

HOSPITAL ROUTE MAP

401, 402, & 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

PREPARED FOR

MERANI HOSPITALITY, INC.

FIGURE 1

DISCLAIMER:
PROPERTY OF TURNKEY ENVIRONMENTAL RESTORATION., LLC. IMPORTANT: THIS DRAWING PRINT IS LOANED FOR MUTUAL ASSISTANCE AND AS SUCH IS SUBJECT TO RECALL AT ANY TIME. INFORMATION CONTAINED HEREON IS NOT TO BE DISCLOSED OR REPRODUCED IN ANY FORM FOR THE BENEFIT OF PARTIES OTHER THAN NECESSARY SUBCONTRACTORS & SUPPLIERS WITHOUT THE WRITTEN CONSENT OF TURNKEY ENVIRONMENTAL RESTORATION., LLC.

ATTACHMENT B

HOT WORK PERMIT FORM

TurnKey Environmental Restoration, LLC

HOT WORK PERMIT

PART 1 - INFORMATION

Issue Date:
Date Work to be Performed: Start: Finish (permit terminated):
Performed By:
Work Area:
Object to be Worked On:

PART 2 - APPROVAL

(for 1, 2 or 3: mark Yes, No or NA)*

Will working be on or in: Finish (permit terminated):

1. Metal partition, wall, ceiling covered by combustible material? yes no
2. Pipes, in contact with combustible material? yes no
3. Explosive area? yes no

* = If any of these conditions exist (marked "yes"), a permit will not be issued without being reviewed and approved by Thomas H. Forbes (Corporate Health and Safety Director). Required Signature below.

PART 3 - REQUIRED CONDITIONS**

(Check all conditions that must be met)

	PROTECTIVE ACTION		PROTECTIVE EQUIPMENT
	Specific Risk Assessment Required		Goggles/visor/welding screen
	Fire or spark barrier		Apron/fireproof clothing
	Cover hot surfaces		Welding gloves/gauntlets/other:
	Move movable fire hazards, specifically		Wellintons/Knee pads
	Erect screen on barrier		Ear protection: Ear muffs/Ear plugs
	Restrict Access		B.A.: SCBA/Long Breather
	Wet the ground		Respirator: Type:
	Ensure adequate ventilation		Cartridge:
	Provide adequate supports		Local Exhaust Ventilation
	Cover exposed drain/floor or wall cracks		Extinguisher/Fire blanket
	Fire watch (must remain on duty during duration of permit)		Personal flammable gas monitor
	Issue additional permit(s):		

Other precautions:

** Permit will not be issued until these conditions are met.

SIGNATURES

Orginating Employee: Date:
Project Manager: Date:
Part 2 Approval: Date:

ATTACHMENT C

NYSDOH GENERIC COMMUNITY AIR MONITORING PLAN

Appendix C1
New York State Department of Health
Generic Community Air Monitoring Plan

Overview

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

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

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

Community Air Monitoring Plan

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

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

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

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. 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.

1. 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.

2. 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.

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

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

Particulate Monitoring, Response Levels, and Actions

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

1. 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.

2. 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.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

Appendix C2
Fugitive Dust and Particulate Monitoring

A program for suppressing fugitive dust and particulate matter monitoring at hazardous waste sites is a responsibility on the remedial party performing the work. These procedures must be incorporated into appropriate intrusive work plans. The following fugitive dust suppression and particulate monitoring program should be employed at sites during construction and other intrusive activities which warrant its use:

1. Reasonable fugitive dust suppression techniques must be employed during all site activities which may generate fugitive dust.

2. Particulate monitoring must be employed during the handling of waste or contaminated soil or when activities on site may generate fugitive dust from exposed waste or contaminated soil. Remedial activities may also include the excavation, grading, or placement of clean fill. These control measures should not be considered necessary for these activities.

3. Particulate monitoring must be performed using real-time particulate monitors and shall monitor particulate matter less than ten microns (PM10) with the following minimum performance standards:

(a) Objects to be measured: Dust, mists or aerosols;
(b) Measurement Ranges: 0.001 to 400 mg/m3 (1 to 400,000 :ug/m3);
(c) Precision (2-sigma) at constant temperature: +/- 10 :g/m3 for one second averaging; and +/- 1.5 g/m3 for sixty second averaging;
(d) Accuracy: +/- 5% of reading +/- precision (Referred to gravimetric calibration with SAE fine test dust (mmd= 2 to 3 :m, g= 2.5, as aerosolized);
(e) Resolution: 0.1% of reading or 1g/m3, whichever is larger;
(f) Particle Size Range of Maximum Response: 0.1-10;
(g) Total Number of Data Points in Memory: 10,000;
(h) Logged Data: Each data point with average concentration, time/date and data point number
(i) Run Summary: overall average, maximum concentrations, time/date of maximum, total number of logged points, start time/date, total elapsed time (run duration), STEL concentration and time/date occurrence, averaging (logging) period, calibration factor, and tag number;
(j) Alarm Averaging Time (user selectable): real-time (1-60 seconds) or STEL (15 minutes), alarms required;
(k) Operating Time: 48 hours (fully charged NiCd battery); continuously with charger;
(l) Operating Temperature: -10 to 50^{o} C (14 to 122^{o} F);
(m) Particulate levels will be monitored upwind and immediately downwind at the working site and integrated over a period not to exceed 15 minutes.

4. In order to ensure the validity of the fugitive dust measurements performed, there must be appropriate Quality Assurance/Quality Control (QA/QC). It is the responsibility of the remedial party to adequately supplement QA/QC Plans to include the following critical features: periodic instrument calibration, operator training, daily instrument performance (span) checks, and a record keeping plan.

5. The action level will be established at 150 ug/m3 (15 minutes average). While conservative,

this short-term interval will provide a real-time assessment of on-site air quality to assure both health and safety. If particulate levels are detected in excess of 150 ug/m3, the upwind background level must be confirmed immediately. If the working site particulate measurement is greater than 100 ug/m3 above the background level, additional dust suppression techniques must be implemented to reduce the generation of fugitive dust and corrective action taken to protect site personnel and reduce the potential for contaminant migration. Corrective measures may include increasing the level of personal protection for on-site personnel and implementing additional dust suppression techniques (see paragraph 7). Should the action level of 150 ug/m3 continue to be exceeded work must stop and DER must be notified as provided in the site design or remedial work plan. The notification shall include a description of the control measures implemented to prevent further exceedances.

6. It must be recognized that the generation of dust from waste or contaminated soil that migrates off-site, has the potential for transporting contaminants off-site. There may be situations when dust is being generated and leaving the site and the monitoring equipment does not measure PM10 at or above the action level. Since this situation has the potential to allow for the migration of contaminants off-site, it is unacceptable. While it is not practical to quantify total suspended particulates on a real-time basis, it is appropriate to rely on visual observation. If dust is observed leaving the working site, additional dust suppression techniques must be employed. Activities that have a high dusting potential--such as solidification and treatment involving materials like kiln dust and lime--will require the need for special measures to be considered.

7. The following techniques have been shown to be effective for the controlling of the generation and migration of dust during construction activities:

(a) Applying water on haul roads;
(b) Wetting equipment and excavation faces;
(c) Spraying water on buckets during excavation and dumping;
(d) Hauling materials in properly tarped or watertight containers;
(e) Restricting vehicle speeds to 10 mph;
(f) Covering excavated areas and material after excavation activity ceases; and
(g) Reducing the excavation size and/or number of excavations.

Experience has shown that the chance of exceeding the 150ug/m3 action level is remote when the above-mentioned techniques are used. When techniques involving water application are used, care must be taken not to use excess water, which can result in unacceptably wet conditions. Using atomizing sprays will prevent overly wet conditions, conserve water, and provide an effective means of suppressing the fugitive dust.

8. The evaluation of weather conditions is necessary for proper fugitive dust control. When extreme wind conditions make dust control ineffective, as a last resort remedial actions may need to be suspended. There may be situations that require fugitive dust suppression and particulate monitoring requirements with action levels more stringent than those provided above. Under some circumstances, the contaminant concentration and/or toxicity may require additional monitoring to protect site personnel and the public. Additional integrated sampling and chemical analysis of the dust may also be in order. This must be evaluated when a health and safety plan is developed and when appropriate suppression and monitoring requirements are established for protection of health and the environment.

APPENDIX D

RADIOLOGIC WORK PLAN AND SUPPORT DOCUMENTS

Greater Radiological Dimensions, Inc.
1527 Ridge Road – Lewiston, NY 1409
Phone: (716)754-2654 Fax: (716)754-2622

Description: Radiological Material Work Plan

Prepared for: Merani Hospitality, Inc.

Project Location: 401, 402 and 430 Buffalo Avenue Site
Niagara Falls, New York, BCP Site No. C932164

1.0 Purpose:

The purpose of this Work Plan and associated support documents, including the Technical Approach and Radiological Health and Safety Plan (attached), is to present the means and methods that will be required to address on-Site elevated radiological soil / fill, and provide radiological technical support, screening and oversight of the investigation and removal of elevated radiological material on the 401, 402, and 430 Buffalo Avenue, Niagara Falls, New York Site (Site).

This radiological work plan and associated radiological support documents have been prepared in association with the NYSDEC Brownfield Cleanup Program (BCP) work plan prepared by TurnKey Environmental Restoration, LLC and Benchmark Environmental Engineering and Science, PLLC. GRD is solely responsible for the contents of this work plan.

Greater Radiological Dimensions Inc. (GRD), a Licensed Radiological Material Handling Company (New York State Department of Health Radioactive Materials License # C5514), will provide radiological oversight for the investigation, pre-screening, remedial excavation, minimization, segregation and off-site transportation of radiologically-impacted soil / fill wastes for off-site disposal at an approved disposal facility.

2.0 Background:

Based on the location of the Site within an area of Niagara Falls New York that is recently known to contain historic slag material which exhibits elevated levels of naturally-occurring radioactive material (NORM) and technologically-enhanced, naturally-occurring radioactive material (TENORM), radiological screening of the Site was recommended by the NYSDEC to be completed as part of the BCP activities. The environmental and pre-demolition investigation (TurnKey, August 2014) indicated areas of the 401 Buffalo Avenue parcel contain elevated radiological material above background levels, with readings as high as 40,000 counts per minute (cpm) being recorded in the pool area.

The 402 and 430 Buffalo Avenue parcels were previously part of the National Bisquit / Shredded Wheat Factory, and based on the former commercial / industrial use of this portion of the Site, a gamma walkover screening of the entire parcel is planned during the Remedial Investigation (RI) of the Site.

Any elevated radiological material that is planned to be removed during remedial and / or redevelopment activities will be handled in accordance with this work plan and associated technical documents.

3.0 Screening of Potential Radiologic Material:

During intrusive activities, it will be necessary to pre-screen the areas and determine if elevated radiological material is present above the established background. Prior to excavation a radiological technician (Rad Tech) will perform a gamma walkover of the surface area, utilizing a Ludlum Model #2221 Detector paired with a #44-10 sodium iodide probe. Utilizing the results of the gamma walkover; along with visually screening; the rad tech will determine when and how often to scan buckets during excavation.
If elevated activity is found to be approaching the NYSDEC established threshold of separation, the technician will then scan each bucket until levels are at or below background. The threshold is typically determined to be at or near 1.5 to 2 times background; this threshold has previously been used on the properties per the NYSDEC. Therefore, the threshold for the Site would be 12,000-14,000 cpm.

Any material above the threshold will be segregated to the radiological-contaminated lay-down area. A contaminated material lay-down area will be established and appropriately posted. This area will have a plastic under-lay and will be covered with poly sheeting at all times. For more specific means, methods and requirements refer to the Radiation Health and Safety Plan.

Radiological general area air monitoring will be completed during the excavation and handling of elevated radiological material. General air monitoring will be completed in addition to the BCP Community Air Monitoring Plan.

the following procedure for Radiological general area air monitoring will be utilized:

Three (3) F&J low-volume air monitors will be placed waist high within 20 feet of the excavation at upwind, down wind and cross wind of excavation / load out area. The monitors will run during all excavation / load out activities and the filter cartridges will be collected daily.

The 47mm filters will be counted immediately for any excessive levels, then held for 5 days for radon decay, then recounted with a Ludlum model #2929 alpha / beta filter counter or equivalent. The results of air monitoring data will be reported using the guidance in NRC Regulatory Guide 8.25 (attached). All Air Sample data will be compared with the derivative air concentrations (DAC) that are the most conservative for the contaminants expected to be present. Radioactive contaminants in Appendix B of New York's State Sanitary code # "10 NYCRR part 16-ionizing radiation" will be used to assess the exposure potentials, as appropriate.

All instruments will be calibrated in accordance with regulatory guidance and subjected to daily quality checks to ensure proper operating condition and functionality. The data will be recorded on field survey forms and reviewed by senior radiological staff.

4.0 Oversight/Rad Support of Load Out, Shipping and Disposal of Contaminated Material:

With the approval from the NYSDEC and the acceptance of sample results from the approved off-site disposal facility and the facility's state regulatory agency, the radiological -contaminated material will be loaded into the appropriate shipping containers for off-site transportation by licensed radiological transporter and disposal at registered disposal facility. GRD will provide a certified waste shipper if needed who will ensure that all of the necessary permits and state regulatory requirements are fulfilled. The trucks will be lined with poly and covered (tarped). A dose rate survey of the trailer and cab will be performed, with a Bicron µR meter, in order to determine the dose rate in (µr / hr). The tires will be pre-scanned prior to leaving the Site, and if levels are more than two times the background, the tires will be decontaminated utilizing water prior to being released from the excavation site. Decon materials will be containerized for off-site disposal. Details are provided in the support documents.

Once the load out of contaminated material has been completed, all associated equipment will be scanned and released. A pre- and post-gamma walkover survey of the radiological-contaminated staging area will be performed.

5.0 Reporting:

Daily field logs will be utilized to record daily activities, screening results and sampling, and equipment usage and calibration results. Additional documentation, including: radiological waste characterization sample results, disposal facility applications and approvals, off-site transporter licenses, radiological worker training certifications, and disposal manifests and tonnage reports will be provided in the close out documents.

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Greater Radiological Dimensions Inc. 1527 Ridge Road , Lewiston, NY 14092	

LOCATION: 401, 402 and 430 BUFFALO AVENUE Site

Niagara Falls New York BCP Site No. C932164

TECHNICAL APPROACH

Prepared By	**Stuart Pryce** **Project Manager / Sr. Technician**	
Approved By:	George Weissenburger Program Manager / Sr. Technician	

The anticipated scope of consultant work is as follows:

- Provide radiation health and safety consulting.
- Obtain Radioactive Materials license coverage for Merani Hospitality, Inc. (Merani), and Turnkey Environmental Restoration, LLC (TurnKey) and Benchmark Environmental Engineering and Science, PLLC (Benchmark), their subcontractors, for this project.
- Write a Contaminated Materials Handling Plan (CHMP) for the project. A draft copy of the CMHP must be submitted to Merani, or designated subcontractor, for review and comment. The following is a suggested CHMP outline:

    Introduction

    - Protection of Workers and General Public
        - General Concepts
        - General Radiation Protection Methodologies
        - Personal Protective Equipment
        - Contamination Control
        - Fugitive Dust Control
        - Instrumentation
        - Contamination Release Limits
    - Excavation and Management of Soils and Slag
        - General
        - Radiation Field Screening Procedures
        - Segregation and Transport of Radiologically Contaminated Materials
        - Contaminated Material Staging Area
    - Decontamination of Equipment
    - Emergency Event Guidelines
    - Site Worker Radiation Safety Training Requirements
    - Radiological Documentation
        - Screened Material
        - Excavation Actions
        - Training
        - Equipment Decon
        - Project Personnel Contact Information

    - References
    - Training Outline
    - Glossary of Terms

Radioactively Contaminated Materials Handling Plan for the Project

Introduction

Greater Radiological Dimensions, Inc. (GRD) has contracted to provide radiation health and safety consulting, radiation monitoring, and job-site field surveys.

GRD shall be responsible only for radiation-related support services, including radiation related consulting, monitoring, surveying and minor decontamination within radiation control areas for this project. The non-radiological aspects of the project shall be the responsibility of Merani and their designated subcontractors, including ,excavation and utility installation (and attendant health and safety), non-radioactive air monitoring, dust control, disposal and re-use of non-radiologic excavated materials and waste.

GRD will prepare relevant Radiation Work Permits (RWPs), Radiation Standard Operating Procedures (RSOPs), and Radiation Health and Safety Plans (RHASPs). It is the responsibility of Merani and/or its subcontractors to prepare all other relevant plans.

Protection of Workers and General Public

General Concepts

In summary, GRD will take measures to minimize exposure to ionizing radiation for the general public, Merani, and associated contract works, and GRD workers and associated contract employees. General methodologies and rules are described in more detail below.

The overarching philosophy/methodology for protection is As Low As Reasonably Achievable (ALARA), whereby workers keep any received dose ALARA through formal procedures and sound work practices, including monitoring and personal protective equipment – PPE, as described below.

General Radiation Protection Methodologies

General Rule for Safe Use of Radioactive Material

The radiation dose received by any person from external or internal exposure to ionizing radiation in a radiation installation (a controlled area in which radioactive material or machines generating ionizing radiation or both are used) must be held to the lowest possible value consistent with effective use of the installation. Exposure of personnel, and the general public, to ionizing radiation, must never exceed the legal maximum permissible values. Control of ionizing radiation exposure is based on the assumption that any exposure involves some risk. However, occupational exposure within accepted limits represents a very small risk compared to the other risks voluntarily encountered in other work environments. The policy of GRD is to maintain occupational exposures of individuals within allowable Radiation Exposure Guides. The individual and collective dose to workers is maintained As Low As Reasonably Achievable (ALARA). ALARA is a part of the normal work process where people are working with ionizing radiation. Management at all levels, and in all areas, as well as each individual worker, must take an active role in minimizing this radiation exposure. Disposal of all radioactive waste must be in accordance with procedures contained in GRD's Radiation License. The radiation dose received by any person from external and/or internal exposure to ionizing radiation in a non-controlled area must be held as close to natural background levels as possible. Exposure to the general public from any operation must never exceed the annual legal maximum permissible exposure level of 100 mRem per year above the natural background level. Legal maximum permissible dose levels are those specified in the current edition of the New York State Department of Health Sanitary Code, Chapter I, Part 16, Ionizing Radiation: and in Title 10, Part 20, of the Code of Federal Regulations (10 CFR 20), Radiation Protection. These two reference materials contain definitions of terms used in this document. Federal and State regulations shall be considered as a part of GRD's procedures outlined within this document.

GRD shall employ the following methods/procedures for ensuring radiation protection of workers and the general public:

- General and specific RWPs (radiation work permits) are written for a 6-month period and will be reviewed and revised as conditions change. Specific RWPs are written for jobs that are outside the scope of work covered in a general RWP.
- Procedures in RWPs will be followed.
- Employ personnel monitoring – Thermoluminescent Detector (TLD) bioassays; TLD's to be worn between neck & waist.
- Control of area access by posting radiation areas.
- Materials sampling.
- Use of a log book to track work activities.
- Performance of RWP surveys, which accompany the RWP.
- If needed, buffer areas shall be placed at egress points from contaminated areas.
- Keep access egress logs.
- Slag is a heavy material, but airborne material arising from slag has been shown not to be an issue from historical data from other BCP Site(s) in Niagara Falls, New York.
- Instrumentation to be calibrated yearly by a commercial service.
- Instruments are set up to +/- 2 sigma measurement tolerances.
- Daily source checks of all instruments are to be performed and recorded on daily performance sheets.
- Source jigs will be performance checked to obtain appropriate use geometry.
- Loose contamination surveys shall be performed using swipes for 100 cm2 area. LAWs (large area wipes) can also be used to detect loose contamination as another method of radiation surveying. In this case, a cloth, such as maslin, is used in place of 100 cm2 swipes.100 cm2 swipes will be counted on instrumentation that can detect beta, gamma, and alpha emitters.
- Direct contamination surveys will be performed by scanning with instrumentation that detects beta, gamma, and alpha.
- Equipment surveys that pertain to any material or equipment in a controlled area shall be performed on a weekly basis.
- Equipment surveys will be performed for equipment that will remain on the job site, if it is being released from controlled areas.
- Gamma walk-over survey of all accessible areas fo the BCP Site will be comeplted prior to intrusive activities
- Excavation surveys shall be performed, in areas of the Site that have been identified as elevated during previous assessment or during the walk-over survey, during excavation activities.
- Collection of radiologic waste characterization samples for disposal approval, as required.
- Personnel surveys/monitoring of personnel shall be performed on a schedule set by the RWP.
- All surveys will be available for workers to review conditions and will also be included in RWP packages.
- Conditional release surveys will be performed when materials and equipment are leaving a controlled area.
- An unconditional release survey is performed when equipment is being released from the job site. Equipment surveys are also required when maintenance is performed on equipment.

- All surveys shall be documented.

Personal Protective Equipment (PPE)

Use and Selection of Protective Clothing

PPE will be selected based on the contamination levels in the work area and the anticipated work activity, ALARA and safety considerations, and consideration of non-radiological hazardous materials that may be present. Surfaces are considered radiologically contaminated if above Table 4 levels.

PPE provided will be in good condition and free of chemical or radioactive contamination and may include the following items at the discretion of the RSO:

- Full Set Coveralls (TyvekTM or cotton)
- Cotton glove liners
- Rubber or chemical resistant gloves
- Shoe covers
- Protective overshoes
- Hood (TyvekTM or cotton)

Protective clothing and equipment selected for project tasks will be described in the GRD RHASP, together with procedures for donning and removing PPE without spreading contamination or contaminating the worker. The necessary PPE for a task will be specified by the RWP.

Use and Selection of Respiratory Protection Devices

GRD's documented respiratory protection program details specific procedures for respiratory usage, fit, cleaning, and so forth. Engineering control measures will be provided to limit the concentrations of radioactivity in air to levels below those that constitute an airborne radioactivity area to the extent feasible. When this level is not feasible, other methods such as administrative controls and respiratory protection will be employed to limit the potential for intake of radioactive material.

Only respiratory protection equipment that is tested and certified by the National Institute for Occupational Safety and Health (NIOSH) will be used. Protection factors listed in Appendix A of 10 CFR 20 will be used in the assessment of potential radioactive material intake. Selection of appropriate respiratory protection devices will be designated within either the HASP or the RWP. At a minimum, respiratory protection devices will be selected so that a protection factor greater than the multiple by which peak concentrations or airborne radioactivity exceed the values specified in Appendix B of 10 CFR 20 is not exceeded. Only respiratory protection equipment that has been specifically certified for emergency use by NIOSHI Mine Safety and Health Administration (MSHA) will be used as emergency devices. Whenever respiratory protection will be used at a site, the following additional minimum requirements will be met:

Air sampling for radiation will be performed to identify the potential hazard, permit proper equipment selection, and estimate exposures. Surveys and bioassays, as appropriate, will be performed to evaluate actual intakes. Respirators will be tested for operability immediately prior to each use. Written procedures will be available regarding selection, fitting, issuance, maintenance, medical testing and testing of respirators (including testing for operability prior to each use), supervision and training of personnel, monitoring (including air sampling and bioassays), and recordkeeping.

Radioactive Contamination Control

The best way to control the spread of radioactive contamination is to prevent it from occurring. However, in virtually any environment, this is impossible. Therefore, the next best solution is to delineate and enforce boundaries beyond which contamination will not be permitted. Access should be limited to as few points as possible to minimize the possibility of undetected contamination being carried out of the area. These boundaries should enclose the smallest area possible and should be monitored to ensure that no contamination can escape. Monitoring should include, but not be limited to, surveys of all personnel and equipment entering and leaving the contaminated areas, the entry and exit areas, and any boundaries that are not solid (i.e. any rope boundaries, turnstiles, gates, doorways, etc.).

At the entrance points, it is also helpful to have a buffer zone with a step-off pad that will allow personnel entering and exiting the contaminated area a place to don or to remove anti-contamination (Anti-C) clothing and to frisk themselves for contamination before their entrance or exit. This buffer zone should be surveyed frequently to ensure that it is maintained contamination-free. If this area is the only egress from the contaminated area, and it is clean, then the likelihood that contamination will spread beyond that point is remote.

The boundaries of entry points to any contaminated area should be clearly marked and posted with the requirements for entry. This may include Anti-C clothing, respirators, or only protective gloves (PPE). There should also be a supply of the proper clothing available at the entrance to the area and waste cans in which to dispose of the clothing upon exiting. Finally, there should be a person present in the vicinity of the entrance/exit point to ensure that proper frisking and logging is performed and to deal with any problems that may arise.

Much of radiological contamination control is similar to chemical contamination control. The best way to prevent personal contamination is to avoid coming in contact with any source of contamination. If this is not possible, then one should carefully dress in Anti-C clothing that is appropriate for the nature and amount of contamination that is present. Upon exiting an area, one should remove any of the potentially-contaminated clothing and perform a personal survey to ensure that there was no leakage of contamination past the protective clothing. Anything that comes in contact with a piece of contaminated material such as the ground, a fence, a truck tire, an excavator bucket, etc., should be treated as contaminated and either left in the contaminated area, placed in a bag to prevent the spread of contamination from that object to other areas, or decontaminated and removed from the area.

Some additional Guidance for contamination control has been provided by the US NRC (Nuclear Regulatory Commission); e.g., IE Circular No. 81-07: Control of Radioactively Contaminated Material". Excerpts relevant to this Project are shown below. Items and material should not be removed from the restricted area until they have been surveyed or evaluated for potential radioactive contamination by a qualified* individual. Personal effects (e.g., notebooks, tools, flashlights, etc.) which are hand carried need not be subjected to the qualified individual survey or evaluation, but these items should be subjected to the same survey requirements as the individual possessing the items. Contaminated or radioactive items and materials must be controlled, contained, handled, used, and transferred in accordance with applicable regulations.

The contamination monitoring using portable survey instruments or laboratory measurements should be performed with instrumentation and techniques (survey scanning speed, counting times, background radiation levels) necessary to detect 5000 dpm/100 cm2 total and 1000 dpm/100 cm2 removable beta/gamma contamination. Instruments should be calibrated with radiation sources having consistent energy spectrum and instrument response with the radio nuclides being measured. If alpha contamination is suspected appropriate surveys and/or laboratory measurements capable of detecting 100 dpm/100 cm2 fixed and 20 dpm/100 cm2 removable alpha activities should be performed.

A qualified individual is defined as a person meeting the radiation protection technician qualifications of Regulatory Guide 1.8, Rev. 1, which endorses ANSI N18.1, 1971.

In evaluating the radioactivity on inaccessible surfaces (e.g., pipes, drain lines, and duct work), measurements at other appropriate access points may be used for evaluating contamination provided the contamination levels at the accessible locations can be demonstrated to be representative of the potential contamination at the inaccessible surfaces. Otherwise, the material should not be released for unrestricted use.

Federal, State, and Municipal regulations for the control of radioactive contamination shall be considered and followed as a part of GRD's procedures. GRD shall employ the following methods / procedures for contamination control:

- All areas identified as containing radioactive contaminants shall be surrounded by posting ropes.
- Buffer areas will be identified per RWPs.
- Access and egress logs shall be kept. Workers shall initial the logs upon entrance and exit and will be frisked appropriately at egress points.
- Workers shall sign the RWP to acknowledge that each worker has read and understands the radiological conditions, PPE that they will wear, and will follow any special instructions stated in the RWP.
- PPE shall be worn per the approved RWP.
- Conditional release surveys on equipment that will remain on site shall be conducted on a weekly basis and the results documented.
- Unconditional release surveys of equipment to be leaving the site shall be performed and documented in accordance with the Section 2.2 guideline in DOE 10CFR 835.
- Materials will be bagged and appropriately tagged.
- Laydown areas will be established and appropriately posted.
- Laydown areas will have a plastic underlayment on the ground for material to lay on; such contaminated material will be covered at all times.
- Contaminated material will be placed in lined trucks and transported to laydown areas; no posting on trucks will be required at the job site.
- A bag at the egress will be in place where all PPE shall be deposited.

  Excavators or equipment used in controlled areas that have contamination above release criteria will either have to stay in controlled area or be decontaminated by established procedures. The decontamination method that is most effective and efficient on excavator buckets and tires is water-based washing, which is performed in a controlled area. After washing and drying, the equipment is then surveyed and the results documented. If the ground is contaminated during such operations, contaminated material / soil will be contained and captured.
- Any contaminants arising from a decontamination operation with be captured and contained.
- Unloading of contaminated material at laydown areas will require the presence of a radiation technician to ensure truck and other equipment tires are free of contamination and that all postings are returned to their original locations, so that areas remain controlled.
- Radiation technicians will control the course of excavations and can serve as a posting in some cases.
- Continuous radiation-monitoring coverage and intermittent coverage will be provided by technicians, depending on job situations and conformance with the RWP.
- Buffer areas always will accompany contamination areas.
- Conditional release surveys will be performed when equipment, tools, or machinery are leaving controlled areas / contamination and will be remaining on site.
- Unconditional release surveys will be performed for material or equipment leaving the Project site.

- Contaminated material will be placed in lined trucks and covered if transported on public roads.

Fugitive Dust Control

General

It should be the responsibility of the excavation and construction contractor to provide fugitive dust emissions control at the job site. Some suggested control measures, such as the erection of screens/barriers/enclosures, covers on piles, covers on trucks, water sprays, latex- binder sprays, and chemical conditioning. Such control measures can be found in US EPA Document EPA/540/2-85/003, Nov 1985, “Dust Control at Hazardous Waste Sites”.
GRD will be responsible for the monitoring of dust for radiation. GRD will control dust stirring and emissions by its monitoring personnel by appropriate measures.

Merani Responsibility

Regulations call for the demolition contractor to prepare a Fugitive Dust Suppression Plan coupled with a Community Air Monitoring Program. Elements of this submittal will be consistent the NYSDOH Generic Community Air Monitoring Plan. The elements of this submittal should include:

- Description of dust suppression techniques to be employed during site activities including excavation, demolition and earthwork.

- Description of particulate monitoring techniques and frequency, instrumentation and analytical methods.

- Location of monitoring points.

- Record keeping of meteorological data.

- Action levels, corrective actions, and stop work levels.

- Quality Assurance / Quality Control Plan.

- Demolition, Excavation, and Construction Work Plans

- Identification of the qualified professional who prepared the plan.

During construction of the Project, water or other dust-suppression substances approved by local, state and federal regulators will be used to control dust along public roads as well as Project access roads as needed throughout the duration of construction activities. Globe and its contractors will require reduced vehicle speed on unpaved roads. The enforcement of reduced vehicular speed within the Project boundary will reduce the amount of fugitive dust that would be generated by passing construction traffic.

Instrumentation

GRD's suite of instruments includes personnel dosimeters, radiation survey meters, alpha/gamma detectors, and sample counting meters. Specific instruments include:

Ludlum 2221 w/44-10 Gamma detector Ludlum M-12w/44-9 Beta-gamma frisker Ludlum M-12 Alpha frisker
Ludlum M-19 Gamma dose rate meter
Ludlum 2360 w/43-89 Alpha-beta frisk
Ludlum M-12w/43-5 Alpha frisker
Ludlum 2241w/w44-38 Beta /Gamma dose rate meter
Ludlum 2929w/43-10-1 Alpha-beta-gamma smear & filter counter
Ludlum 2221w/44-1 Gamma detector with Trimble GPS.

Table 1 lists further details about these instruments.

Table 1: GRD Radiation Detection Instruments

Type	Number Available	Radiation Detected	Sensitivity Range	Use
Gamma detector	5	Gamma	0-500 kcpm	Gamma-walkover surveys.
Gamma detector with GPS	1	Gamma	0-500 kcpm	Gamma-walkover surveys, using GPS.
Beta-gamma frisker	2	Beta, gamma	0-500 kcpm	Personal frisking; field surveys.
Gamma dose rate meter	1	Gamma	0-5 mR/hr	Surveys
Alpha Beta frisker	2	Alpha, beta	0-500 kcpm	Personal frisking, field surveys.
Alpha frisker	2	Alpha	0-500 kcpm	Personal frisking, field surveys.
Beta /Gamma dose rate meter	1	Beta, gamma	0-200 mR/hr	Surveys.
Alpha-beta-gamma counter	1	Alpha, beta, gamma	0-9,999,999 cpm	Smear & filter counting.

Instrument calibrations will be performed by a commercial calibration service and calibrations will be performed by persons licensed to perform such services by the US Nuclear Regulatory Commission or an Agreement State. A copy of this license will be kept on file with calibration certificates. GRD will do no in-house calibrations. However, GRD will source-check instruments before use (with radiation-permit exempt sources). GRD, Inc. will require that the calibration service follow the guidance and documentation provided in Appendix B of New York State Radiation Guide 1.7 (July 2006) and provide the appropriate Survey Meter Calibration Reports. GRD will employ radiation-permit-exempt 'check sources' to check / verify the operation of survey meters / instruments whenever such devices are used. Check sources are Tc-99, Cs-137, and Po-210.

Calibration Report

Calibration reports from the commercial service will adhere to the documentation provided in Appendix B of New York State Radiation Guide 1.7 (July 2006).

Contamination Release Limits

Radiological contamination survey, documentation, and labeling requirements will be established for all property / material released from an RCA (Radiation Control Area). All equipment, materials, and property used in an RCA established for contamination control will be considered as potentially contaminated and will not be released to an uncontrolled or unrestricted area until they have been surveyed and meet criteria established by the RSO.

Excavation and Management of Soils

General

GRD will be responsible for providing radiation health and safety support to in-field operations to ensure that workers and the general public are adequately protected from radiation hazards. Such work includes close support for construction and utility workers, radioactive air monitoring, and surveys of excavated / removed material, stored materials, equipment, and materials and equipment to be taken offsite. GRD will prepare its own radiation work permits, health and safety plans, and standard operating procedures. Merani or its chosen contractors shall be responsible for preparing such permits and plans for their respective work topics.

Radiological (rad) removal work surveys, monitoring, and decontamination shall be performed under the direct supervision of GRD personnel in conformance with GRD's Site-Specific Radiological Safety Plan. Such a plan shall be approved by the NYSDEC and the NYSDOH (e-mail correspondence is sufficient).

Radiation Field Screening Procedures Radiation Surveys

Radiological monitoring and surveys of radiation exposure levels, contamination, and airborne radioactivity will be conducted to:

- Characterize workplace conditions and detect changes in those conditions;
- Verify the effectiveness of physical design features, engineering and process controls, and administrative control procedures,
- Demonstrate regulatory compliance;
- Detect the gradual buildup of radioactive material;
- Identify and control potential sources of personnel exposure; and
- Identify areas requiring postings.
- Monitoring will be performed only by trained and qualified personnel and will be conducted as specified by the project RSO.
- Minimally, radiological surveys will be conducted. Once per shift at entrance or exit points, between contamination areas and clean areas; Daily in RCAs; Weekly in radiation and / or contamination areas; and Weekly in clean areas.

The radiological field measurements will be performed throughout the project. The surveys will focus on the primary radiological contaminants of concern. A gamma scan of the soils surrounding Project excavation activities (out to 15 meters beyond the work area) will be performed to document the status prior to and following groundbreaking/excavation. Radiation detection and measurement instrumentation will be selected based on the type and quantity of radiation to be measured. The instruments used for direct measurements will be capable of detecting the radiation of concern to minimum detectable concentrations (MDCs). The instrumentation to be used by the GRD project team is provided in Table 1. Scan MDCs for various radionuclides are listed in NUREG-1507, Table 6.4 for a scan speed of approximately 1 meter per second. The radionuclides that will be measured are primarily natural uranium and Ra-NUREG -1507, Table 6.4 in the subject reference lists scan MDCs for a 2”×2” NaI(Tl) scintillation detector of 80 and 2.8 picocuries per gram (pCi/g) for natural uranium and Ra-226, respectively. Daily instrument quality control (QC) checks will be documented and performed before and after each day's work.

Static alpha, static alpha + beta, removable alpha, removable beta, and direct gamma exposure rate measurements will be carried out periodically. Instrumentation will be the same instrument types that will be used during pre-excavation surveys. More than one survey instrument will be used for static alpha, and static alpha + beta measurements. Approximately two to four separate areas encompassing excavation paths will be selected and within each area two to four measurements of each (static alpha, static alpha + beta, removable alpha, removable beta, and gamma exposure) will be obtained at unique locations within the area. It is expected that static measurement count times will be about one minute each unless otherwise directed by the RSO to achieve lower detection limits. Soil samples should be collected at three locations and analyzed to determine the concentrations of naturally occurring radionuclide (U-234, U-235, U-238, Ra- 226, Th- 230, Th-232, and Th-228).

Gamma scans will be performed on areas out to 15 meters beyond the work area to establish the existing radiological conditions. This data will establish the comparison for post-surveys to insure excavation activities do not radiologically contaminate other areas and to prevent contamination from outside areas from contaminating the excavation debris. Gamma scans of the areas will be performed using a 2”x 2” NaI (Tl) detector (Ludlum Model 44-10 detector or equivalent) with a 2350-1 data logger or equivalent. Surveys will be performed moving the detector in a serpentine pattern at a speed of no greater than 1 meter per second, covering at least 50% of the area. The surveys will identify posted areas and areas of elevated radioactivity in the soils.

Radiation-Related Air Sampling

General area and personal air sampling (if required) will be conducted in accordance with the guidance in NRC Regulatory Guide 8.25. Air sampling will be employed when necessary to determine whether confinement or suppression of radioactive material is effective, to determine required workplace administrative controls, to estimate worker intakes, and to determine what personal protective equipment (PPE) is appropriate.

General area and/or perimeter air sampling for airborne radioactivity will be conducted with low-volume air samplers F and J Model LV-1 or equivalent (0-100 1pm). The low-volume samplers will use 47mm filters and will be counted on a Ludlum model 2929 sample counter or equivalent, for alpha and beta immediately to determine any excessive levels. The filters will be changed daily. Following a 5 day hold time for radon decay, where the potential for airborne radioactivity is above background levels, the sample will be counted again to determine the actual activity without radon progeny contribution.

High-volume air samplers are those with sufficient flow rate to achieve a minimum detectable activity (MDA) of 10% of the applicable DAC in an 8-hour shift. Air sample filters will be analyzed on site for gross alpha and gross beta in accordance with written procedures. In work zones with a potential for short-term airborne excursions, representative breathing zone samples will be collected in the immediate vicinity of work being performed to determine whether the area is an airborne radioactivity area requiring additional work controls or to assess the worker's intake of airborne radioactive materials. When required to estimate worker intakes, representative personal air sampling from a member of each field team working in radiologically contaminated areas will be conducted for airborne radioactivity in the breathing zone. The data will be compared with the DACs that are the most conservative for the contaminant(s) expected to be present to gauge employee exposure potential. DACs for radioactive contaminants in Appendix B to 10 NYCRR 16 will be used to assess exposure potentials, as appropriate.

Segregation and Transport of Radiologically Contaminated Materials

Excavated soil will be examined/monitored in the field by GRD personnel for radioactive contamination. Radioactively contaminated soil shall be placed in a temporary laydown area for storage and further monitoring. Merani or other contractor personnel will examine excavated or stored soil/materials for other potential contamination (e.g., chemicals). An on-site competent person will evaluate soil intended for off-site reuse for consistency with regulations. “Clean” excavated soil will be temporarily staged for characterization, if necessary.

It is currently anticipated that affected soil may be live-loaded (after appropriate screening) into vehicles for transport and disposal (or reuse) off site, presuming approval is previously received from the facility accepting the waste.

A separate Transportation and Disposal Plan will be prepared by GRD for the subject Project. The Transportation and Disposal Plan purpose is to aid the assigned project staff in performing transportation related work, assuring that compliance with motor carrier, federal, state and local regulations are understood and adhered to applicable transportation activities performed by employees and lower tier subcontractors. The project team shall implement the Transportation and Disposal Plan in accordance with existing procedures to ensure that the transportation of hazardous materials on-site and off-site is performed in accordance with applicable federal, state and local rules and regulations.

Unless otherwise indicated, the following codes, standards, laws, and regulations establish the minimum requirements for transportation-related work:

- 10 CPR 830- Nuclear Safety Management
- 10 CFR 835- Occupational Radiation Protection
- ICAO/IATA- Dangerous Goods Regulations
- ISO 9001- Quality Management Standard
- FMCSR- Federal Motor Carrier Safety Regulations
- NYCRR- New York Codes, Rules, Regulations
- TDEC Rule 1200-1-7
- Title 29 CFR 1910- Occupational Safety and Health Standards
- Title 40 CFR 61, 262-263 and 700-789
- Title 49 CFR, 100-185, 325 and 355-399

Radiologically Contaminated Material Staging Area

Prior to the start of any excavation or Site clearing work, a subsurface clearance review of the Site will be conducted. Support facilities including an equipment/vehicle decontamination pad and equipment staging areas will be prepared at the Site. Additionally, staging areas for the temporary storage of excavated "clean" soil, or any affected soil that will not be live-loaded for off-site transport and disposal, will be constructed adjacent to excavation areas. Soil staging areas will be constructed with a double layer of 6-mil polyethylene sheeting bermed at the sides with hay bales or equivalent material of similar mass and shape. Staged excavated soil will be covered at the end of each work day and during moderate or heavy precipitation events. These facilities will meet the requirements established in the RHASP for the Exclusion Zone, "Clean" excavated soil will be temporarily staged for characterization, if necessary.

It is currently anticipated that affected soil may be live-loaded (after appropriate screening) into vehicles for transport and disposal (or reuse) off site, presuming approval is previously received from the facility accepting the waste.

Decontamination of Equipment

Equipment decontamination area(s) will be established at predetermined locations as required. These areas will be available for the cleaning of light and heavy equipment (tracked construction equipment, vehicles, etc.) used during radiological excavation and remediation activities. In- place cleaning may include rinsing and/or dry, gross cleaning. If wet decontamination methods are used, water will be captured and containerized for characterization and disposal. All equipment will be evaluated for removable radioactive contamination before leaving the facility.

Equipment will not be demobilized from the Site until it has satisfied an outbound radiological survey and is free released. Once completed, the equipment and support materials can be returned to the rental company or shop location as appropriate.

Surface contamination levels presented in Table 2 will be used to determine if a piece of equipment is contaminated with radioactive materials. When decontamination is necessary, decontamination will be performed using techniques that are appropriate based on site-specific conditions. Generally, dry decontamination methods such as high-efficiency particulate air (1-1EPA) vacuuming or wipe-downs are preferred when facilities for the collection of radiological contaminated wastewater are not in place. If adequate facilities exist for the collection of such fluids, it may be appropriate to use a wet decontamination technique. Additional decontamination methods in extreme conditions include sand or abrasive blasting. Specific decontamination procedures and requirements shall be made under the direction of the RSO.

Emergency and Abnormal Event Guidelines

Details on the site-specific radiological emergency procedures are provided in the RHASP. All site personnel will be instructed in their emergency responsibilities and the emergency procedures. An emergency hospital is identified in the RHASP and maps to this facility are readily available. Merani/site contractors will require their own HASP, with included emergency procedures. Both HASPS shall be shared with all personnel.

Radiological Documentation

GRD shall only be responsible for records pertaining to radiation surveys, monitoring, individual exposures, and limited decontamination of excavated material. Records associated with radiation surveys and measurements performed to support activities associated with D&D of a site and equipment are:

- Name of the person making the evaluation and recording the results;
- Date of the survey;
- Instrument serial number used for surveys and measurements;
- Results obtained: and
- Applicable review.

Records for Individuals

GRD will record contamination levels observed and procedures followed for incidents involving contamination of individuals. The record should include name of individuals involved, description of work activities, calculated dose, probable causes (including root causes), steps taken to reduce future incidents of contamination, times and dates, and the surveyor's signature. Records to be maintained include the following (as available):

- Doses received by individuals, for whom monitoring was required during previous employment.
- Doses received by individuals for whom monitoring was required:
- Dose assessments for individuals for whom bioassay was performed:
- Doses to the embryo / fetus of a declared pregnant employee:
- Written declarations of pregnancy;
- Written withdrawal of declaration of pregnancy.

RSP records will be maintained to document compliance with regulatory requirements and the exercise of due diligence in the control of radiological hazards for the protection of employees, members of the public, and the environment. These records will be transferred to the project file at the conclusion of the project.

Screened Material Records

During field screening of material, all results will be documented in a GRD daily log. Results will then be inputed into a computer generated GRD radiological survey form.

Excavation Actions Records

GRD shall only be responsible for records of radiation surveys, monitoring, and limited decontamination of excavated material. Excavation activities will be documented on a GRD daily log, Results will then be inputted into a computer generated GRD radiological survey form, which includes a map of areas of excavation and activity for all materials.
Radiological surveys will be documented on a survey map with areas of elevated (greater than two times the area background) exposure rates (or count rates) clearly marked. Areas of elevated activity will be reviewed by the RSO.

Training Records

All GRD employees and anyone working in contaminated areas, must have an 8-hour. radiation worker class. At the end of training, a test will be administered, the results of which will be kept on file. A certificate issued upon completion of training. (test / training approved by NYDOH)

Equipment Decontamination Records

All equipment to be used in contaminated areas will be documented on an incoming GRD survey form. All outgoing equipment will be surveyed and documented in the same manner. Equipment requiring decontamination will have a pre- decontamination survey performed. A post decontamination survey will also be documented.

Training Outline

Training in radiation protection will be under the aegis of Greater Radiological Dimensions, LLC of Lewiston, NY. GRD, Inc. confirms that it will follow the model procedure for training and instruction that is shown in Appendix A of the New York State Department of Health Radiation Guide 1.7 (July 2006). An outline of key GRD training is summarized below.
Periodic radiological safety training is necessary to ensure that all individuals understand the general and specific radiological hazards, their responsibility to GRD, Inc. and the public for safe handling of radioactive materials, and to maintain their individual radiation exposure ALARA. The appropriate degree of training for each individual will be established based on the nature of the job assignment (i.e. the location where the work will be performed, the hazards associated with that particular area, and the methods used to perform the work). Workers will be categorized as General Workers (those who do not frequent the Controlled Radiation Zone (CRZ) and typically do not work with radiation or radioactive materials), or Radiation Workers (those who do). General Workers will not have unescorted access to the CRZ. Visitors may be exempted from training requirements provided that he/she is escorted, has received a safety briefing, and has written authorization from the RSO or designee.Each worker who is categorized as a Radiation Worker will receive a minimum of 8 hours classroom training prior to initial assignment if they have no prior experience in equivalent radiological work. The purpose of the training is to teach proper methods for working with radiation and handling radioactive materials, to discuss the effects of radiation to explain the risks of occupational exposure, and to identify the specific hazards associated with the operations to be conducted.

The following topics will be covered:

Radioactive materials and radiation;
Biological effects of radiation;
Risks of occupational exposure;
Exposure limits;
ALARA, minimizing exposure (time distance, and shielding);
Personnel dosimetry;
Protective clothing and equipment (PPE);
Radiation detection — operation, calibration, and use;
Contamination control;
Decontamination;
Responsibilities of radiation workers;
Federal and State Regulations and License provisions for the protection of personnel from radiation and radioactive material;
Emergency response;
Radiation exposure reports available to workers;
Respiratory protection program;
Radiation work permits (RWPs).

Workers with documented prior radiological work experience need receive only as much training as is necessary to ensure a level of competence comparable with trained workers. Reciprocity will be established with radiation worker qualification through other nuclear facility training programs. Qualifications of the trainer shall be a minimum of five (5) years operational radiation protection experience plus 40 hours of formal training in radiation protection. The training session is followed by a written test which must be passed (80% pass rate) before unescorted access is allowed to the RCA. Records of required training are maintained in each worker's file. The RSO may authorize individuals to challenge any training requirement and demonstrate the requisite level of knowledge in radiation safety by successfully completing a written exam and demonstration of practical factors. Hands-on training should be used for newly trained individuals without prior radiation work experience to ensure understanding and proficiency in radiation safety practices.

Quality Control (QC)

QC measures shall be conducted and documented, ensure specifications and requirements are being met, and review and approve any additional procedures or plans required, and training records. Health & Safety Training Certificates and proof of medical certifications as described in reference (a) will be provided for all GRD employees and Benchmark Turnkey and its subcontractors to upon request.

Glossary of Terms

Absorbed Dose (D) – Energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest in that material. The units of absorbed dose are the rad and the gray (Gy).

Airborne Radioactivity Area – Area where the measured concentration of airborne radioactivity above natural background exceeds a peak concentration of 1 derived air concentration (DAC) or 12 DAC-hours during the hours a worker is present during one week.
Any discarded material that is not recycled and does not meet the definition of a hazardous waste, as defined in 40 CFR 261. A subset of non-hazardous waste includes Special Waste.

As Low As Reasonably Achievable (ALARA) – An approach to radiological control or a process to manage and control exposures to the work force and to the general public at levels as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations.

Bioassay – Measurement of radioactive material deposited within or excreted from the body. This process may include whole body and organ counting as well as collection of urine and fecal samples. Contaminated Area – An area in which radioactive contamination is present that exceeds removable levels presented in Table 3.

Committed Dose Equivalent (HT,50) – The dose equivalent to organs or tissues of reference that will be received from an intake of radioactive material by a person during the 50-year period following the intake.

Committed Effective Dose Equivalent (HE,50) – The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to these organs or tissues ($HE,50=\Sigma wTxHT,50$).

Controlled Area – An area to which access is controlled in order to protect personnel from exposure to radiation and radioactive materials. An area in which the existing or potential radiation and radioactivity levels are above normal background but are less than that designating a radiological area or a restricted area.

Derived Air Concentration (DAC) – The concentration of a radionuclide in air that, if breathed over the period of a work year (2000 hours), would result in the annual limit on intake being reached.

Disintegration per Minute (dpm) – The rate of emission by radioactive material as determined by correcting the counts per minute observed by a detector for background, efficiency, and counting geometry associated with the instrument.

Dose – A generic term for the amount of energy deposited in body tissue due to radiation exposure. Technical definitions for dose terms necessary for various exposure calculations and recordkeeping purposes include the following:

Dose Equivalent (HT) – The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and Sievert (Sv).

Effective Dose Equivalent (HE) – The sum of the products of the dose equivalent to the organ or tissue (HT) and the weighting factors (WT) applicable to each of the body organs or tissues that are irradiated (HE = SWT x HT) and the committed dose equivalent to an individual organ or tissue (for internal exposures).

Fixed Contamination – Radioactive material that cannot readily be removed from surfaces by nondestructive means such as causal contact, wiping, brushing, or washing.

Frisking – Process of monitoring personnel for contamination.

GRD – Greater Radiological Dimensions, Inc.

Hazardous Material – A substance or material that the DOT has determined is capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and is designated as hazardous under Section 5103 of Federal Hazardous Materials Transportation Law (49 U.S.C. 5103). The term includes temperature sensitive materials, materials designated as Hazardous in the Hazardous Materials Table (see 49 CFR 172.101), and materials that meet the defining criteria for hazard classes and divisions in part 173 of subchapter C of this chapter.
Hazardous Waste – A waste that exhibits one or more of the characteristics of hazardous waste in 40 CFR 26I , Subpart D.

Hazardous Work Permit (HWP) – Permit that identifies Hazardous conditions and health and safety hazards, establishes worker protection and monitoring requirements, and also contains specific approvals for radiological work activities. The HWP serves as an administrative process for planning and controlling radiological work where a Hazardous and informing the worker of the radiological, health, and safety issues.

Health Physics – The practice of radiological protection or radiation safety.

HASP – Health and Safety Plan. A plan included in investigation or cleanup work plans which outlines protective measures for site workers and the community during investigation or cleanup activities

High Radiation Area – An area, accessible to personnel, in which radiation levels could result in a person receiving a dose equivalent to or in excess of 100 mrem in 1 hour at 30 cm from the radiation source or from any surface that the radiation penetrates.

IRM – Interim Remedial Measures, An IRM is a discrete set of planned actions for both emergency and non-emergency situations that can be conducted without the extensive investigation and evaluation of a Remedial Investigation / Feasibility Study (RI / FS).

Internal Dose – The portion of the dose equivalent received from radioactive material taken into the body.

Low-Level Radioactive Waste – A radioactive waste that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, byproduct material [as defined in Section 1 le.(2) of the Atomic Energy Act of 1954, as amended], or naturally occurring radioactive material (including technically enhanced naturally occurring radioactive material (TENORM)). [Adapted from Nuclear Waste Policy Act of 1982, as amended]

Material – Refers to anything being moved, removed or transported. This includes, but is not limited to, chemical and / or radiological contaminated materials, discarded material, equipment, material to be recycled, supplies, samples, and / or waste.

Occupational Dose – The dose received by a person during employment in which the person's assigned duties involve exposure to radiation and to radioactive material. Occupational dose does not include dose received from background radiation, as a patient from medical practices, from voluntary participation in medical research plans, or as a member of the public.

Optically Stimulated Luminescence Dosimeter (OSL) – Radiation detection and measuring device used to record the radiological exposure of personnel or area to certain types of radiation.

Personnel Dosimetry – Devices designed to be worn by a single person for the assessment of dose equivalent such as film badges, optically stimulated luminescence dosimeters, thermoluminescent dosimeters, and pocket ionization chambers.

Personnel Monitoring – Systematic and periodic estimate of radiation dose received by personnel during work hours.

Qualified Shipper – Personnel or subcontractor qualified to identify and classify material, determine packaging requirements, complete shipping papers and perform pre-shipment reviews. The minimum qualifications for the qualified shipper is at least three (3) years of experience in hazardous materials shipping activities with advanced training in transportation covering air, highway, and rail shipment of hazardous materials, and including radioactive materials, hazardous waste and mixed waste.
QC – Quality Control. Quality control is a process by which entities review the quality of all factors involved in a project or production operation.

Radiation – Ionizing radiation that includes alpha particulate, beta particulate, X-rays, gamma rays, neutrons, and other particulates capable of producing ions.

Radiation Area – An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent or in excess of 5 mrem in 1 hour at 30 cm from the source of radiation or from any surface that the radiation penetrates.

Radioactive Material Area – A controlled area or structure where radioactive material is used, handled, or stored.

Radioactive Waste – Any garbage, refuse, sludge, and other discarded material, including solid, liquid, semisolid, or contained gaseous material, that must be managed for its radioactive content.

Radiological Controlled Areas (RCA)- Includes Radioactive Materials Areas, Radiation Areas, Contamination Areas, or Airborne Radioactivity Areas.

Radiological Work Permit (RWP) – Permit that identifies radiological conditions, establishes worker protection and monitoring requirements, and contains specific approvals for radiological work activities. The RWP serves as an administrative process for planning and controlling radiological work and informing the worker of the radiological, health and safety issues.

Radiological Worker – Worker whose job assignment requires work on, with, or in the proximity of radiation-producing machines or radioactive materials. A radiological worker has the potential of being exposed to more than 100 mrem per year, which is the sum of the dose equivalent from external irradiation and the committed effective dose equivalent from internal irradiation.

Record – A completed document or other media that provides objective evidence of an item, service, or process.

Recyclable Material – A material that can be used, reused, or reclaimed. A material is used or reused if it is either: I) employed as an ingredient (including use as an intermediate) in an industrial process to make a product: or 2) employed as a substitute for a commercial product. A material is reclaimed if it is processed to recover a useable product or if it is regenerated *Removable Contamination* – Radioactive material that can be removed from surfaces by nondestructive means, such as casual contact, wiping, brushing, or washing.
SOP - Standard Operating Procedure. A prescribed procedure to be followed routinely; usually containing work-specific instructions and / or rules.

Special Waste – A waste that is difficult or dangerous to manage and may include bulky or industrial waste.

Survey – An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of radioactive material or other source of radiation. When appropriate, such an evaluation includes a physical survey of the location of radioactive material and measurements or calculations of levels of radiation, or concentrations or quantities of radioactive material present.

Total Effective Dose Equivalent (TEDE) – The sum of the deep dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures).

Total Organ Dose Equivalent (TODE) – The sum of the deep dose equivalent (for external

Transportation-Related Work – Includes, but is not limited to, identifying, classifying, containerizing, marking, labeling, placarding, preparing shipping papers, offering for shipment, or transporting materials as a result of work performed pursuant to this project.

Unrestricted Area – An area designated by the Nuclear Regulatory Commission (NRC) or Agreement State as being an area to which access is neither limited nor controlled by an NRC or Agreement State licensee.

Waste Acceptance Criteria – The technical and administrative requirements that a waste must meet to be accepted at a storage, treatment or disposal facility.

References

NYS Radiation Material Handling License # C5514, issued to Greater Radiological Dimensions, Inc., March 21, 2012.
10 CPR 830- Nuclear Safety Management
10 CFR 835- Occupational Radiation Protection
ICAO/IATA- Dangerous Goods Regulations
ISO 9001- Quality Management Standard
FMCSR- Federal Motor Carrier Safety Regulations
NYCRR- New York Codes, Rules, Regulations
TDEC Rule 1200-1-7
Title 29 CFR 1910- Occupational Safety and Health Standards
Title 40 CFR 61, 262-263 and 700-789
Title 49 CFR, 100-185, 325 and 355-399

Project Personnel Contact Information

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Greater Radiological Dimensions, Inc. **1527 Ridge Road** **Lewiston, NY 14092**	**Document: GRD-TI-001**

LOCATION: 401 , 402 , 430 BUFFALO AVENUE Site

Niagara Falls, New York BCP Site No. C932164

RADIOLOGICAL SAFETY PLAN

Prepared By	**Stuart Pryce** **Project Manager / Sr. Technician**	
Approved By:	**George Weissenburger** **Program Manager / Sr. Technician**	

1. Scope

1.1. Purpose

This document establishes the basis for the radiological controls to be implemented during the performance of work at any client's facility. Operations are subject to the conditions of the applicable Radioactive Materials License and the requirements of applicable regulations. The requirements and guidelines in this document were developed to ensure workers are afforded a safe work environment, to provide a compliant Radiation Protection Program, and to maintain occupational and environmental exposure to ionizing radiation "As Low As Reasonably Achievable" (ALARA).

1.2. Applicability

This document applies to all GRD, Inc. employees, contractors, subcontractors, and visitors at any licensed facility or job site.

1.3. Policy

GRD, Inc. places its highest priority on ensuring the safety and health of its employees and neighbors and protecting the environment. This priority extends to all areas affected by site operations. GRD, Inc. is committed at all levels to implementing a Radiation Protection Program based on the highest standards.

1.4. Responsibilities

1.4.1 The Radiation Safety Officer (RSO) is responsible for ensuring compliance with this Plan, associated procedures, and GRD, Inc. Radioactive Materials License. He has the authority to direct all aspects of the Radiation Protection Program and to ensure compliance with required regulations. The RSO is organizationally independent from operations and has the authority and responsibility to stop any activity which is not conducted in a safe manner or in compliance with the license, applicable regulations, and procedures.

1.4.2 Radiological Safety Technicians (RST) are responsible for determining, by sampling and measurement, compliance with this document. An RST has the authority to stop work if he/she suspects the initiation or continuation of the activity will result in either imminent danger to a worker or a violation of program requirements.

1.4.3 All site personnel are responsible for compliance with the requirements of the Radiation Protection Program and implementation procedures. All personnel have the responsibility and authority to stop work through their supervisor if considered unsafe.

1.5. Quality Assurance

1.5.1 Periodic audits (at least annually) of the Radiation Protection Program will be made during the course of operations to ensure compliance with this document. Audit schedules for individual activities will be identified considering the ALARA, regulatory, and safety reviews in accordance with implementing procedures.

1.5.2 Key elements of Quality Assurance include:

- Conducting Pre-construction quality control meetings
- Performance of daily quality control checks;
- Daily inspection of site, materials, equipment and construction progress;
- Conduct process and materials audits and quality control tests;
- Tracking and documentation of performance versus standards;
- Development of corrective actions;
- Provision of continuing support;
- Maintain "as-built" drawings current with field changes

1.6. Implementation

The provisions of this document will be implemented through radiological safety procedures. These procedures are working documents and will be updated and modified as changes in facilities, equipment, regulations and conditions change.

2. Worker Training In Radiation Protection

2.1. Radiological Safety Training Requirements

2.1.1 Periodic radiological safety training is necessary to ensure that all individuals understand the general and specific radiological hazards, their responsibility to GRD, Inc. and the public for safe handling of radioactive materials, and to maintain their individual radiation exposure ALARA.

2.1.2 The appropriate degree of training for each individual will be established based on the nature of the job assignment (i.e. the location where the work will be performed, the hazards associated with that particular area, and the methods used to perform the work). Workers will be categorized as General Workers (those who do not frequent the Controlled Radiation Zone (CRZ) and typically do not work with radiation or radioactive materials), or Radiation Workers (those who do). General Workers will not have unescorted access to the CRZ. Visitors may be exempted from training requirements provided that he/she is escorted, has received a safety briefing, and has written authorization from the RSO or designee.

2.2. Basic Radiological Safety Training

2.2.1 Each worker who is categorized as a Radiation Worker will receive a minimum of 8 hours classroom training prior to initial assignment if they have no prior experience in equivalent radiological work. The purpose of the training is to teach proper methods for working with radiation and handling radioactive materials, to discuss the effects of radiation to explain the risks of occupational exposure, and to identify the specific hazards associated with the operations to be conducted.

2.2.2 The following topics will be covered:

- Radioactive materials and radiation;
- Biological effects of radiation;
- Risks of occupational exposure;
- Exposure limits;
- ALARA, minimizing exposure (time distance, and shielding);
- Personnel dosimetry;
- Protective clothing and equipment (PPE);
- Radiation detection - operation, calibration, and use;
- Contamination control;
- Decontamination;
- Responsibilities of radiation workers;
- Federal and State Regulations and License provisions for the protection of
- Personnel from radiation and radioactive material;
- Emergency response;
- Radiation exposure reports available to workers;
- Respiratory protection program;
- Radiation work permits (RWPs).

2.2.3 Workers with documented prior radiological work experience need receive only as much training as is necessary to ensure a level of competence comparable with trained workers. Reciprocity will be established with radiation worker qualification through other nuclear facility training programs. Qualifications of the trainer shall be a minimum of five (5) years operational radiation protection experience plus 40 hours of formal training in radiation protection. The training session is followed by a written test which must be passed (80% pass rate) before unescorted access is allowed to the RCA. Records of required training are maintained in each worker's file. The RSO may authorize individuals to challenge any training requirement and demonstrate the requisite level of knowledge in radiation safety by successfully completing a written exam and demonstration of practical factors. Hands-on training should be used for newly trained individuals without prior radiation work experience to ensure understanding and proficiency in radiation safety practices.

3. Radiation Surveys

3.1. General

3.1.1 Radiation surveys are performed as necessary to ensure personnel do not exceed radiation exposure limits and to meet requirements for posting Radiation, High Radiation, and Very High Radiation Areas. These surveys are performed to determine whether abnormal radiation levels exist and to determine the extent and magnitude of radiation levels. The surveys in this section shall be the minimum performed. .

3.1.2 Radiation surveys shall be performed whenever operations are performed that might be expected to change existing radiation levels. Examples of such operations include movement or removal of shielding, radioactive waste processing, and relocation of radioactive materials.

3.1.3 Temporary boundaries (e.g., rope boundaries) of radiation areas shall be surveyed weekly to ensure radiation areas do not extend beyond posted boundaries.

3.1.4 Gamma surveys shall be performed at least weekly in posted radiation, high radiation (if accessible), and radioactive material storage areas. Very high radiation areas shall be surveyed upon entry or when a change of conditions warrant.

3.1.5 When highly radioactive equipment (i.e., contact radiation level greater than 100 mrem/hr) is moved, gamma surveys should be performed in spaces surrounding work areas (including the spaces above and below them if applicable) where personnel are likely to be exposed to radiation.

3.1.6 Potentially contaminated ducts, piping, and hoses outside the RCA shall be surveyed at least monthly when in use or at least annually when not in use (e.g., deactivated systems) for gamma radiation.

3.1.7 Beta-gamma surveys of ventilation system filters shall be performed whenever maintenance work or filter change-out is performed.

3.1.8 Other surveys should be performed as necessary to control personnel exposure to gamma, beta, and alpha radiation. Such surveys should include: (1) a gamma survey during initial entry into a confined space containing potentially radioactive piping; (2) gamma surveys in spaces where significant radiation levels might exist from adjacent operating equipment; (3) alpha, beta/gamma measurements when personnel might come in contact with surfaces contaminated with alpha and beta-emitting radioactive material.

3.1.9 Surveys shall be conducted when performing operations which could result in personnel being exposed to small intense beams of radiation. These operations include maintenance which requires the removal of shielding, or opening shipping/storage containers of radioactive equipment. When surveying are as or equipment where intense small beams of radiation could be present, an instrument should be used with an audible response (e.g., earphones). The probe is moved at a speed which is determined by considering the size of the probe, the instrument response time, the possible intensity of the beam, and the general dose rates in the area. For equipment with complex shield designs, RSTs and workers should be briefed on the equipment design so that the areas most likely to have small beams can be given special attention.

3.1.10 Gamma radiation surveys shall be performed weekly on a revolving basis in the areas of the work site where radioactive materials are not stored or handled. The survey should consist of a scan of accessible areas, offices, lunchrooms, etc. Unrestricted areas adjacent to the restricted area boundary shall be surveyed on a weekly basis. The survey shall consist of measurements taken at 50 foot intervals around the entire perimeter.

3.2. Contamination Surveys for Material Release

3.2.1 Material that is removed from the RCA will be surveyed for surface contamination. Only material which meets the requirements of GRD, Inc.'s free release criteria will be allowed to exit the RCA without restriction. Material not meeting the free release criteria must be transferred directly to another RCA and/or packaged and labeled for storage or shipment prior to release from the RCA.

3.3. Normal Survey Plan

3.3.1 A free release survey shall be conducted by first surveying the item for removable contamination. The smears shall be counted using an appropriate portable survey instrument. To obtain better sensitivity for radionuclides with very restrictive release limits, a low background laboratory instrument may be used.

3.3.2 A fixed contamination survey is subsequently performed on the item using an appropriate portable survey instrument. The scan rate should not exceed 1 inch per second. The entire surface of the item to be released shall be surveyed. For greater sensitivity where required, a scaler equipped detector can be used along with a statistically valid survey plan approved by the RSO.

3.4. Special Survey Plan

3.4.1 For large amounts of homogeneous material with known history, and the material is either (a) not been exposed to contamination, (b) only suspected of being contaminated, or (c) decontaminated with a method that removes the entire surface area that was contaminated; a special survey plan may be used that surveys less than 100 percent of the surface area. This plan must be specific to the material surveyed and specify a detailed sample and survey plan. This survey plan must be approved by the RSO.

4. ALARA Program

4.1. Minimizing Radiation Exposure

4.1.1 GRD, Inc. shall maintain personnel radiation exposure ALARA. A continuing effort is required to meet this goal by developing and implementing improvements to work procedures and work performance.

4.1.2 All work shall be performed in the RCA under the direction of an approved procedure, approved work instruction, or RWP

4.1.3 Individual work procedures shall specify applicable actions (e.g. mockup training, use of temporary shielding, or removal of equipment from high radiation areas) to be used to minimize radiation exposure while working.

4.1.4 Supervisory personnel and radiological safety personnel shall ensure that personnel are not lingering unnecessarily in radiation areas.

4.1.5 Before entering the RCA, a worker shall receive specific job training and/or briefings necessary to enable him/her to perform his/her work with minimum radiation exposure. Examples include mockup training for specific jobs or periodic briefings by supervisory personnel for routine work.

4.1.6 Radiation levels shall be identified by the use of signs which clearly show the areas with the high and low radiation levels.

4.1.7 GRD, Inc. maintains records of the cumulative radiation exposure involved in performing work and establishes ALARA goals as necessary to improve methods to minimize personnel radiation exposure in future work.

4.2. Plans, Procedures and work instructions

4.2.1 Major work shall be performed under the guidance of a task specific plan, procedure, work instruction, or RWP. Determination of the need for specific approved plans, procedures, work instructions, or permits shall be made by the OM, the RSO, and the Quality Assurance Manager.

4.2.2 Plans, procedures or work instructions may describe the task, radiological conditions, or radiological controls, and shall be approved by the RSO or designee. A RWP will supplement the above with specific contamination or exposure control measures, monitoring requirements, and work instructions.

4.2.3 A pre-job ALARA briefing shall be held prior to beginning work performed under a plan, procedure, work instruction, or RWP to ensure all personnel understand the task, radiological conditions, and radiological controls.

4.3. <u>Radiological Work Permit (RWP)</u>

4.3.1 The RWP is an administrative mechanism to inform personnel of area radiological conditions, entry/exit requirements and specific work requirements that may apply to the task being performed. The RWP shall be used to maintain occupational radiation exposure ALARA, to minimize the spread of contamination, and to provide for augmented monitoring and surveillance where required. A description of the task to be performed and the radiological conditions associated with the work shall be recorded on the RWP. Also specified are the protective measures, dosimetry, and training required by personnel entering the designated area.

4.3.2 A standing RWP is used to govern activities in areas where hazards have been well characterized and radiological conditions are relatively stable. This includes routine activities such as tours and inspections, radiological surveys, and "light work" activities covered by procedures. Standing RWPs must be approved by the RSO or designee and the OM, and are reissued 011 an annual basis. Specific task RWPs are generally issued for the duration of the activity to be performed.

4.3.3 An RWP shall be obtained for all work activities that involve occupational radiation exposure or the potential spread of contamination. This includes activities not specifically covered by an approved plan, procedure or work instructions that are performed in any of the following conditions:

- Entry into a posted Radiation, High Radiation, or Very High Radiation Area;
- Entry into a posted Contamination or Airborne Radioactivity Area;
- Any work within the RCA or on contaminated or potentially contaminated equipment or surfaces;
- Maintenance work that would require the breaking of any process line, tank, vessel, or enclosure containing radioactive material that may become loose or airborne during the task

4.3.4 Signs indicating the need for the RWP shall be conspicuously posted at the entrances to areas were the RWP is required.

4.3.5 It is the responsibility of supervisors proposing to conduct work activities within required areas to initiate the issue of the RWP.

4.3.6 The RST shall complete the RWP after discussion of proposed work activities with the supervisor and performance of appropriate surveys.

4.3.7 Prior to beginning work, the RST shall conduct a pre-job ALARA. Briefing with all personnel working under the RWP. Items discussed shall include work scope, radiological conditions, dosimetry and protective clothing requirements, limiting conditions including stay times and hold points, and emergency actions. All personnel to perform work shall sign the RWP signature form to indicate an understanding of the requirements. Personnel added to the RWP after initiation of work shall be briefed by the RST prior to starting work and shall sign the RWP signature form.

4.3.8 During work under the conditions of a RWP, if radiological conditions change, or the scope of work is changed or expected to change, another RWP will be required and a pre-job ALARA briefing held.

4.3.9 The RST shall determine the type and degree of radiological monitoring required for a specific task. This determination should be based on the potential for radiation exposure or contamination spread and the experience of the personnel conducting the work.

4.3.10 An RWP shall be terminated by the initiator one year from the date of its initiation, or at the completion of the task, whichever comes first. If the work must be continued, a new RWP shall be initiated with the appropriate approvals, briefings, and documentation.

4.3.11 The RSO or designee shall ensure an indexed RWP log is maintained. The RWP log shall include: RWP #, date of issuance, date of termination and reason for RWP (work scope).

4.3.12 The RSO or designee shall ensure that all RWPs are terminated within the time allotted by paragraph 8.3.8 above, and shall ensure copies of all terminated R\VPs are maintained in the facility file throughout the duration of the activities.

5. **Access Control and Restricted Areas**

5.1. General Access

5.1.1 Restricted Areas are maintained for purposes of protecting members of the public against undue risk from exposure to radiation or radioactive materials. Radiation levels at the facility are controlled such that an individual at the Restricted Area boundary could not receive a dose in excess of2 mrem in any hour from external sources, or a cumulative exposure of 100 mrem in a year. Within the Restricted Area are the RCA and support areas. All visitors and vendors must enter the site through the administrative area where a visitor access log is maintained. Visitors are escorted in the RCA.

5.1.2 The RCA may include Radiation, High Radiation, Very High Radiation, Contamination, Airborne Radioactivity, and approved Radioactive Material Storage Areas as appropriate. Access control to the RCA shall be provided via the RW'P process and a formal access control point. The RCA boundary shall consist of engineered barriers and administrative controls which prevent access by unauthorized personnel, and ensure that authorized personnel have received appropriate training arid qualification. The access control requirements are applicable to all employees, contractors and visitors who may have need to enter this area.

5.2. Radiological Areas and Postings

5.2.1 Radiological areas are maintained at various locations inside the RCA, as required. Radiological areas include and will be posted as follows.

- Radiation Area is an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 5mrem in an hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. To mark such areas, signs shall be conspicuously posted; signs shall contain the conventional magenta three bladed symbol on yellow background and the words "CAUTION RADIATION AREA"; signs are permitted to state the general area radiation level. In addition, "DOSIMETRY REQUIRED" and "RWP REQUIRED" may be posted. No loitering is allowed in these areas.
- High Radiation Area is an area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 100 mrem in an hour at 30 centimeters from the radiation source or from any surface that the radiation penetrates. Such areas shall be posted and locked or guarded. The requirement to lock or guard a posted high radiation area does not apply to tanks or voids posted as high radiation areas if entry requires the removal of complex closures. Positive control shall be established for each individual entry into a high radiation area and shall be established in such a way that no individual is prevented from leaving the high radiation area. Prior to locking an unoccupied high radiation area, the area shall be inspected to ensure that no personnel remain inside. No loitering or entry by unauthorized personnel shall be allowed in these spaces. High radiation areas shall be conspicuously posted at entrances into the area. Signs shall contain the conventional magenta three-bladed symbol on yellow background and the words "CAUTION: HIGH RADIATION AREA". In addition, "CONTACT RADIATION SAFETY PRIOR TO ENTRY" shall be posted.
- Very High Radiation Area is an area, accessible to individuals, in which radiation levels could result in an individual receiving an absorbed dose in excess of 500 rads in 1 hour at 1 meter from a radiation source or from any surface that the radiation penetrates. Signs shall contain the conventional magenta three-bladed symbol on yellow background and the words: "GRAVE DANGER, VERY HIGH RADIATION AREA". In addition to the control requirements described above for a High Radiation Area, access and security controls for very high radiation areas shall be implemented to ensure an individual cannot gain unauthorized access.

  NOTE: PRIOR WRITTEN APPROVAL FROM THE RSO AND QA MANAGER IS REQUIRED FOR ENTRY INTO VERY HIGH RADIATION AREAS.
- Airborne Radioactivity Area is an area where airborne radioactive material exists in concentrations in excess of the derived air concentrations (DACs) specified in Table 1, column 3 of Appendix. B to 10 CFR 20 *(OAC 3701:1-38- 12, Appendix* C, *Table* 1), or to such a degree that an individual in the area without respiratory protection could exceed during a week, an intake of 0.6% of the ALI or 12 DAC-hours. Signs shall be posted at entrances to areas where airborne radioactivity levels exceed or have the potential to

exceed these levels. These signs shall contain the conventional three-bladed magenta symbol on yellow background and the words "CAUTION: AIRBORNE RADIOACTIVITY AREA." The requirements to wear respiratory equipment may also be included on the sign along with the anti-contamination clothing requirements.

- Contamination Area is an area having loose (removable) contamination on exposed surfaces greater than 1000 dpm/100 cm2 beta-gamma activity or 20 dpm/100 cm2 alpha radioactivity. Signs shall be posted at entrances to areas where surface contamination levels exceed or have the potential to exceed these levels. These signs shall contain the conventional three-bladed magenta symbol on yellow background and the words "CAUTION: CONTAMINATION AREA." The requirements to wear anti-contamination clothing or perform personal contamination surveys may also be included on the sign.
- Radiologically Controlled Area (RCA) is an area to which access can be controlled for radiation exposure or contamination control purposes. An RCA typically serves as a buffer around a contamination or radiation area and provides access control for personnel, equipment and material monitoring. Signs shall be posted at entrances to these areas which contain the conventional three-bladed magenta symbol on yellow background and the words "CAUTION: RADIOLOGICALLY CONTROLLED AREA."
- Radioactive Material Storage Area is an area where radioactive material is used or stored in amounts exceeding 10 times the quantity of such material specified in appendix C to 10 CFR 20 *(OAC 3701:1-38-18, Appendix A).* Entrances to areas where radioactive materials are handled or stored that meet this criteria shall be posted with signs having the conventional magenta three-bladed symbol on yellow background and the words "CAUTION: RADIOACTIVE MATERIAL." This posting is in addition to posting required for other radiological areas.

5.2.2 An Access Control Point is a location on the perimeter of a restricted area, or the RCA through which all entries and exits are made. Precautions are taken at the appropriate access control point to prevent the inadvertent exposure to radiation or the spread of contamination to adjacent uncontaminated areas. The dimensions and material requirements of an access control point depend on the type of work to be performed, the number of personnel involved, and the location of the work.

5.3. Temporary Shielding

5.3.1 Since incorrect installation, unauthorized movement, or removal of temporary shielding can result in large changes in work area radiation levels and subsequent radiation exposure, control of temporary shielding is essential.

5.3.2 Temporary shielding installation and removal should be controlled by written instructions. These instructions shall specify locations and amounts of temporary shielding.

5.3.3 After installation, temporary shielding shall be inspected and surveys conducted to ensure it is properly located.

6. Controlling Airborne Radioactivity

6.1. General

6.1.1 The primary reason for control of airborne radioactivity is to minimize internal radiation exposure resulting from inhalation of airborne radioactive materials. An intake of radioactive material is measured in units of DAC-hours (DAC multiplied by hours of exposure), which is directly proportional to CEDE.

6.1.2 Radioactivity in the form of particulates, gases, or both can become airborne through sources such as (1) radioactive system leaks, (2) grinding or welding a contaminated component, (3) decontamination operations, (4) disturbing surface contamination deposited on a work surface, (5) improper use of a containment enclosure, (6) inadequate vacuum cleaner and ventilation system control, (7) inadequate application of procedures for venting and draining radioactive systems or components, (8) damage or detects in instrumentation calibration or check sources, and (9) radon from radium sources or from trace amounts of natural radium impurities in construction materials.

6.1.3 Engineering controls shall be used, to the extent practical, to reduce the potential for the release of airborne radioactivity. These -include agents that fix loose contamination, HEPA-filtered ventilation, local exhaust ventilation, containments, decontamination, and wrapping, as required.

6.1.4 Airborne radioactivity monitoring provides a record of ambient airborne radioactivity in the work place, a tool to assess worker intakes, verify required posting, and evaluate the adequacy of engineered and administrative controls for maintaining exposure ALARA.

6.1.5 The RSO will prescribe the continuous or periodic sampling required to detect and evaluate the levels of airborne radioactivity in work areas and exhaust air systems in accordance with this section and Reference 2.1.7. Air sampling is required for activities where an individual is likely to receive in one year, an intake in excess of 10% of the applicable ALL Representative air samples are collected and intakes tracked and controlled such that personnel exposure complies with 10 CFR § 20.1502 *(OAC 3701:1-38-12)* requirements. Continuous air monitoring systems with local and remote alarm capability are provided where the potential for airborne radioactivity is higher during maintenance or off-normal conditions. Portable air samplers and/or personal breathing zone air samplers are used as necessary to monitor specific work activities.

6.1.6 It should be noted that this monitoring is primarily concerned with the control of particulate airborne activity. Certain unique situations with noble gases may be encountered, and will require special monitoring techniques.

6.1.7 Routine bioassays may be performed to supplement air monitoring data for workers where normal operating conditions would result in an intake of radioactive material in excess of 10% of the applicable ALI in 10 CFR 20 *(OAC 3701:1-38).* Routine bioassays include baseline measurements prior to exposure, termination measurements at termination of employment or change in work status, and periodic measurements (as determined 011 a site specific basis to meet 10 CFR § 20.1204 *(OAC 3701:1-38-12)* requirements). Special monitoring bioassays will be performed on a case-by-case basis in the event of unusual or unexpected monitoring results at the discretion of the RSO. Examples of situations that may require special monitoring include: the presence of unusually high levels of facial or nasal contamination, entry into airborne radioactivity areas without appropriate exposure controls, loss of system or container integrity, a CAM alarm, or incidents that result in contamination of wounds or other skin absorption.

6.1.8 Unplanned individual exposures with estimated intakes greater than 0.02 Annual Limit on Intake (ALI) will be investigated. Individual intakes greater than 0.1 ALI will be investigated using follow-up bioassay measurements and available work place monitoring data.

6.2. <u>Limits for Airborne Radioactivity</u>

6.2.1 The administrative limit for occupational exposure to airborne radioactivity is 8 DAC hours in anyone day. The DAC values are found in table 1 of appendix B to 10 CFR 20 *(OAC 3701:1-38-12, Appendix* C *Table* 1). Site specific administrative control levels for occupational exposure to airborne radioactivity are given in Section 6.1.3.

6.2.2 Engineering controls should be designed and operated in such a manner that personnel are not routinely exposed to airborne radioactivity levels that may require use of respiratory protection equipment

6.2.3 Investigation Levels. Any measurement which indicates the airborne radioactivity concentration to be in excess of 2% of the applicable DAC shall be investigated to determine the cause of the airborne radioactivity levels. Appropriate controls shall be implemented to maintain the airborne radioactivity levels ALARA.

6.3. <u>Requirements for Controlling Personnel Exposure to Airborne Radioactivity</u>

6.3.1 Personnel exposure to airborne radioactivity is controlled using fixatives, ventilation, containments or respiratory protection equipment for work in areas with high levels of surface contamination (e.g., >100,000 dpm/100 cm2 beta-gamma, >2000 dpm/100 cm2 alpha) because of the likelihood that this surface contamination could be resuspended. In some circumstances, respiratory equipment might be necessary in areas where surface contamination exists at lower levels due to the nature of the work.

6.3.2 Engineered controls shall be used to the maximum extent practicable to prevent personnel from being exposed to airborne radioactivity above the administrative control levels in Section 6.1.3. These controls are recommended during radiological work which has been known to cause or is expected to cause airborne radioactivity, and will be provided for in the RWP.

6.3.3 The need for personnel to wear respiratory protection equipment where airborne radioactivity is likely to exceed 25% of the DAC in table 1 of appendix B of 10 CFR 20 *(OAC 3701:1-38-12, Appendix* C *Table* 1) shall be evaluated and documented prior to area entry. Worker efficiency with respiratory protection equipment will be considered in areas with elevated external radiation in order to maintain the TEDE ALARA.

6.3.4 Personnel shall not be exposed to airborne radioactivity such that their daily intake exceeds 8 DAC-hours without prior approval of the RSO.

6.3.5 Signs shall be posted at entrances to airborne radioactivity areas. The requirements for respiratory protection equipment shall also be included on the sign with the anti-contamination clothing requirements where appropriate.

6.3.6 When personnel not wearing respiratory equipment may be exposed to airborne radioactivity above the limits of Section 10.2, ventilation and/or containment should be provided which will capture airborne particulate radioactivity U1 a controlled ventilation system with a high efficiency particulate au' (HEP A) filter. Other controls such as the use of loose fitting prefabricated drapes, ventilated shrouds, ventilated glove-bags, the use of fixatives, or misting may reduce ambient airborne radioactivity to a level that would preclude the use of respiratory protection.

- HEP A filters shall be installed in the ventilation exhaust from radioactive work areas in which work in progress could cause the discharge of airborne radioactivity to the environment.
- HEPA filters shall be installed in the exhaust from contamination containments to prevent personnel from being exposed to high airborne radioactivity.
- HEP A filters shall be installed in vacuum cleaners used for decontamination of loose surface contamination.

6.3.7 Positive pressure air purifying respirators, air supplied masks, hoods, or suits may be worn for work where airborne radioactivity is expected to be significant. Self contained breathing apparatus will be utilized for very significant airborne radioactivity concentrations.

6.4. <u>Elevated Airborne Radioactivity Response</u>

6.4.1 Elevated airborne radioactivity associated with operations can result from many causes. It can be indicated by a CAM alarm, retrospectively by a portable or personal air sample exceeding the applicable limit of Section 10.2, or by visual observation of a radioactive system leak or rupture. General methods for controlling personnel exposure to airborne radioactivity are contained in Section 10.3. An appropriate response to elevated airborne radioactivity is given below:

6.4.2 Immediate Action. Operations identified to be the cause of elevated airborne radioactivity shall be stopped until adequate control is established. Unessential personnel shall be evacuated from the affected area. Essential personnel shall don respiratory protection in accordance with Section 6.7. Unfiltered ventilation from the affected spaces shall be secured. Ventilation systems which contain high efficiency filters in exhaust ducts need not be secured. The extent of the airborne radioactivity should be determined by sampling the affected area and adjacent areas using p0l1abie air samplers. If the elevated airborne radioactivity is indicated by alarm of a CAM monitoring a ventilation exhaust or a work area, the instrument should be checked to ensure the alarm is not the result an electrical transient. Gamma radiation levels at the CAM should be measured to determine if the CAM alarm was caused by high radiation levels external to the CAM. Supplementary actions need not be taken if the alarm is determined to be a false alarm.

6.4.3 Supplementary Action. Supplementary actions are carried out to facilitate recovery operations and the return of the plant to normal status. Sampling and analysis shall be performed to identify the source of the airborne radioactivity. In order to minimize the need for respiratory protection equipment, and reduce personnel exposures to airborne radioactivity, consideration shall be given to ventilating the facility with additional HEPA filtered ventilation systems. Gamma surveys of ventilation filters and ducts as well as surface contamination in the vicinity should be performed to facilitate recovery. When resuming operations, portable air samples are used to confirm the cause of elevated airborne radioactivity has been corrected.

Evacuated personnel should be monitored for contamination and decontaminated as necessary. Personnel exposed to elevated airborne radioactivity shall be evaluated for intake in accordance with Section 6.1.

6.4.4 Reports - A report of any occurrence involving elevated airborne radioactivity (above the limits of Section 6.2) in areas occupied by personnel not wearing respiratory equipment shall be made in accordance with Section 17. This report shall include the results of monitoring personnel for internally deposited radioactive material as required.

6.5. Monitoring for Airborne Radioactivity

6.5.1 The method used for monitoring airborne radioactivity shall have a Minimum Detectable Activity (MDA) equal to or less than 10% of the applicable DAC. Refer to Reference 2.1.7 for MDA calculations.

6.5.2 Airborne particulate surveys shall be performed with portable air samplers whenever airborne radioactivity levels above the limits of Section 6.1 are suspected.

6.5.3 Personnel air samplers (lapel type) shall be used whenever portable sampling cannot be positioned in such a manner to be representative of the breathing zone of the worker. Examples would include large work areas with intervening structures, components, etc., or activities which require the worker to be mobile.

6.5.4 Records of airborne radioactivity measurements are required for regulatory purposes. The records shall be maintained legibly and retained in the on site file in accordance with Section 17.0. These records should include at least the following information:

- Date and time of sample and measurement
- Location
- Reason for sample
- Sampling equipment and counting Instrument used
- Results of most recent efficiency, MDA, and background measurements
- Airborne radioactivity in µCi/ml
- Signature of RST
- Signature of persons reviewing records.

6.6. Air Sample Analysis

6.6.1 When handling air samples collected from areas known or suspected of containing airborne radioactivity care should be taken to prevent the spread of contamination and cross contamination of samples taken. If significant short lived radionuc1ide concentrations are expected, the samples shall be counted initially and then decay counted to determine the actual long-lived radioactivity.

6.6.2 Counting Activities. Low background automatic alpha/beta counting systems are used for screening and gross activity analysis. Spectroscopy is used to identify a particular radionuclide in an air sample. All systems used for air sample analysis shall be set up and operated in accordance with manufacturer's instruction.

6.6.3 Calculation of Airborne Radioactivity Concentration. Airborne radioactivity concentration is typically recorded in units of mCi/ml, and reported as a percentage of the applicable DAC. In order to calculate concentration, it is necessary to accurately determine the volume of air sampled and the radioactivity deposited on/in the air sample filter media. Additionally, due to unique characteristics of the filter media such as collection efficiency, self-adsorption, and flow rate, correction factors may be necessary to accurately calculate concentration.

6.6.4 Determination of DAC-Hours. A DAC-hour is a mathematical expression of intake, derived by dividing the measured concentration of radioactive material in air by the respective DAC for the radionuclide in question, and then, multiplying by the number of hours of exposure to that radionuclide. One ALI can be expressed as 2000 DAC-hours, which is equivalent to a CEDE of 5 rem.

6.6.5 An individual's expected intake in DAC-hours should be estimated during the work planning process by considering measured air concentrations, the expected stay time in the work area, and the nature of the activity. In the interest of maintaining radiation exposure ALARA, stay times, the use of engineered or administrative controls including respiratory protection, and the methods used to conduct the work activity can be optimized in order to minimize overall dose. A record of intake in DAC-hours shall be recorded in order to demonstrate compliance with conditions of 10 CFR 20 (*OAC 3701:1-38*). Records shall be maintained in accordance with 10 CFR 20.2103 (*OAC 3701:1-38-20*) and section 17.0.

7. **Use of Respiratory Protection Equipment**

7.1. General

7.1.1 Table 1 of appendix B to 10 CFR 20 (*OAC 3701:1-38-12 Appendix C, Table 1*) lists the ALIs and DACs for occupational exposure to radioactive materials. GRD, Inc. is committed to design of processing facilities and control of work in such a manner as to maintain CEDE ALARA. However, when process or other engineering controls are not practical to control airborne radioactive materials below those contained in the definition of an airborne radioactivity area, intakes may be limited by use of respiratory protection equipment.

7.1.2 The RSO or designee is responsible to ensure that the qualification requirements are met and documented for personnel using respiratory protection equipment. A copy of this document shall be maintained by the RSO or designee in the on-site file.

7.1.3 The use, cleaning and inspection requirements for respiratory protection equipment shall be accordance with Reference 2.1.11.

7.1.4 No person shall wear a respiratory protection device for a period of more than four consecutive hours without a one ham break and for more than a total of six hours in any one day.

7.2. High Efficiency Particulate Air CHEPA) Filter Requirements

7.2.1 HEPA filtered systems shall be tested prior to use following each set up and after each filter change. Acceptance criteria is a transmission of 0.03% or less dioctylphthalate (DOP) (or use of equivalent testing methodology) particulate per applicable DOP test procedure.

7.2.2 Great care shall be used in installing HEPA filters to assure the filter material separators are in the vertical position, tight seals are made around the edges of the filters, and that filters are not damaged during installation. Minor damage will greatly reduce the efficiency of these filters.

7.2.3 Used filters shall be disposed of as radioactive waste since loose surface contamination could be present on interior pleats.

7.2.4 Instructions in manufacturers' manuals shall be followed for use and filter change-out.

7.3. Portable Ventilation System

7.3.1 A portable ventilation system can be constructed by adapting a portable blower with a HEPA filter. Such a system can be used during maintenance or an elevated airborne radioactivity condition to reduce airborne radioactivity without contaminating installed ventilation systems.

7.3.2 A vacuum cleaner with installed HEPA filter can also be used effectively to reduce airborne radioactivity in a space by re-circulating the air in the space through the high efficiency filter. Such a system must be tested prior to use as per Section 6.8.1.

7.4. Release of Airborne Radioactivity to the Environment

7.4.1 Releases of airborne radioactivity to the environment may require an Environmental Protection Agency (EPA) permit and/or a State Air Quality Control Permit. Required permitting and limits shall be evaluated prior to each project at a customer's facility. Such releases shall be evaluated for compliance with regulatory requirements (EPA, State, etc.) and the evaluation documented.

7.4.2 Airborne effluents should be controlled when possible through wet scrubbing and/or HEPA filtration of the exhaust. Monitoring is conducted by taking a representative sample at the exhaust stack during all periods of processing operation, and measuring for selected radionuclide. Processing of radioactive materials shall be stopped immediately if these systems are in-operative.

7.4.3 The site specific requirements for environmental monitoring may include air monitoring stations. The licensee requirements for the type and frequency will be followed. Analysis of these samples is performed to demonstrate compliance with Subpart D-Radiation Dose Limits for Individual Members of the Public of 10 CFR 20 dose limits (*OAC 3701:1-38-13*). Specific environmental monitoring guidelines are provided in Section 16.

8. **Surface Contamination Control**

8.1. General

8.1.1 It is the intention of GRD, Inc. to maintain generally accessible areas free of contamination. Office areas and other areas outside the RCA will be maintained to keep surface contamination levels as low as possible, but in no case greater than the unrestricted release criteria in Appendix B.

8.1.2 Surface contamination levels in the RCA will be maintained ALARA to facilitate optimum access for operations, use of personal protective equipment, and dose reduction in accordance with established plans, procedures and instructions. Should there be an increase in contamination outside the RCA, it will be investigated by the RSO or designee. Procedures to prevent recurrence will be implemented. Radioactive contamination of surfaces (such as floors, equipment, clothing and skin) may result from work operations, leaks of radioactive fluids, or gradual precipitation of airborne radioactive contamination onto exposed surfaces. The primary reason for limiting surface contamination is to minimize possible ingestion or inhalation of radioactive materials. In addition, surface contamination is limited to minimize transfer of radioactive materials to the environment beyond the control of GRD. In case of very high levels of surface contamination, control of external radiation exposure from this contamination may be necessary. Surface contamination is divided into two classes in this section: (1) loose contamination can be removed from surfaces with relative ease and may be readily dispersible, and (2) fixed contamination remains on affected surfaces and is not further reduced by normal non-destructive decontamination techniques. Areas where loose contamination levels exceed the applicable limits in Appendix B are posted and controlled as a Contamination area. The controls shall include conspicuous boundaries, restricted access, step-off pads, protective clothing requirements, and monitoring upon exit. A typical method for determining levels of loose contamination is to wipe the surface in question (usually a 100 sq. cm area) with a dry adsorbent material using moderate pressure, and then measuring the wipe for radioactivity. Levels of fixed contamination on a surface is determined by placing a radiation detector in direct contact with the surface, and either making a static measurement or scanning the surface by moving the detector slowly.

8.1.3 Contamination control procedures should be considered in planning and performance of all jobs. A dedicated set of "hot tools" should be used in the RCA to avoid the necessity to transfer the equipment across a contamination control boundary. When using clean tools or equipment in contaminated areas, the use of plastic sleeves or strippable paint to prevent contamination or facilitate decontamination is warranted. The extent of the contamination control procedures used should be commensurate with the amount of radioactive material being handled, and the nature of the task.

8.2. Surface Contamination in Uncontrolled Areas

8.2.1 Surface contamination levels for uncontrolled surfaces should be kept as low as possible. Areas where contamination exceeds established limits shall be either decontaminated in a timely manner, or painted or otherwise sealed to prevent the spread of contamination.

8.2.2 Acceptable surface contamination levels in uncontrolled areas are dependent upon (1) radionuclides being processed in the facility (2) applicable regulatory requirements, and (3) facility operating parameters.

8.2.3 Limits for loose and fixed contamination are usually dictated in the "NRC or Agreement State Radioactive Materials License, are based on the release limits found in Appendix B.

8.3. Surface Contamination in Radiologically Controlled Areas

8.3.1 The RCA is established, among other things, as a formal boundary to prevent the uncontrolled spread of radioactive materials. This boundary serves as the point at which certain precautions are taken, including training, protective clothing, and monitoring to prevent a worker from unknowingly contaminating his/her self, and transferring the contamination to the uncontrolled area. The RCA serves as a buffer between the more contaminated areas and those that are not contaminated. Significant levels of fixed contamination may exist in these areas; however, loose contamination levels are maintained to established limits.

8.3.2 Areas where surface contamination exceeds the established limits, areas "where equipment or materials are handled with exposed parts exceeding these levels, and areas where activities may cause contamination in

8.3.3 excess of the limits in Appendix B shall be designated as Contamination Areas (CA) until such areas, equipment, or materials have been adequately sealed or decontaminated to meet these limits. CAs may be established on a more permanent basis to facilitate operations. The CA boundary will serve as the initial and primary boundary to prevent the spread of contamination.

8.3.4 Access to a CA shall be limited by the conditions of a RWP to allow only personnel with appropriate anti-contamination clothing, monitoring equipment, and participation in the internal dosimetry program to enter. Choice of appropriate anti-contamination clothing is discussed in Section 12.1.

8.3.5 Personnel with open wounds shall not enter CA without prior approval of the RSO or designee. Open wounds shall be adequately protected from contamination prior to a person working in these conditions.

8.3.6 Entrances to CA shall be posted conspicuously with signs, stating the access restrictions, requirements for anti-contamination clothing and masks, levels of loose surface contamination and radiation dose rates. If the entrance to a CA and the step-off pad cannot be positioned at an existing barrier (door), magenta and yellow rope barriers or equivalent shall be used to mark the affected area clearly.

8.3.7 Smoking, eating, drinking and chewing shall not be permitted in CAs. Prescription medications may be taken under approved and controlled conditions. This provision is essential to minimize the possibility of transferring contamination from the hands or other areas to the mouth. For the same reason, hands should be kept away from the face, nose, mouth, and ears while in a CA.

8.3.8 Where operations such as grinding or machining are being performed without containment on contaminated components or equipment, the area of the operations shall be considered subject to the spread of loose contamination. The area shall be posted as a CA until such time as the work can be completed, the area surveyed, and down-posted.

8.3.9 Where surveys for loose contamination have not been made, but contamination is suspected, the area shall be posted as a CA pending the results of contamination surveys.

8.3.10 Levels and extent of loose surface contamination inside a CA shall be limited to control possible re-suspension of radioactive materials, to reduce airborne radioactivity, to reduce the potential for the spread of contamination, to simplify subsequent decontamination, and to minimize personnel radiation exposure.

8.3.11 Personnel leaving a CA shall (a) remove their outer anti-contamination clothing and (b) monitor or be monitored for surface contamination where background levels of radiation will permit.

8.4. <u>Methods for Controlling Surface Contamination</u>

8.4.1 The most effective means of controlling radioactive surface contamination is containment at the source through the use of ventilated enclosures around contaminated items to keep the radioactive material inside. Containments can be simple drapes, tents, or pans, or elaborate pre-fabricated glove-bags or large walk-in enclosures. Containments should be used as much as practical when working on the surfaces or components which have been exposed to radioactive materials. Plastic sheet, bags, or easily decontaminated containers may be used to enclose clean material and prevent contamination of clean items inside the enclosure. The following specific requirements shall be followed when working or handling contaminated equipment and materials.

8.4.2 Workers shall have been trained on the use of containments and instructions for using containment enclosures shall be readily available during work planning.

8.4.3 Containment enclosures shall be inspected prior to use to determine if they are properly constructed and ready for use. Enclosures shall then be marked to certify this inspection was completed. Personnel using containment enclosures shall inform radiological safety personnel of any damage to containment enclosures which occurs during work. When a containment enclosure is damaged or is unfit for use, the enclosure shall be conspicuously tagged to prevent its inadvertent use by personnel unaware of the problem until repaired. Containment enclosures shall not be removed or altered without approval of the RSO or designee.

8.4.4 Ventilation should be controlled during operations involving radioactivity to prevent spreading the radioactive contaminants through an area or to the environment. The basic methods of controlling contamination by ventilation are by providing clean supply air into the contaminated work area and by providing filtered local exhaust ventilation close to the work, or from a containment enclosure erected around it. The exhaust capability should always exceed the supply including discharges from pneumatic tools.

8.4.5 HEPA filters (and HEPA system pre-filters) may become contaminated so that handling a used filter may spread contamination. Therefore, great care should be exercised when removing used filters. Contaminated used filters are normally removed by the bag-out method into plastic bags.

8.4.6 A buildup of detectable levels of surface contamination can occur through the deposition of radioactive material from the air without having significant levels of airborne radioactivity. Therefore, all process ventilation exhaust ducts or ventilation system ducts from radioactive work areas should be considered potentially contaminated. When opening these potentially contaminated systems, they should be surveyed and decontaminated as practical for similar reasons, if a portable exhaust blower is used in a contaminated space, surface contamination should be checked on surfaces exposed to the filtered exhaust of this blower.

8.4.7 When HEPA filters are installed in ventilation systems for radiological areas, labels should be prominently affixed verifying proper installation of the filters. These labels should be located so that they are destroyed when the filters are removed. HEPA filtered ventilation systems shall be tested in accordance with Section 10.8.

8.4.8 Potentially contaminated air that has not passed through a high efficiency filter should not be discharged to locations occupied by personnel or where supply ventilation can return it to an occupied area.

8.4.9 Consideration should be given to controlling contamination which has been collected in ventilation equipment and systems not normally used for radiological work, i.e. HVAC systems, and in particular those systems in adjacent spaces which may have become contaminated during a spill Prior to work on these items, radiation measurements should be taken, the items treated as contaminated, and radiological control precautions established to prevent spreading contamination.

8.5. <u>Method for Measuring Surface Contamination</u>

8.5.1 A rate meter with a thin window probe (G-M) or equivalent will detect radioactive beta-gamma surface contamination on materials and personnel by slowly scanning the probe held within about *1/2* inch of the surface. Alpha-emitting contamination is normally monitored using a sensitive proportional or scintillation detector. An instrument and detector should be used that has a MDA for contamination measurements of < 90% of the applicable limit with a goal of <10% of the limit. If background levels are higher than will permit the above stated NIDA, equipment or personnel to be monitored for release shall be relocated to an area of lower radiation levels or the area or instrument detector shielded to lower background levels. A reading of 100 cpm above background indicates excess contamination.

8.6. <u>Method for Monitoring Personnel Contamination</u>

8.6.1 Personnel monitoring (frequently referred to as "frisking" when done with a handheld instrument) shall be performed when exiting CAs or RCAs. Monitoring of personnel for surface contamination is typically done with all automated portal type personnel contamination monitor established at a formal control point.

8.6.2 Monitoring of personnel by taking swipes for loose surface contamination on the skin or clothing shall not be done since swipes may tend to imbed radioactive particles. Special circumstances may require the use of adhesive tape to remove contaminated particles for measurement.

8.6.3 When personnel have been adequately trained in frisking procedures, self monitoring will be permitted; however, frisking may be performed by a RST.

8.6.4 If facial contamination is detected, or it is suspected that radioactive material have been taken into the body even though no facial contamination is evident, the RSO or designee shall be notified and the individual monitored for internal radioactivity. Measurements of the radioactivity of nose and throat swabs may be used. Decontamination shall be performed in accordance with Section 13.4.

8.7. <u>Frequency of Surveys for Monitoring Areas for Surface Contamination</u>

8.7.1 Minimum site specific contamination survey requirements are dictated by the NRC or Agreement State Radioactive Materials License, and detailed in Reference 2.1.14.

8.7.2 Routine contamination surveys shall be performed at a frequency commensurate with the risk of loss of surface contamination control for the area in question. In the interest of ALARA, contamination surveys in High or Very High Radiation Areas are done only upon entry, or when a change of conditions dictates.

8.7.3 Sealed source leak testing, if required, will be performed in accordance with Reference 2.1.3.

8.7.4 Operations such as the following also require surveys:

- Decontamination and release of equipment
- Inspection or maintenance on components and piping which are associated with radioactive or potentially radioactive systems
- Areas where radioactive liquid leaks have occurred or where airborne radioactivity has exceeded the concentrations of Section 10.2. Surveys are required to determine the need for anti-contamination clothing and to determine the extent of contaminated areas
- Upon initial entry into tanks or voids potentially contaminated radioactive materials and when opening ventilation exhaust ducting from radioactive material work areas
- In addition, any normally uncontaminated system which is suspected of containing radioactive materials shall be surveyed when opened for inspection, maintenance or repair. Contamination control procedures should be used until the portion of the system being worked on is proven to be uncontaminated. Water drained or flushed from these systems shall be treated as radioactive and sampled as appropriate;
- Contamination surveys should be performed in plenums downstream of HEP A filters during routine filter replacement, to determine radioactivity buildup in ducts downstream of filters;
- Prior to replacing filters on HVAC ducts serving a radiological work area, filters should be surveyed to determine if radioactivity is present;
- Surveys for contamination fixed in paint should be performed prior to removal of paint in potentially contaminated areas. These surveys should be performed by counting paint scrapings for gross activity;
- Surveys to support RWP development or work planning.

8.8. <u>Records of Contamination</u>

8.8.1 Records of surface contamination surveys shall be maintained in the on site files throughout the duration of the operations in accordance with Section 17.0

8.8.2 Any occurrence which results in loose surface contamination greater than the applicable site specific free release limits for uncontrolled areas shall be reported in accordance with Section 17.0.

8.8.3 Any spread of contamination in the RCA or CAs which results in work being stopped for more than four hours or takes more than four hours to clean up shall be reported in accordance with Section 17.0.

8.8.4 Records of surface contamination surveys shall be retained in the on site file throughout the duration of the operations file in accordance with Section 17.0.

9. Anti-Contamination Clothing and Equipment

9.1. <u>General</u>

9.1.1 Anti-contamination clothing (Anti-Cs) is used to help prevent personal skin and clothing contamination, and the spread of radioactive materials outside the RCA or CAs. Anti-contamination clothing is required when either surface contamination or airborne radioactivity levels exceed prescribed limits.

9.2. <u>Requirements for Wearing Anti-Contamination Clothing</u>

9.2.1 The RSO or designee in consultation with other safety disciplines shall determine the appropriate requirements for Anti-Cs and shall so note on the applicable RWP. The recommended type of Anti-Cs for various applications and radiological conditions are provided in Reference 2.1.10. In addition, miscellaneous equipment used for the control of exposure to radioactive materials is described.

9.3. <u>Donning and Doffing of Anti-Contamination Clothing</u>

9.3.1 It may be necessary to remove personal clothing before putting on Anti-Cs for comfort when working in high temperature spaces. Typically, a modesty garment is worn from the change facility to and from the donning/doffing point for the Anti-Cs.

9.3.2 Anti-Cs shall be inspected by the wearer prior to donning to ensure the garment is free of rips, tears, missing buttons, or malfunctioning zippers. Damaged clothing shall not be worn.

9.3.3 Used Anti-Cs shall be removed at the appropriate step-off pad in a manner that will preclude personal skin or clothing contamination and the spread of contamination across the boundary. Used Anti-Cs shall be deposited in the appropriate receptacle upon doffing.

10. **Radioactive Decontamination**

10.1. General

10.1.1 Decontamination may be required for components, tools and equipment, work areas, clothing or personnel. Each of these subjects as well as alternatives to decontamination is discussed in this section. These include, in some case, storage for decay, disposal without decontamination, or restricted use without complete decontamination. By the very nature of decontamination process, the generation of secondary waste materials must be considered. Volumes of both solid and liquid wastes shall be minimized. Unauthorized chemicals shall not be used. These may cause difficulties in waste processing. Most radioactive contamination can be removed by normal cleaning. Wiping with a damp rag soaked with an appropriate cleaning agent will usually provide satisfactory decontamination.

10.1.2 If large variations in surface contamination levels exist on highly contaminated surfaces, cleaning shall be from less contaminated toward more contaminated areas to prevent radioactivity from being spread to less contaminated areas. Cleaning solutions and cloths used in these decontamination operations shall be disposed of as radioactive waste. During decontamination operations, precautions shall be taken to limit the spread of contamination, such as by taking care not to splash solutions, by properly wearing anti-contamination clothing, and by wearing masks as necessary" Filtered ventilation may be required to minimize the possibility of contamination being inhaled by personnel performing the decontamination.

10.2. Decontamination of Tools and Equipment

10.2.1 In decontaminating tools and equipment, appropriate radiological control shall be used to prevent the spread of contamination, and to control airborne radioactivity, and radiation exposure. The following applies to the decontamination of tools and equipment.

10.2.2 Tools and equipment which may be used again in contaminated areas may be temporarily stored in the contaminated area or in a "hot tool locker" without decontamination if proper radiological controls and procedures are used. If certain tools are to be used solely in CAs, these tools should be durable and distinctively marked to indicate they are always treated as potentially contaminated.

10.2.3 In some cases, the need for decontaminating tools may be minimized by taping some portions, such as the handles, prior to use and stripping off the contaminated tape after use. Large tools are often wrapped in plastic instead of tape. These tools need to be swiped or frisked at completion of decontamination to verify the effectiveness of the treatment.

10.2.4 Heavily contaminated tools can spread surface contamination. Therefore: such tools should be partially decontaminated as may be necessary several times throughout a work shift. Heavily contaminated tools can be readily identified without taking swipes by measuring their radiation level The purpose of decontaminating these tools will usually be to reduce their radiation levels rather than to remove all loose surface contamination.

10.2.5 When only a few tools require decontamination, wiping with cloths soaked in an approved decontamination solution is a convenient, effective procedure. This method is also useful when only a portion of a tool is contaminated. A disadvantage of wiping procedures is the potentially large amount of solid radioactive waste produced.

10.2.6 Mechanical decontamination methods, such as using abrasives which remove some of the surface of the tool, can be useful in special circumstances where contamination is not removed by chemical cleaning. In such cases, control of possible airborne radioactivity is essential.

10.2.7 In decontaminating oily or greasy tools or equipment, consideration should be given to the fact that oil or grease may inhibit waste processing or disposal only decontamination solutions approved by the RSO or designee may be used.

10.3. Decontamination of Areas

10.3.1 Contaminated areas shall first be isolated and radioactive materials then removed while being careful to avoid spreading contamination. In some cases, tape may be used to lift loose contamination from surfaces. If contamination levels are not sufficiently reduced, use of solvents (non-hazardous to prevent mixed waste), strong chemicals, or mechanical removal of some of the surface may be necessary. The areas shall be surveyed by approved methods prior to release to ensure surface contamination is below the established limits. On painted or covered surfaces, if washing will not remove the contamination, the paint or covering shall be removed. During the process of paint removal, control of airborne and surface contamination from dust and paint chips will be necessary.

10.3.2 Contaminated areas should be decontaminated as soon as practical to minimize spread of contamination and to facilitate removal before the contamination is fixed on the surface. If high radiation levels from the contamination contribute significantly to personnel radiation exposure during cleanup, it may be desirable to decontaminate the most heavily contaminated area first.

10.4. <u>Decontamination of Clothing</u>

10.4.1 Anti-contamination clothing shall be laundered and surveyed before reuse to minimize the possibility of spreading radioactive contamination to the wearer. This requirement does not apply to disposable Anti-Cs.

10.5. <u>Decontamination of Personnel</u>

10.5.1 Decontamination of personnel shall be performed within an established RCA (unless otherwise approved by the RSO or designee).

10.5.2 The objectives of skin decontamination are to remove as much of the radioactive material as practicable in order to reduce the skin dose rate and to prevent the ingestion or inhalation of the material An over-aggressive skin decontamination effort must be avoided since it may injure the natural barriers in the skin and so increase absorption.

10.5.3 Reports of skin contamination shall be made in accordance with the requirements of Section 17.

11. **Radioactive Waste Handling**

11.1. <u>Packaging Radioactive Materials</u>

11.1.1 Radioactive materials shipped for disposal or to another location shall be appropriately packaged and treated as required by USDOT, applicable federal and state regulations, and applicable disposal site criteria. Shipping shall be performed by the RSO or designee, or a Shipper/Broker in accordance with applicable plans, procedures, and/or instructions. The specific radioactive material handling and packaging requirements will be identified in operations procedures.

11.2. <u>Radioactive Material Storage</u>

11.2.1 Storage of radioactive materials will be in accordance with all applicable license requirements and, at a minimum, all radioactive material storage areas will be posted. Access to these areas will be controlled to prevent unauthorized access, unauthorized removal of radioactive material, and to minimize radiation exposure.

11.3. <u>Fire Protection Practices</u>

11.3.1 Proper selection of a fire resistant storage area for radioactive material will minimize release of radioactivity to the environment in the event of a fire. However, the following additional fire protection practices shall be considered for storage of radioactive material to minimize the possibility of a fire and spread of contamination in the event of a fire.

- Storage of radioactive material in fire-resistant containers or spaces is desirable to minimize contamination spread. In addition, containers of highly flammable radioactive materials shall be stored in areas segregated from other storage to reduce the risk: of spreading a fire. These areas will be approved by the RSO or designee.
- Smoking shall not be permitted in radioactive material storage areas.
- An up-to-date inventory of locations where radioactive materials are stored shall be available to personnel who might be called to fight a fire in such areas. This list shall also identify unusual hazards which may be present.

- Periodic inspections of radioactive material storage areas shall be made to identify fire hazards. Deficiencies shall be promptly corrected.
- Combustible materials shall be minimized inside radioactive material storage areas and should not be stored next to surrounding walls.
- Welding, burning, or other operations which may cause a fire shall not be conducted inside or next to radioactive material storage areas without prior authorization of the RSO or designee.

11.4. Contamination Control

11.4.1 Storage locations should be considered potentially contaminated. Personnel in these areas, particularly if they handle contaminated material, shall wear Anti-Cs commensurate with the task. Reasonable care shall be taken in packaging and storing contaminated items to prevent the spread of contamination and to ensure that entry to areas where such storage is permitted does not result in the contamination of personnel or other areas.

11.5. Radiation Exposure Control

11.5.1 Storage of radioactive materials can result in possible personnel radiation exposure in the storage area and surrounding areas. Facilities should store radioactive material so as to minimize the radiation exposure of personnel entering or working in the area and of personnel in surrounding spaces. Radiation surveys of the storage area and of spaces immediately around the storage area shall be performed to ensure proper posting of radiation areas and prevent inadvertent exposure of personnel in the storage space or surrounding spaces. When necessary, temporary shielding should be used to reduce radiation levels.

11.6. Outdoor Storage

11.6.1 Radioactive materials shall be stored where they are protected from adverse weather. Radioactive material shall not be stored outside the Restricted Area. Outdoor storage is only permitted in a covered storage area with a permanent roof, or during short periods to accommodate loading or unloading as required. It is important that packaged materials be stored in a manner that permits periodic monitoring of the area and adjacent containers to ensure there is no release of radioactive materials.

11.7. Minimize Radioactive Material in Storage

11.7.1 In order to minimize the complexities of accounting for a large amount of radioactive material and the possibility of losing radioactive material, it shall be consolidated in as few areas as practical and the amount of radioactive material in storage shall be minimized.

11.8. Labeling of Radioactive Material

11.8.1 Each container of radioactive material shall bear a durable clearly visible label which identifies the radioactive contents (radionuclides present, quantity of radioactivity present, material description, date for which the activity was estimated, and radiation levels), and depicts the radiation symbol and the words "CAUTION, RADIOACTIVE MATERIAL". Exceptions include the following:

- The quantity of radioactive material is less than the amounts listed 111 Appendix C 10 CFR 20 *(OAC 3701:1-38-18, Appendix A)*
- The material is continuously attended by a trained radiation worker
- The material is in transport and is packaged and labeled in accordance with DOT regulations;
- The material is contained in installed process equipment such as piping, tanks, transfer equipment, and treatment units.
- Empty containers which are used or intended to be used for the packaging or handling of radioactive materials will be clearly marked "EMPTY", and any radioactive markings defaced or removed from any container released off-site for unrestricted use.

11.9. Shipping Radioactive Materials

11.9.1 All shipments or transfers of radioactive material over public areas (i.e., public highways, waterways, airways, etc.) including shipments made with private or government vehicles, must comply with appropriate USDOT, federal, state, and local transportation regulations.

11.9.2 Shipments of radioactive material shall be performed in accordance with established plans, procedures, and/or instructions. Records of radioactive material transfer shall be maintained in the permanent site files by the RSO or designee.

11.10. Contaminated Equipment Repair. Maintenance and/or Storage

11.10.1 Equipment which has been used in the nuclear industry may require repairs, maintenance, or storage. All work of this nature is performed per *RWPs* and plans, procedures and instructions as required.

11.11. Actions and Reporting in Case of Loss of Radioactive Material

11.11.1 If radioactive material associated with GRD operations is suspected of being lost, immediately notify the RSO and OM and conduct a search for the lost material. A primary purpose of this search is to ascertain that no persons will receive inadvertent internal or external radiation exposure from this material.

12. Radioactive Waste Management

12.1. General

12.1.1 Working with radioactive material can frequently lead to contamination of structures and equipment, protective equipment and clothing, and material used in decontamination. If any of the contaminated material cannot be used further, it becomes radioactive waste. Waste minimization consists of three primary objectives; (1) source reduction, (2) recycling, and (3) volume reduction. Waste minimization must be practiced on levels of the company, from top-level management down to the worker. Training programs, procedures, and work practices will be reviewed annually for waste minimization practices.

12.2. Source Reduction

12.2.1 Source reduction activities are those which reduce or eliminate the production of radioactive waste, or seek to reduce the volume or amount of clean material that comes in contact with radioactive material. Examples include:

- Taking care to 110tstore radioactive materials with non-radioactive materials
- Removal of packaging from clean material before taking the material into the
- RCA, or bringing the minimum amount of clean material into the RCA necessary to perform a task
- Taking care to not bring clean tools, equipment or material into the RCA unless a contaminated tool, equipment or material is not already available
- Taking care not to touch a contaminated surface or allow clothing, tools, or other equipment to do so;
- Confining radioactive material and contamination to as small an area as practical to minimize the decontamination effort later
- Avoiding the use of disposable liners, drip pads or plastic floor covers in the RCA. Do use smooth non-porous surfaces that can be easily decontaminated
- Minimizing loose surface contamination levels and airborne contamination levels to prevent inadvertent contamination of adjoining areas and equipment
- Choosing decontamination methods that generate the smallest total waste volume
- Preventing spills of contaminated materials.

12.3. Recycling

12.3.1 Recycling is using, reusing or reclaiming material that would become radioactive waste and aims to delay the point at which there is no further use for contaminated equipment or material Some strategies include:

- Returning contaminated waste generated at the site while processing a customer's material to the customer;
- Recycling contaminated laundry by using it in first stage decontamination of highly contaminated areas
- Using contaminated wood for cribbing inside burial boxes
- Choosing decontamination methods that recycle or regenerate the cleaning media
- Reusing contaminated equipment or areas with as little decontamination between jobs as practical, cross contamination and dose considerations taken into account

12.4. Volume Reduction

12.4.1 Volume reduction is reducing the waste volume to the minimum practical and is not strictly waste minimization, but is essential to conserve disposal site resources. Work practices will consider the following strategies;
- Packing material in burial containers to reduce void space to a minimum
- Cutting or segmenting of odd shapes to facilitate packing
- Using compaction for compressible material
- Evaporation of liquids as much as practical before disposal.

13. **Personnel Monitoring and Bioassay**

13.1. External Dosimetry Program

13.1.1 For purposes of monitoring exposure to radiation, personnel dosimetry shall be provided to an individual likely to exceed 10% of the limits in Section 6.1.1. The specific monitoring requirements for personnel radiation exposure for all GRD activities is determined and approved by the RSO. Reference 2.1.8 provides the procedure for the issue and processing of dosimetry, and the recording of personnel radiation exposure for all personnel working at the site.

13.1.2 All individuals shall wear appropriate personnel dosimetry for RCA entry Visitors or contract workers shall be issued personnel dosimetry (TLD or SRD) for Radiation Area entry and shall not be allowed access to High Radiation Areas or Airborne radioactivity Areas. Specific requirements for a particular work activity shall be communicated to personnel in the ALARA briefing conducted in accordance with Reference *2.1A.* The RSO may allow access by Visitors or Contractors to an RCA provided continually monitored by a Radiation Worker with appropriate monitoring and/or dosimetry.

13.2. Thermoluminescent Dosimetry (TLD) or Optically Stimulated Luminescent (OSL) Dosimetry

13.2.1 TLDs or OSLs shall be the dosimetry of record and shall be worn on the frontal area of the torso between the neck and the waist. TLD's will be processed and evaluated by a dosimetry processor who holds current accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) for the radiation(s) most closely approximating the type of radiation(s) to which individuals are exposed. Normal issue TLDs or OSLs will be worn to assess whole body deep and shallow dose. If dose to the extremities or the lens of the eye is anticipated to exceed 10% of the limits in Section 6.1.1, special TLDs or OSLs will be issued.

13.2.2 In situations where beta radiation is significant, the lens of the eye shall receive special consideration. Personnel shall be shielded from the beta radiation using masks or eye protection (safety glasses), and/or anti-contamination clothing. If the beta radiation cannot be shielded, methods for controlling beta radiation exposure shall be evaluated and implemented to maintain exposures ALARA.

13.2.3 Certain radioactive isotopes commonly given for medical diagnostic purposes can result in measurable radiation levels for some period after receiving the administration. The dose received from this administration is exempt from regulation. All individuals shall notify the RSO if they have received such treatment. In such a situation, the person may be restricted from wearing dosimetry until the medical isotope is eliminated from the body to the extent that it will not affect TLD or OSL measurements. The purpose of the restriction is to avoid including radiation exposure from the medical isotope to that received from occupational sources.

13.2.4 Such personnel shall also be restricted from entering areas requiring monitoring for contamination until the medical isotope is eliminated from the body to the extent that it will not affect personnel monitoring equipment. In such situations, the RSO and the OM shall determine an appropriate work assignment for the individual until the restriction can be released.

13.2.5 Lost or damaged dosimetry shall be reported to the RSO.

13.2.6 Personnel dosimetry records for an individual shall be made available to an authorized requestor and to the individual upon written request. This information will be readily available to enable an individual to keep track of their own exposure.

13.3. Self-Reading Dosimeters (SRDs)

13.3.1 In addition to the TLD, SRDs shall be worn to monitor radiation exposure in certain circumstances. SRD's shall be worn in accordance with the applicable RWP. The following circumstances shall require SRD:

- All personnel entering a Radiation or High Radiation shall be monitored by a SRD WOl11 at the same location on the body as the TLD. The above does not preclude the use of SRDs for other exposure monitoring.
- Additional SRDs may be required if the location of the maximum dose on the body is not certain.
- Typically, devices used as SRDs include pocket ionization chambers or electronic dosimeters.

13.3.2 SRD Records. The RSO or designee shall maintain a log of all SRD results between routine TLD read-out cycles. Before an SRD is re-zeroed, the measured radiation exposure is recorded. The individual's monthly, quarterly and/or yearly exposure totals are determined. The individual is thereby prevented from inadvertently exceeding the administrative control levels

13.3.3 Reading SRDs. SRDs shall be read by the wearer prior to entering High Radiation or Very High Radiation Areas and periodically thereafter to maintain their own radiation exposure ALARA. To prevent an off-scale reading, dosimeters shall be read, re-zeroed, and doses recorded whenever the reading exceeds three-fourths of full scale. When a pocket dosimeter reading is off-scale or a dosimeter is lost under conditions such that an elevated exposure is possible, the person's TLD shall be processed immediately and the person restricted from work in radiological areas until their exposure bas been determined. The RSO or designee shall notify the OM for appropriate work assignment for the individual during the restriction.

13.3.4 SRD Testing Requirements. SRDs in use shall be tested at least every six months to ensure accuracy. If dosimetry performance is suspected to be unacceptable due to excessive drift or fails in use, the RSO shall initiate action to correct the problem.

13.4. <u>Internal Dosimetry Program</u>

13.4.1 The site internal dosimetry requirements for specific activities will be determined and approved by the RSO. Reference 2.1.9 provides the procedure for the internal radiation monitoring of individuals, submittal of bioassay samples, and the types and applications of various measurements. Specific requirements for a particular work activity shall be communicated to personnel during the ALARA briefing.

13.4.2 Internal radiation monitoring shall be performed when an individual is likely to receive an intake of radioactive material in excess of 10% of the Annual Limits on Intake (ALIs) as defined in 10 CFR § 20.1003 *(OAC 3701:1-38-12).* All personnel with the intake potential as defined above shall participate in the internal radiation monitoring program. Monitoring shall consist of baseline, routine, diagnostic, and termination bioassay sampling and/or in-vivo counts as determined to be appropriate by the RSO. Additionally, suspected intakes of radioactive materials as may be indicated by a positive routine bioassay, significant personnel contamination, elevated airborne radioactivity, or an ingestion of radioactive material shall be investigated by internal monitoring. Waivers of internal monitoring requirements may be granted by the RSO for contractors and visitors, provided the basis for the waiver is documented. Access restrictions for contractors and visitors are given in Section 6.1.7 above. Minors and declared pregnant women who are likely to receive in one year a CEDE in excess of 10% of the applicable limits in 10 CFR 20 *(OAC 3701:1-38)* shall participate in an internal monitoring program.

13.4.3 The following techniques for internal radiation monitoring shall be employed by the RSO or designee depending upon the workplace contaminant and conditions, and the nature of the activity:

- Air Sampling - Concentrations of radioactive materials in air in work areas may be used in lieu of bioassay measurements to determine internal exposure if the bioassay data is unavailable, inadequate, or the air sampling data is demonstrated to be more accurate.
- Bioassay - An estimate of the amount of internal exposure can be calculated by measuring the quantity of radionuclides in bodily excreta (collections of urine, feces, etc.) and relating the excretion rate to body burden by the use of biokinetic models.
- In-vivo counting - An estimate of the amount of internal contamination by gamma emitting radionuclides is obtained by measuring the gamma radiation emitted from the body and analyzing the pulse height spectrum. This technique can also be used to measure the bremsstrahlung from energetic beta emitters.

13.4.4 Each occupational intake of radioactive material that is confirmed by a positive bioassay shall be investigated and an estimate of the initial intake calculated using standard retention models.

13.4.5 For a confirmed intake, the CEDE will be determined and entered in the individual's exposure record. An intake resulting in a CEDE of greater than 0.1 rem will require an investigation to determine cause and identify corrective actions. .A. CEDE of greater than 0.5 rem will result in a restriction from radiological areas pending completion of the investigation and an exposure evaluation.

13.4.6 Procedures for the collection of in-vitro bioassay samples are found in Reference 2.1.9. The services of an accredited laboratory will be used to perform the analysis of samples. In-vivo counting shall be performed by an approved vendor.

13.4.7 All reports of internal radiation monitoring shall be maintained on site in a readily retrievable file in accordance with Section 17.0. Copies of these reports shall be made available to the monitored individual upon written request, as required by Section 17.0.

13.4.8 Exposure Records. The RSO or designee shall maintain records of personnel exposure and shall forward those records and data as required by 10 CFR 20 (OA C 3701: 1-38).Occupational exposure records are recorded on NRC Form 5 or equivalent. GRD will demonstrate compliance with the requirements of 10 CFR 20 (OAC 3701:1-38) by summing external and internal doses. Any recorded eye dose, skin dose, or planned special exposure dose will be maintained separately. Dose evaluation reports are prepared, maintained, and submitted per 10 CFR 20 (OAC 3701:1-38) and provided to workers per 10 CFR 19.13 (OAC 3701:1-38-10).

NEW YORK STATE DEPARTMENT OF HEALTH

RADIOACTIVE MATERIALS LICENSE

Pursuant to the Public Health Law, Part 16 of the New York State Sanitary Code, Industrial Code Rule 38, and in reliance on statements and representations heretofore made by the licensee designated below, a license is hereby issued authorizing radioactive material(s) for the purpose(s), and at the place(s) designated below. The license is subject to all applicable rules, regulations, and orders now or hereafter in effect of all appropriate regulatory agencies and to any conditions specified below.

1. NAME OF LICENSEE FEIN 45-0917795 Greater Radiological Dimensions, Inc. Phone (937) 260-3533	3. LICENSE NUMBER C5514 4. EXPIRATION DATE March 21, 2022
2. ADDRESS OF LICENSEE 1527 Ridge Road Lewiston, New York 14092	5a. REFERENCE b. AMENDMENT NO. **DH 11-1048** -

6. Radioactive Materials (elements in mass number)	7. Chemical and/or physical form	8. Maximum quantity licensee may possess at any one time
A. Any	A. Any, as potentially or known contaminated materials	A. Any, as present at client site(s)

9. Authorized use.

Condition 6.A.:

For use incident to providing radiation protection and general health physics support to clients, as authorized under this license and approved by the Department, and in accordance with the documents referenced in Condition 11 of this license.

10. A. The Radiation Safety Officer (RSO) for this License is George Weissenburger.

B. Licensed material shall be used by, or under the supervision of, George Weissenburger, by persons with the training and experience described in Condition 16 of the License.

APPENDIX E

PROJECT DOCUMENTATION FORMS

TurnKey Environmental Restoration, LLC

INSPECTOR'S DAILY REPORT

CONTRACTOR					
CLIENT		DATE:			

LOCATION			DAY		JOB NO.	
WEATHER		TEMP	° F	START		END	

WORK PERFORMED:

CONTRACTOR ACTIVITIES:

[PUT CONTRACTOR ACTIVITIES HERE, BE SPECIFIC. TYPE OF EQUIPMENT, ACTIVITIES PERFORMED, BY WHOM, LOCATION OF LANDFILL ETC.]

TURNKEY ACTIVITIES:

[PUT ENGINEER ACTIVITIES HERE, BE SPECIFIC. TYPE OF EQUIPMENT, ACTIVITIES AND TESTING PERFORMED, SAMPLES COLLECTED, BY WHOM, LOCATION OF LANDFILL ETC.]

TEST PERFORMED		*QA PERSONNEL* SIGNATURE			
PICTURES TAKEN	none	REPORT NO.			
VISITORS	none	SHEET	1	OF	

TurnKey Environmental Restoration, LLC

INSPECTOR'S DAILY REPORT

CONTRACTOR					
CLIENT				DATE:	

LOCATION				DAY		JOB NO.	
WEATHER		TEMP	° F	START		END	

TurnKey
Environmental
Restoration, LLC

INSPECTOR'S DAILY REPORT

MEETINGS HELD & RESULTS:

CONTRACTOR'S WORK FORCE AND EQUIPMENT

DESCRIPTION	*H*	*#*	*DESCRIPTION*	*H*	*#*	*DESCRIPTION*	*H*	*#*	*DESCRIPTION*	*H*	*#*
Field Engineer						Equipment			Front Loader Ton		
Superintendent			Ironworker			Generators			Bulldozer		
						Welding Equip.			DJ Dump truck		
Laborer-Foreman			Carpenter						Water Truck		
Laborer									Backhoe		
Operating Engineer			Concrete Finisher						Excavator		
						Roller			Pad foot roller		
Carpenter						Paving Equipment					
						Air Compressor					

REMARKS:

REFERENCES TO OTHER FORMS:

SAMPLES COLLECTED:					
SAMPLE NUMBER					
APPROX. LOCATION OF STOCKPILE					
NO. OF STOCKPILE					
DATE OF COLLECTION					
CLIMATOLOGIC CONDITIONS					
FIELD OBSERVATION		SHEET		OF	

DAILY LOG				
	DATE			
	REPORT NO.			
	PAGE	OF		

PROBLEM IDENTIFICATION REPORT

Date:

Project:

Job No:

Location:

CQA Monitor(s):

Client:

Contractor:

Contractor's Supervisor:

WEATHER CONDITIONS:

Ambient Air Temp. - A.M.:

Ambient Air Temp. - P.M.:

Wind Direction:

Wind Speed:

Precipitation:

Problem Description:

Problem Location (reference test location, sketch on back of form as appropriate):

Problem Causes:

Suggested Corrective Measures or Variances:

Linked to Corrective Measures Report No. or Variance Log No.

Approvals (initial):

CQA Engineer:

Project Manager:

Signed:

CQA Representative

DAILY LOG	DATE			
	REPORT NO.			
	PAGE	OF		

CORRECTIVE MEASURES REPORT

Date:

Project:

Job No:

Location:

CQA Monitor(s):

Client:

Contractor:

Contractor's Supervisor:

WEATHER CONDITIONS:

Ambient Air Temp. - A.M.:

Ambient Air Temp. - P.M.:

Wind Direction:

Wind Speed:

Precipitation:

Corrective Measures Undertaken (reference Problem Identification Report No.)

Retesing Location:

Suggested Method of Minimizing Re-Occurrence:

Approvals (initial):

CQA Engineer:

Project Manager:

Signed:

CQA Representative

APPENDIX F

FIELD OPERATING PROCEDURES

(PROVIDED ELECTRONICALLY)

APPENDIX E

SUMMARY OF FIELD OPERATING PROCEDURES

REMEDIAL INVESTIGATION WORK PLAN

401, 402 AND 430 BUFFALO AVENUE SITE

NIAGARA FALLS, NEW YORK

TurnKey FOP No.	Procedure
001.0	Abandonment of Boreholes Procedure
002.0	Abandonment of Monitoring Wells Procedure
004.3	Ambient Air/Subslab Vapor Sample Collection Procedure
007.0	Calibration and Maintenance of Portable Dissolved Oxygen Meter
008.0	Calibration and Maintenance of Portable Field pH/Eh Meter
009.0	Calibration and Maintenance of Portable Field Turbidity Meter
011.0	Calibration and Maintenance of Portable Photoionization Detector
012.0	Calibration and Maintenance of Portable Specific Conductance Meter
015.0	Documentation Requirements for Drilling and Well Installation
017.0	Drill Site Selection Procedure
018.0	Drilling and Excavation Equipment Decontamination Procedures
021.0	Establishing Horizontal and Vertical Control
022.0	Groundwater Level Measurement
023.1	Gorundwater Purging procedures Prior to Sample Collection
024.1	Groundwater Sample Collection Procedures
026.1	Hollow Stem Auger (HSA) Drilling Procedures
031.2	Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedure
032.1	Management of Investigation-Derived Waste (IDW)
033.0	Monitoring Well Construction for Hollow Stem Auger Boreholes
036.0	Monitoring Well Development Procedures
039.1	NAPL Detection and Sample Collection Procedure
046.0	Sample Labeling, Storage and Shipment Procedures
047.0	Screening of Soil Samples for Organic Vapors During Drilling Activities
054.2	Soil Description Procedures Using The Visual-Manual Method
057.0	Soil Sample Collection for VOC Analysis - EnCore Sampling
063.2	Surface and Subsurface Soil Sampling Procedures
073.1	Real-Time Air Monitoring During Intrusive Activities
076.0	"Before Going Into the Field" Procedure
078.0	Geoprobe Drilling Procedure
084.0	Calibration and Maintenance of Portable Particulate Meter
085.0	Field Quality Control Procedures

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FIELD OPERATING PROCEDURES

Abandonment of Borehole Procedures

FOP 001.1

ABANDONMENT OF BOREHOLE PROCEDURE

PURPOSE

Soil borings that are not completed as monitoring wells will be plugged by filling the holes with a cement/bentonite grout. Field staff will calculate the borehole volume and compare it to the final installed volume of grout to evaluate whether bridging or loss to the formation has occurred. These calculations and the actual volume placed will be noted on the Boring Log.

PROCEDURE

1. Determine most suitable seal materials. Grout specifications generally have mixture ratios as follows:

   Grout Slurry Composition (% Weight)

   1.5 to 3.0% - Bentonite (Quick Gel)
   40 to 60 % - Cement (Portland Type I)
   40 to 60 % - Potable Water

2. Calculate the volume of the borehole base on the bit or auger head diameter plus 10% and determine the volume of grout to be emplaced. Generally, the total mixed volume is the borehole volume plus 20%.

3. Identify the equipment to be used for the preparation and mixing of the grout. Ensure the volume of the tanks to be used for mixing has been measured adequately. Document these volumes on the Well Abandonment/Decommissioning Log (sample attached).

4. Identify the source of the water to be used for the grout and determine its suitability for use. In particular, water with high sulfate, or chloride levels or heated water should not be used. These types of waters can cause operational difficulties or modify the set-up for the grout.

5. Identify the equipment to be used for emplacing the grout. Ensure that the pump to be used has adequate pressure to enable complete return to surface.

6. Identify the volumes to be pumped at each stage or in total if only one stage is to be used.

7. Prepare the borehole abandonment plan and discuss the plan and activities with the drilling contractor prior to beginning any mixing activities.

8. Begin mixing the grout to be emplaced.

9. Record the type and amount of materials used during the mixing operation. Ensure the ratios are within specifications tolerance.

10. Begin pumping the grout through the return line bypass system to confirm all pump and surface fittings are secure.

11. Initiate downhole pumping from the bottom of the borehole. Record the times and volumes emplaced on the Well Abandonment/Decommissioning Log (sample attached).

12. Document the return circulation of grout. This may be facilitated by using a colored dye or other tagging method if a mudded borehole condition exists prior to grout injection.

13. Identify what procedures will be used for grouting in the upper 3 feet. When casing exists in the borehole, decisions are required as to the timing for removal and final disposition of the casing. Generally, it will not be removed prior to grouting because of the potential for difficult access and loss of circulation in the upper soil or rock layers. Accordingly, when cement return is achieved at surface, the casing is commonly removed and the borehole is topped off with grout or soils. If casing removal is not possible or not desired, the casing left in place should be cut off at a depth of 5 feet or greater below ground surface. If casing is not present during grouting, the grout level in the borehole is topped off after the rods or tremie pipe is removed.

14. Clear and clean the surface near the borehole.

15. The uppermost five feet of the borehole at the land surface should be filled with material physically similar to the natural soils. The surface of the borehole should be restored to the condition of the area surrounding the borehole. For example, concrete or asphalt will be patched with concrete or asphalt of the same type and thickness, grassed areas will be seeded, and topsoil will be used in other areas. All solid waste materials generated during the decommissioning process must be disposed of properly.

16. A follow-up check at each site should be made within one week to 10 days of completion. It should be noted that on occasion, the grout and/or surface material may settle over several days. If settling occurs, additional material physically similar to surrounding materials (i.e., asphalt, concrete, or soil) must be used to match the existing grade.

17. Document borehole and/or well/piezometer decommissioning activities on a Well Abandonment/Decommissioning Log (sample attached).

ATTACHMENTS

Well Abandonment/Decommissioning Log (sample)

REFERENCES

ASTM D 5299: *Guide for Decommissioning of Ground Water Wells, Vadose Zone Monitoring Devices, Boreholes, and Other Devices for Environmental Activities.*

NYSDEC, July 1988, *Drilling and Monitoring Well Installation Guidance Manual.*

NYSDEC, November 2009, *CP-43: Groundwater Monitoring Well Decommissioning Policy.*

Driscoll, F.G., 1987, *Groundwater and Wells*, Johnson Division, St. Paul, Minnesota, 1089 p.

WELL ABANDONMENT/ DECOMMISSIONING LOG

PROJECT INFORMATION	WELL INFORMATION
Project Name:	WELL I.D.:
Client:	Stick-up (fags):
Project Job Number:	Total Depth (fbgs):
Date:	Screen Interval (fbgs):
Weather:	Well Material:
	Diameter (inches):
BM/TK Personnel:	
Drilling Company:	Drilling Company Personnel:
Drill Rig Type:	

DECOMMISSIONING PROCEDURES

Time	Description of Field Activities

PREPARED BY: DATE:

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FIELD OPERATING PROCEDURES

Abandonment of Monitoring Wells Procedure

FOP 002.0

ABANDONMENT OF MONITORING WELLS PROCEDURE

PURPOSE

This guideline presents a method for the abandonment and decommissioning of wells that are no longer reliable as competent monitors of formation groundwater. Well abandonment and decommissioning is required in order to remove a potential pathway for the vertical migration of impacted groundwater and/or surface water.

PROCEDURE

1. Examine the existing well to be abandoned/decommissioned and review well construction detail information (if applicable) to determine well depth,, screened interval, diameter, material of composition and other construction details. Establish appropriate equipment requirements for removal of the well.

2. Determine the most suitable seal materials as discussed in the next section.

3. Attempt to remove the well using a drilling rig, by using the following procedures:
   - Attaching the winch line to the well to see if it can be removed by pulling;
   - Using the rig's hydraulics to advance casing incrementally;
   - If a cable tool rig is available, bump back the casing using the cathead and drive block.

3. Upon removal of the well, ream the borehole by advancing the augers approximately one foot beyond the total depth of the well. Rotate the augers at a speed sufficient to remove the construction materials (i.e., filter pack, bentonite seal, etc.) from the borehole annulus (if possible). Backfill the resulting borehole with cement/bentonite grout, by tremie method, to approximately one foot below ground surface. Fill the remaining borehole to match the existing grade elevation and material of construction (i.e., clean native soil, concrete or asphalt, as necessary). Go to Step 10.

4. If the well cannot be removed from the borehole over-drill the borehole and well to approximately two (2) feet below the well depth. Upon reaching the desired depth, remove the well from within the augers and go back to Step 3.

5. If the borehole cannot be reamed out using conventional drilling techniques (i.e., over-drilled), remove or puncture the base plate of the well screen using the drill rig and associated equipment by pounding with the drill rods. Upon filling the well with grout by tremie method, slowly pull the well from the ground surface to allow the grout to evacuate through the bottom of the well to fill the void space created by removal of the well casing. Continue adding grout mix to the well casing, as necessary, to fill the void space to approximately one foot below ground surface. Fill the remaining borehole to match the existing grade elevation and material of construction (i.e., clean native soil, concrete or asphalt, as necessary). Go to Step 10.

   If the driller is unsuccessful at removing or puncturing the base plate of the well due, in part, to well construction materials (i.e., stainless steel or black iron), go to Step 6.

6. Insert a tremie pipe down the well to the bottom and pump a cement/bentonite grout mixture to a depth one to two feet above the top of the screen.

7. Perform a hydraulic pressure test on the portion of the well casing above the grouted screen section. Allow the grout to set up for a period not less than 72 hours before pressure testing of the grouted interval. Place a pneumatic packer a maximum of 4.5 feet above the top of the slotted screen section of the well. The infiltration pressure applied to the packer shall not exceed the pressure rating of the well casing material. If the interval between the top of the grout and the bottom of the packer is not saturated, potable water will be used to fill the interval. A gauge pressure of 5 psig at the well head shall be applied to the interval for a period of 5 minutes to allow for temperature stabilization. After 5 minutes, the pressure will be maintained at 5 psig for 30 minutes. The grout seal shall be considered acceptable if the total loss of water to the seal does not exceed 0.5 gallons over a 30-minute period.

8. If the grout seal is determined to be unacceptable, tremie grout an additional 5 feet of well riser above the failing interval and retest as specified above (see Step 7).

9. If the grout seal is determined to be acceptable, tremie grout the remainder of the well until grout displaces all formation water and a grout return is visible in the well at the surface. Cut off well casing at a depth of five feet or greater below ground surface and backfill the remaining borehole to match the existing grade elevation and material of construction (i.e., clean native soil, concrete or asphalt, as necessary).

10. Record all well construction details and abandonment procedures on the **Well Abandonment/Decommissioning Log** (sample attached).

CEMENT/BENTONITE GROUT MIXTURE

The cement/bentonite grout mixture identified below is generally considered the most suitable seal material for monitoring well advancement and abandonment. Grout specifications generally have mixture ratios as follows:

Grout Slurry Composition (% Weight)

1.5 to 3.0% - Bentonite (Quick Gel)
40 to 60% - Cement (Portland Type I)
40 to 60% - Potable Water

MISCELLANEOUS

All removed well materials (PVC, stainless steel, steel pipe) should be decontaminated (if necessary) as per the project specific **Drilling and Excavation Equipment Decontamination FOP** and removed from the site. The project manager will determine the destination of final disposal for all well materials. All drill cuttings (depending on site protocol) should be placed in DOT-approved 55-gallon drums, labeled and sampled in accordance with TurnKey's field operating procedure **Management of Investigation-Derived Waste** in order to determine proper removal and disposal procedures. The drilling subcontractor will provide any potable water utilized during this field activity from a known and reliable source (see Notes section).

ATTACHMENTS

Well Abandonment/Decommissioning Log (sample)

REFERENCES

New York State Department of Environmental Conservation, July 1988, *Drilling and Monitoring Well Installation Guidance Manual.*

Driscoll, F.G., 1987, *Groundwater and Wells*, Johnson Division, St. Paul, Minnesota, p. 1089.

TurnKey FOPs:
018 *Drilling/Excavation Equipment Decontamination Protocols*
032 *Management of Investigation-Derived Waste*

NOTES

Tap water may be used from any municipal water treatment system. The use of an untreated potable water supply is not an acceptable substitute.

WELL ABANDONMENT/ DECOMMISSIONING LOG

PROJECT INFORMATION	WELL INFORMATION
Project Name:	WELL I.D.:
Client:	Stick-up (fags):
Project Job Number:	Total Depth (fbgs):
Date:	Screen Interval (fbgs):
Weather:	Well Material:
	Diameter (inches):
BM/TK Personnel:	
Drilling Company:	Drilling Company Pers[illegible]l:
Drill Rig Type:	

DECOMMISSIONING PROCE[illegible]ES

Time	Description of Field Activiti[illegible]

PREPARED BY: DATE:

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FIELD OPERATING PROCEDURES

Soil Vapor Sample Collection Procedures

FOP 004.4

SOIL VAPOR SAMPLE COLLECTION PROCEDURE

BACKGROUND

In October 2006, the New York State Department of Health (NYSDOH) finalized their vapor intrusion guidance document entitled "Guidance for Evaluating Soil Vapor Intrusion in the State of New York." (www.health.state.ny.us/nysdoh/gas/svi_guidance/), which has been guiding NYSDOH and New York State Department of Environmental Conservation (NYSDEC) decisions concerning the need for subslab vapor mitigation at sites undergoing investigation, cleanup and monitoring under formal NY Sate remedial programs (e.g., Brownfield Cleanup Program sites, Inactive Hazardous Waste Site Remediation Program sites, etc.). The guidance presents two soil vapor/indoor air matrices to assist in interpreting subslab and ambient air data (i.e., "Matrix 1" and "Matrix 2"). As of June 2007, six compounds have been assigned to these two matrices as follows:

Volatile Chemical	Soil Vapor / Indoor Air Matrix
Carbon tetrachloride	Matrix 1
1,1-Dichloroethene	Matrix 2
cis-1,2-Dichloroethene	Matrix 2
Tetrachloroethene	Matrix 2
1,1,1-Trichloroethane	Matrix 2
Trichloroethene	Matrix 1
Vinyl chloride	Matrix 1

Additional matrices will be developed when a chemical's toxicological properties, background concentrations, or analytical capabilities suggest that major revisions are needed. Both matrices are attached as Figures 1 and 2.

PURPOSE

The procedures presented herein delineate the scope of additional investigation at a building on the project site to determine if volatile organic compounds (VOCs) detected in groundwater and/or soil near the building are intruding into the building airspace or have the potential, in sufficient concentrations, to adversely impact indoor air quality. The soil vapor, subslab vapor, and ambient air monitoring procedures follow the NYSDOH Final Soil Vapor Intrusion Guidance (October 2006) as well as USEPA Methods TO-14 and TO-15, for volatile organic compounds (VOCs) using Summa passive canisters.

SURVEYS AND PRE-SAMPLING BUILDING PREPARATION (IF REQUIRED)

If required, a pre-sampling inspection should be performed prior to each sampling event to identify and minimize conditions that may interfere with the proposed testing. The inspection should evaluate the type of structure, floor layout, airflows, and physical conditions of the building(s) being studied. This information, along with information on sources of potential indoor air contamination, should be identified on a building inventory form. An example of the building inventory form is attached. Items to be included in the building inventory include the following:

- Construction characteristics, including foundation cracks and utility penetrations or other openings that may serve as preferential pathways for vapor intrusion;
- Presence of an attached garage;
- Recent renovations or maintenance to the building (e.g., fresh paint, new carpet or furniture);
- Mechanical equipment that can affect pressure gradients (e.g., heating systems, clothes dryers or exhaust fans);

- Use or storage of petroleum products (e.g., fuel containers, gasoline operated equipment and unvented kerosene heaters); and

- Recent use of petroleum-based finishes or products containing volatile chemicals.

Each room on the floor of the building being tested and on lower floors, if possible, should be inspected. This is important because even products stored in another area of a building can affect the air of the room being tested.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppb RAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building.

Potential interference from products or activities releasing volatile chemicals may need to be controlled. Removing the source from the indoor environment prior to testing is the most effective means of reducing interference. Ensuring that containers are tightly sealed may be acceptable. When testing for volatile organic compounds, containers should be tested with portable vapor monitoring equipment to determine whether compounds are leaking. The inability to eliminate potential interference may be justification for not testing, especially when testing for similar compounds at low levels. The investigator should consider the possibility that chemicals may adsorb onto porous materials and may take time to dissipate.

In some cases, the goal of the testing is to evaluate the impact from products used or stored in the building (e.g., pesticide misapplications, school renovation projects). If the goal of the testing is to determine whether products are an indoor volatile chemical contaminant source, the removing these sources does not apply.

Once interfering conditions are corrected (if applicable), ventilation may be needed prior to sampling to eliminate residual contamination in the indoor air. If ventilation is appropriate, it should be completed 24 hours or more prior to the scheduled sampling time. Where applicable, ventilation can be accomplished by operating the building's HVAC system to maximize outside air intake. Opening windows and doors, and operating exhaust fans may also help or may be needed if the building has no HVAC system.

Air samples are sometimes designed to represent typical exposure in a mechanically ventilated building and the operation of HVAC systems during sampling should be noted on the building inventory form (see attached sample). In general, the building's HVAC system should be operating under normal conditions. Unnecessary building ventilation should be avoided within 24 hours prior to and during sampling. During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time.

Depending upon the goal of the indoor air sampling, some situations may warrant deviation from the above protocol regarding building ventilation. In such cases, building conditions and sampling efforts should be understood and noted within the framework and scope of the investigation.

To avoid potential interferences and dilution effects, every effort should be made to avoid the following for 24 hours prior to sampling:

- Opening any windows, fireplace dampers, openings or vents;
- Operating ventilation fans unless special arrangements are made;
- Smoking in the building;
- Painting;
- Using a wood stove, fireplace or other auxiliary heating equipment (e.g., kerosene heater);
- Operating or storing automobile in an attached garage;

- Allowing containers of gasoline or oil to remain within the house or garage area, except for fuel oil tanks;
- Cleaning, waxing or polishing furniture, floors or other woodwork with petroleum- or oil-based products;
- Using air fresheners, scented candles or odor eliminators;
- Engaging in any hobbies that use materials containing volatile chemicals;
- Using cosmetics including hairspray, nail polish, nail polish removers, perfume/cologne, etc.;
- Lawn mowing, paving with asphalt, or snow blowing;
- Applying pesticides; and
- Using building repair or maintenance products, such as caulk or roofing tar.

PRODUCT INVENTORY (IF REQUIRED)

If required, the primary objective of the product inventory is to identify potential air sampling interference by characterizing the occurrence and use of chemicals and products throughout the building, keeping in mind the goal of the investigation and site-specific contaminants of concern. For example, it is not necessary to provide detailed information for each individual container of like items. However, it is necessary to indicate that "20 bottles of perfume" or
"12 cans of latex paint" were present with containers in good condition. This information is used to help formulate an indoor environment profile.

An inventory should be provided for each room on the floor of the building being tested and on lower floors, if possible. This is important because even products stored in another area of a building can affect the air of the room being tested.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppb RAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building. Products in buildings should be inventoried every time air is tested to provide an accurate assessment of the potential contribution of volatile chemicals. If available, chemical ingredients of interest (e.g., analyte list) should be recorded for each product. If the ingredients are not listed on the label, record the product's exact and full name, and the manufacturer's name, address and telephone number, if available. In some cases, Material Safety Data Sheets (MSDS) may be useful for identifying confounding sources of volatile chemicals in air. Adequately documented photographs of the products and their labeled ingredients can supplement the inventory and facilitate recording the information.

SAMPLE LOCATIONS

The following are types of samples that are collected to investigate the soil vapor intrusion pathway:

- Subsurface vapor samples:
  - *Soil vapor* samples (i.e., soil vapor samples not beneath the foundation or slab of a building) and
  - *Sub-slab vapor* samples (i.e., soil vapor samples immediately beneath the foundation or slab of a building);
- Indoor air samples; and
- Outdoor air samples.

The types of samples that should be collected depend upon the specific objective(s) of the sampling, as described below.

- Soil vapor

  Soil vapor samples are collected to determine whether this environmental medium is contaminated, characterize the nature and extent of contamination, and identify possible sources of the contamination. Soil vapor sampling results are used when evaluating the following:
  - The potential for *current* human exposures;

- The potential for *future* human exposures (e.g., should a building be constructed); and
- The effectiveness of measures implemented to remediate contaminated subsurface vapors.

- Sub-slab vapor

  Sub-slab vapor samples are collected to characterize the nature and extent of soil vapor contamination immediately beneath a building with a basement foundation and/or a slab-on-grade. Sub-slab vapor sampling results are used when evaluating the following:
  - *Current* human exposures;
  - The potential for *future* human exposures (e.g., if the structural integrity of the building changes or the use of the building changes); and
  - Site-specific attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

  Sub-slab vapor samples are collected after soil vapor characterization and/or other environmental sampling (e.g., soil and groundwater characterization) indicate a need. Subslab samples are typically collected concurrently with indoor and outdoor air samples. However, outside of the heating season, sub-slab vapor samples may be collected independently depending on the sampling objective (e.g., characterize the extent of subsurface vapor contamination outside of the heating season to develop a more comprehensive, focused investigation plan for the heating season).

- Indoor air

  Indoor air samples are collected to characterize exposures to air within a building, including those with earthen floors and crawlspaces. Indoor air sampling results are used when evaluating the following:
  - *Current* human exposures;
  - The potential for *future* exposures (e.g., if a currently vacant building should become occupied); and
  - Site-specific attenuation factors (e.g., the ratio of indoor air to sub-slab vapor concentrations).

Indoor air samples are collected after subsurface vapor characterization and other environmental sampling (e.g., soil and groundwater characterization) indicate a need. When indoor air samples are collected, concurrent sub-slab vapor and outdoor air samples are collected to evaluate the indoor air results appropriately. However, indoor air and outdoor air samples, without sub-slab vapor samples, may be collected when confirming the effectiveness of a mitigation system.

In addition, site-specific situations may warrant collecting indoor air samples prior to characterizing subsurface vapors and/or without concurrent sub-slab sampling due to a need to examine immediate inhalation hazards. Examples of such situations may include, but are not limited to, the following:

- In response to a spill event when there is a need to qualitatively and/or quantitatively characterize the contamination;
- If high readings are obtained in a building when screening with field equipment (e.g., a photoionization detector (PID), an organic vapor analyzer, or an explosimeter) and the source is unknown;
- If significant odors are present and the source needs to be characterized; or
- If groundwater beneath the building is contaminated, the building is prone to groundwater intrusion or flooding (e.g., sump pit overflows), and subsurface vapor sampling is not feasible.

▪ Outdoor air

Outdoor air samples are collected to characterize site-specific background outdoor air conditions. These samples must be collected simultaneously with indoor air samples. They may also be collected concurrently with soil vapor samples. Outdoor air sampling results are primarily used when evaluating the extent to which outdoor sources may be influencing indoor air quality. They may also be used in the evaluation of soil vapor results (i.e., to identify potential outdoor air interferences associated with the infiltration of outdoor air into the sampling apparatus while the soil vapor sample was collected).

SOIL VAPOR SAMPLE COLLECTION PROCEDURES

Soil vapor probe installations (see Figure 3 attached) may be permanent, semi-permanent, or temporary. In general, permanent installations are preferred for data consistency reasons. Soil implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any construction protocol:

- Soil vapor probes should be installed using direct push technology or, if necessary to attain the desired depth, using an auger;
- Porous backfill material (e.g., glass beads or coarse sand) should be used to create a sampling zone 1 to 2 feet in length;
- Soil vapor probes should be fitted with inert tubing (e.g., polyethylene, stainless steel, or Teflon®) of the appropriate size (typically 1/8 inch to 1/4 inch diameter) and of laboratory or food grade quality to the surface;
- Soil vapor probes should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet to prevent outdoor air infiltration and the remainder of the borehole backfilled with clean material;
- For multiple probe depths, the borehole should be grouted with bentonite between probes to create discrete sampling zones; and
- For permanent installations, a protective casing should be set around the top of the probe tubing and grouted in place to the top of bentonite to minimize infiltration of water or outdoor air, as well as to prevent accidental damage.

Soil vapor samples should be collected in the same manner at all locations to minimize possible discrepancies. The following procedures should be included in any sampling protocol:

- At least 24 hours after the installation of permanent probes and shortly after the installation of temporary probes, one to three implant volumes (i.e., the volume of the sample probe and tube) must be purged prior to collecting the samples to ensure samples collected are representative;

- Flow rates for both purging and collecting must not exceed 0.2 liters per minute to minimize outdoor air infiltration during sampling;

- Samples must be collected, using conventional sampling methods, in an appropriate container — one which meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation), meets the requirements of the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and is certified clean by the laboratory;

- Sample size depends upon the volume of sample required to achieve minimum reporting limit requirements; and

- A tracer gas (e.g., helium, butane, or sulfur hexafluoride) must be used when collecting soil vapor samples to verify that adequate sampling techniques are being implemented (i.e., to verify infiltration of outdoor air is not occurring) (discussed later in this procedure). Once verified, continued use of the tracer gas may be reconsidered.

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

- If sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified;

- Outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor ambient air sample locations (if applicable), and compass orientation (north);

- Weather conditions (e.g., precipitation, outdoor temperature, barometric pressure, wind speed and direction) should be noted for the past 24 to 48 hours; and

- Any pertinent observations should be recorded, such as odors and readings from field instrumentation.

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

- Sample identification,
- Date and time of sample collection,
- Sampling depth,
- Identity of samplers,
- Sampling methods and devices,
- Purge volumes,
- Volume of soil vapor extracted,
- If canisters used, the vacuum before and after samples collected,
- Apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and
- Chain of custody protocols and records used to track samples from sampling point to analysis.

SUB-SLAB VAPOR SAMPLE COLLECTION PROCEDURES

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

Sub-slab vapor probe installations (see Figure 4 attached) may be permanent, semi-permanent, or temporary. Sub-slab implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any construction protocol:

- Permanent recessed probes must be constructed with brass or stainless steel tubing and fittings;
- Temporary probes must be constructed with polyethylene or Teflon® tubing of laboratory or food grade quality;
- Tubing should not extend further than 2 inches into the sub-slab material;
- Coarse sand or glass beads should be added to cover about 1 inch of the probe tip for permanent installations; and
- The soil vapor probe should be sealed to the surface with permagum grout, melted beeswax, putty or other non-VOC-containing and non-shrinking products for temporary installations or cement for permanent installations.

Sub-slab vapor samples should be collected in the following manner:

- After installation of the probes, one to three volumes (i.e., the volume of the sample probe and tube) must be purged prior to collecting the samples to ensure samples collected are representative;
- Flow rates for both purging and collecting must not exceed 0.2 liters per minute to minimize outdoor air infiltration during sampling; and
- Samples must be collected, using conventional sampling methods, in an appropriate container — one which meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation), meets the requirements of the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and is certified clean by the laboratory;
- Sample size depends upon the volume of sample required to achieve minimum reporting limit requirements [Section 2.9 of the Guidance], the flow rate, and the sampling duration; and
- Ideally, samples should be collected over the same period of time as concurrent indoor and outdoor air samples.

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

- If sampling within a commercial or industrial building, uses of volatile chemicals in commercial or industrial processes and/or during building maintenance, should be identified;
- The use of heating or air conditioning systems during sampling should be noted;
- Floor plan sketches should be drawn that include the floor layout with sample locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system air supply and return registers, compass orientation (north), and any other pertinent information should be completed;
- If possible, photographs should accompany floor plan sketches;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sample locations (if applicable), compass orientation (north), footings that create separate foundation sections, and paved areas;
- Weather conditions (e.g., precipitation, indoor and outdoor temperature, and barometric pressure) and ventilation conditions (e.g., heating system active and windows closed) should be reported;
- Smoke tubes or other devices should be used to confirm pressure relationships and air flow patterns, especially between floor levels and between suspected contaminant sources and other areas; and
- Any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, ppb RAE, Jerome Mercury Vapor Analyzer, etc.), should be recorded.

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

- Sample identification,
- Date and time of sample collection,
- Sampling depth,
- Identity of samplers,
- Sampling methods and devices,
- Soil vapor purge volumes,
- Volume of soil vapor extracted,
- If canisters used, the vacuum before and after samples collected,
- Apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and

- Chain of custody protocols and records used to track samples from sampling point to analysis.

The following describes the subslab air sampling procedure:

1. Canisters will be supplied by the laboratory that will be conducting the analysis.

2. Sampling will take place in accordance with the project work plan sufficiently spaced to allow locations to be modified, if necessary.

3. The number of Summa canisters required as well as the flow rate of the constant differential low volume flow controllers will be supplied by the laboratory in accordance with the project work plan.

4. The sampling program will consist of concurrently collecting and analyzing one sub-slab vapor sample and one indoor ambient air sample (discussed in the next section). Sample locations should be selected based on the likelihood for potential continuous human occupancy during the workday (i.e., due to the size of the areas and available infrastructure), and to account for the possibility of varying foundation depths in different areas of the building. In addition, sample locations typically are based upon the results of a subsurface investigation (i.e., soil gas survey or boring advancement) conducted prior to air sample collection activities. Canisters are typically placed in areas where the highest concentrations of soil gas were observed. Indoor air sample locations preferably should be selected near the middle of the sampled room, well away from the edges where dilution is more likely to occur.

5. Collect at least one outdoor ambient air sample from a location on the building roof or designated background area of the site positioned away from building ventilation system equipment on the highest portion of the building roof or site. See the Outdoor Ambient Air Sampling Procedure section in this procedure.

6. Field personnel should assure conservative sampling conditions prior to and throughout the sampling event. The building should be closed (windows and doors shut) and existing building ventilation systems should be turned off 12

to 24 hours before the air sampling is scheduled to begin as well as during sample collection. Any air-handling units that may induce large pressure gradients (i.e., exhaust fans, HVAC units etc.) should also be turned off.

7. Any activity being conducted by current building tenants involving volatile organic compounds, such as the use of lacquer thinner and cleaning solvents, prior to and/or during air sampling activities should be noted in the Project Field Book. These activities have the potential to bias the analytical results.

8. At each location, drill an approximately ¾-inch diameter hole through the concrete slab (typically 6-8 inches thick) using a hand-held hammer drill.

9. Measure and record the concrete thickness in the Project Field Book.

10. Insert polyethylene or Teflon® tubing of laboratory or food grade quality into the drilled hole and <u>no further than 2 inches</u> into the subslab material.

11. Seal the tubing with an appropriately sized volatile organic compound-free stopper (i.e., permagum grout, melted beeswax, putty, or other non-VOC-containing and non-shrinking product) into the concrete core hole and secure in-place making sure the fit is very snug. Supplement any visible gaps between the stopper and concrete slab with a VOC-free sealant, such as beeswax or bentonite slurry.

12. Run the tubing assembly through a shroud (plastic pail, cardboard box, or garbage bag) creating a tight seal with the surface making sure not to disturb the seal around the tubing penetration.

13. Enrich the atmosphere of the shroud with helium. Measure and record the helium concentration within the shroud.

14. Purge approximately 1 to 3 tubing volumes (i.e., the volume of the sample probe and tube) using a hand pump (or similar approved device) to ensure the collection of a representative sample.

15. Flow rates for both purging and sample collection must not exceed 0.2 liters per minute to minimize outdoor air infiltration during sampling.

16. Use a portable monitoring device to analyze a sample of soil vapor for the tracer **prior to and after** sampling for the compounds of concern. Note that the tracer gas samples can be collected via syringe, Tedlar bag etc. They need not be collected in Summa® canisters or minicans.

17. If concentrations greater than 10% of tracer gas are observed either prior to and/or after sampling, the probe seal should be enhanced to reduce the infiltration of outdoor air. Following enhancement of the seal, repeat steps 14 through 17 above until purged concentrations are less than 10% of the tracer gas within the shroud.

18. Following tubing purge and adequate seal integrity testing via helium tracer gas, immediately attach a 6-liter Summa Canister fitted with a 24-hour regulator (or approved other duration) to the opposite end of the tubing. Concurrent with each subslab sample location, prepare an indoor ambient air sample by staging a second Summa Canister on a ladder (approximately 2 to 5-feet above the floor) adjacent to the sub-slab sample location.

19. All Summa Canister valves should remain closed until all subslab borings are complete and all of the canisters in their respective positions.

20. Open the valves to all of the canisters for the required collection period (i.e., 24-hours).

21. Following sample collection, close and cap each canister valve.

22. Collect all Summa Canisters and ship, under chain-of-custody command to an approved analytical laboratory for VOC analysis in accordance with USEPA Method TO-14 or TO-15.

23. Repair all concrete openings with a cement patch.

24. Analytical results submitted by the laboratory should be reported as concentrations of each VOC at each location, typically in parts per billion by volume (ppbv).

INDOOR AIR SAMPLE COLLECTION PROCEDURES

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

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

- Sampling duration should reflect the exposure scenario being evaluated without compromising the detection limit or sample collection flow rate (e.g., an 8 hour sample from a workplace with a single shift versus a 24 hour sample from a workplace with multiple shifts). To ensure that air is representative of the locations sampled and to avoid undue influence from sampling personnel, samples should be collected for at least 1 hour. If the goal of the sampling is to represent average concentrations over longer periods, then longer duration sampling periods may be appropriate. Typically, 24 hour samples are collected from residential settings;

- Personnel should avoid lingering in the immediate area of the sampling device while samples are being collected;

- Sample flow rates must conform to the specifications in the sample collection method and, if possible, should be consistent with the flow rates for concurrent outdoor air and sub-slab samples; and

- Samples must be collected, using conventional sampling methods, in an appropriate container — one which meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation), meets the requirements of the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and is certified clean by the laboratory.

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

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

- A product inventory survey must be completed (discussed earlier);
- The use of heating or air conditioning systems during sampling should be noted;
- Floor plan sketches should be drawn that include the floor layout with sample locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system supply and return registers, compass orientation (north), and any other pertinent information should be completed;
- If possible, photographs should accompany floor plan sketches;
- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sample locations (if applicable), compass orientation (north), footings that create separate foundation sections, and paved areas;

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

- Smoke tubes or other devices should be used to confirm pressure relationships and air flow patterns, especially between floor levels and between suspected contaminant sources and other areas; and

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

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

- Sample identification,
- Date and time of sample collection,
- Sampling height,
- Identity of samplers,
- Sampling methods and devices,
- Depending upon the method, volume of air sampled,
- If canisters used, the vacuum before and after samples collected,
- Chain of custody protocols and records used to track samples from sampling point to analysis.

The following describes the indoor air sampling procedure:

1. Canisters will be supplied by the laboratory that will be conducting the analysis.

2. Sampling will take place in accordance with the project work plan sufficiently spaced to allow locations to be modified, if necessary.

3. The number of Summa canisters required as well as the flow rate of the constant differential low volume flow controllers will be supplied by the

laboratory in accordance with the project work plan. Indoor air sampling typically requires the continuous collection of samples over a 24-hour period.

4. The sampling program will consist of concurrently collecting and analyzing one sub-slab vapor sample and one indoor ambient air sample. Sample locations should be selected based on the likelihood for potential continuous human occupancy during the workday (i.e., due to the size of the areas and available infrastructure), and to account for the possibility of varying foundation depths in different areas of the building. In addition, sample locations typically are based upon the results of a subsurface investigation (i.e., soil gas survey or boring advancement) conducted prior to air sample collection activities. Canisters are typically placed in areas where the highest concentrations of soil gas were observed. Indoor air sample locations preferably should be selected near the middle of the sampled room, well away from the edges where dilution is more likely to occur.

5. Collect at least one outdoor ambient air sample from a location on the building roof or designated background area of the site positioned away from building ventilation system equipment on the highest portion of the building roof or site. See the Outdoor Ambient Air Sampling Procedure presented in this procedure.

6. Field personnel should assure conservative sampling conditions prior to and throughout the sampling event. The building should be closed (windows and doors shut) and existing building ventilation systems should be turned off 12 to 24 hours before the air sampling is scheduled to begin as well as during sample collection. Any air-handling units that may induce large pressure gradients (i.e., exhaust fans, HVAC units etc.) should also be turned off.

7. Any activity being conducted by current building tenants involving volatile organic compounds, such as the use of lacquer thinner and cleaning solvents, prior to and/or during air sampling activities should be noted in the Project Field Book. These activities have the potential to bias the analytical results.

8. Concurrent with each subslab sample location, prepare an indoor ambient air sample by staging a second Summa Canister on a ladder (approximately 2 to 5-feet above the floor) adjacent to the sub-slab sample location.

9. All Summa Canister valves should remain closed until all subslab borings are complete and all of the canisters in their respective positions.

10. Open the valves to all of the canisters for the required collection period (i.e., 24-hours).

11. Following sample collection, close and cap each canister valve.

12. Collect all Summa Canisters and ship, under chain-of-custody command to an approved analytical laboratory for VOC analysis in accordance with USEPA Method TO-14 or TO-15.

13. Analytical results submitted by the laboratory should be reported as concentrations of each VOC at each location, typically in parts per billion by volume (ppbv).

OUTDOOR AIR SAMPLE COLLECTION PROCEDURES

Outdoor air samples must be collected simultaneously with indoor air samples and may be collected concurrently with subsurface vapor samples. Outdoor air samples must be collected in the same manner as indoor samples.

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

- Outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sample locations (if applicable), the location of potential interferences (e.g., gasoline stations, factories, lawn movers, etc.), compass orientation (north), footings that create separate foundation sections, and paved areas;

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

- Any pertinent observations, such as odors, readings from field instrumentation, and significant activities in the vicinity (e.g., operation of heavy equipment or dry cleaners) should be recorded.

The following describes the outdoor air sampling procedure:

1. Canisters will be supplied by the laboratory that will be conducting the analysis.

2. Sampling will take place in accordance with the project work plan sufficiently spaced to allow locations to be modified, if necessary.

3. The number of Summa canisters required as well as the flow rate of the constant differential low volume flow controllers will be supplied by the laboratory in accordance with the project work plan.

4. Sample locations typically are collected upwind of the facility.

5. Place canisters on the ground, with a clear plastic sheet beneath to prevent contamination. Locate the sampling inlet approximately 18-inches above the ground surface.

6. Sample collection should take place on warm, dry days. If rain or high humidity conditions develop during sampling, the sampling event should be suspended. Temperature, barometric pressure, and wind speed should be monitored during the sampling event, for use in analysis of the results.

7. The combination of sampling location, height, and meteorological conditions will assure that sampling will measure VOCs at their highest concentrations.

8. Air samples will be analyzed by Gas Chromatography/Mass Spectroscopy (GC/MS) in accordance with EPA Method TO-14 or TO-15.

9. Analytical results will be reported as concentrations of each VOC at each location during each sampling event, typically in parts per billion by volume (ppbv).

TRACER GAS

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

Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer. Typically, sulfur hexafluoride (SF6) or helium are used as tracers because they are readily available, have low toxicity, and can be monitored with portable measurement devices. Butane and propane (or other gases) could also be used as a tracer in some situations. The protocol for using a tracer gas is straightforward: simply enrich the atmosphere in the immediate vicinity of the area where the probe intersects the ground surface with the tracer gas, and measure a vapor sample from the probe for the presence of high concentrations (> 10%) of the tracer. A cardboard box, a plastic pail, or even a garbage bag can serve to keep the tracer gas in contact with the probe during the testing.

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

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

The advantage of the second approach is that the real time tracer sampling results can be used to confirm the integrity of the probe seals prior to formal sample collection. Figure 5 (attached) depicts common methods for using tracer gas. In each of the examples, a, b and c, the tracer gas is released in the enclosure prior to initially purging the sample point. Care should be taken to avoid excessive purging prior to sample collection. Care should also be taken to prevent pressure build-up in the enclosure during introduction of the tracer gas. Inspection of the installed sample probe, specifically noting the integrity of the surface seal and the porosity of the soil in which the probe is installed, will help to determine the tracer gas setup. Figure 5(a) may be most effective at preventing tracer gas infiltration; however, it may not be required in some situations depending on site-specific conditions. Figures 5(b) and 5(c) may be sufficient for probes installed in tight soils with well-constructed surface seals. In all cases, the same tracer gas application should be used for all probes at any given site.

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

During the initial stages of a soil vapor sampling program, tracer gas samples should be collected at each of the sampling probes. If the results of the initial samples indicate that the probe seals are adequate, the project manager can consider reducing the number of locations at which tracer gas samples are employed. At a minimum, at least 10% of the subsequent samples should be supported with tracer gas analyses. When using permanent soil vapor probes as part of a long-term monitoring program, annual testing of the probe integrity is recommended.

QUALITY ASSURANCE / QUALITY CONTROL (QA/QC)

Extreme care should be taken during all aspects of sample collection to ensure that sampling error is minimized and high quality data are obtained. The sampling team members should avoid actions (e.g., fueling vehicles, using permanent marking pens, and wearing freshly dry-cleaned clothing or personal fragrances), which can cause sample interference in the field. Appropriate QA/QC protocols must be followed for sample collection and laboratory analysis, such as use of certified clean sample devices, meeting sample holding times and temperatures, sample accession, chain of custody, etc. Samples should be delivered to the analytical laboratory as soon as possible after collection. In addition, laboratory accession procedures must be followed including field documentation (sample collection information and locations), chain of custody, field blanks, field sample duplicates, and laboratory duplicates, as appropriate.

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

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

New York State Public Health Law requires laboratories analyzing environmental samples collected from within New York State to have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. If ELAP certification is not currently required for an analyte (e.g., trichloroethene), the analysis should be performed by a laboratory that has ELAP certification for similar compounds in air and uses analytical methods with detection limits similar to background (e.g., tetrachloroethene via EPA Method TO-15).

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

DECISION MATRICES (FIGURES 1 AND 2)

The considerations in assigning a chemical to a matrix include the following:

- Human health risks, including such factors as a chemical's ability to cause cancer, reproductive, developmental, liver, kidney, nervous system, immune system or other effects, in animals and humans and the doses that may cause those effects;
- The data gaps in its toxicologic database;
- Background concentrations of volatile chemicals in indoor air [Section 3.2.4]; and
- Analytical capabilities currently available.

To use the matrices accurately as a tool in the decision-making process, the following must be noted:

- The matrices are generic. As such, it may be necessary to modify recommended actions to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or site-specific conditions (e.g., proximity of building to identified subsurface contamination) for the protection of public health. Additionally, actions more conservative than those specified within the matrix may be implemented at any time. For example, the decision to implement more conservative actions may be based on a comparison of the costs associated with resampling or monitoring to the costs associated with installation and monitoring of a mitigation system.

- Indoor air concentrations detected in samples collected from the building's basement or, if the building has a slab-on-grade foundation, from the building's lowest occupied living space should be used.
- Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude the need to investigate possible sources of vapor contamination, nor does it preclude the need to remediate contaminated soil vapors or the source of soil vapor contamination.
- When current exposures are attributed to sources other than vapor intrusion, the agencies must be provided documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix and to support assessment and follow-up by the agencies.

RECOMMENDED ACTIONS

Actions recommended in the matrix are based on the relationship between sub-slab vapor concentrations and corresponding indoor air concentrations. They are intended to address both potential and current human exposures and include the following:

- *No further action*
  When the volatile chemical is not detected in the indoor air sample and the concentration detected in the corresponding sub-slab vapor sample is not expected to substantially affect indoor air quality.

- *Take reasonable and practical actions to identify source(s) and reduce exposures*
  The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile chemical-containing products in places where people do not spend much time, such as a garage or shed).

- *Monitor*
  Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure HVAC systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building specific basis, taking into account applicable environmental data and building operating conditions.

- *Mitigate*
  Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. Methods to mitigate exposures related to soil vapor intrusion are described in Section 4 of the Guidance.

TIME OF YEAR

Sub-slab vapor samples and, unless there is an immediate need for sampling, indoor air samples are typically collected during the heating season because soil vapor intrusion is more likely to occur when a building's heating system is in operation and air is being drawn into the building. In general, heating systems are expected to be operating routinely from November 15th to March 31st throughout the state. However, this timeframe may vary depending on factors, such as the location of the site (e.g., upstate versus downstate) and the weather conditions for a particular year.

A vapor intrusion investigation may also be conducted outside of the heating season. However, the results may not be used to rule out exposures. For example, results indicating "no further action" or "monitoring required" must be verified during the heating season to ensure these actions are protective during the heating season as well.

SAMPLING ROUNDS

Investigating a soil vapor intrusion pathway usually requires more than one round of subsurface vapor, indoor air, and/or outdoor air sampling, for reasons such as the following:

- To characterize the nature and extent of subsurface vapor contamination (similar to the delineation of groundwater contamination) and to address corresponding exposure concerns;

- To evaluate fluctuations in concentrations due to
  - Different weather conditions (e.g., seasonal effects),
  - Changes in building conditions (e.g., various operating conditions of a building's HVAC system),
  - Changes in source strength, or
  - Vapor migration or contaminant biodegradation processes (particularly when degradation products may be more toxic than the parent compounds); or
- To confirm sampling results or the effectiveness of mitigation or remedial systems.

Overall, successive rounds of sampling are conducted until the following questions can be answered:

- Are subsurface vapors contaminated? If so, what are the nature and extent of contamination? What is/are the source(s) of the contamination?
- What are the current and potential exposures to contaminated subsurface vapors?
- What actions, if any, are needed to prevent or mitigate exposures and to remediate subsurface vapor contamination?

Toward this end, multiple rounds of sampling may be required to characterize the nature and extent of subsurface vapor contamination such that

- Both potential and current exposures are adequately addressed;
- Measures can be designed to remediate subsurface vapor contamination, either directly (e.g., SVE system) or indirectly (e.g., soil excavation or groundwater remediation), given that monitoring and mitigation are considered temporary measures implemented to address exposures related to vapor intrusion until contaminated environmental media are remediated; and
- The effectiveness of remedial measures can be monitored and confirmed (e.g., endpoint sampling).

ATTACHMENTS

Figure 1	*Soil Vapor/Indoor Air Matrix 1*
Figure 2	*Soil Vapor/Indoor Air Matrix 2*
Figure 3	*Schematics of a permanent soil vapor probe and permanent nested soil vapor probes*
Figure 4	*Schematic of a sub-slab vapor probe*
Figure 5	*Schematics of tracer gas applications*

Indoor Air Quality Questionnaire and Building Inventory

REFERENCES

New York State Department of Health, *Guidance for Evaluating Soil Vapor Intrusion in the State of New York*, February 2005.

New York State Department of Health, *Indoor Air Sampling & Analysis Guidance.* (February 1, 2005).

Office of Solid Waste and Emergency Response (OSWER). *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*. November 2002.

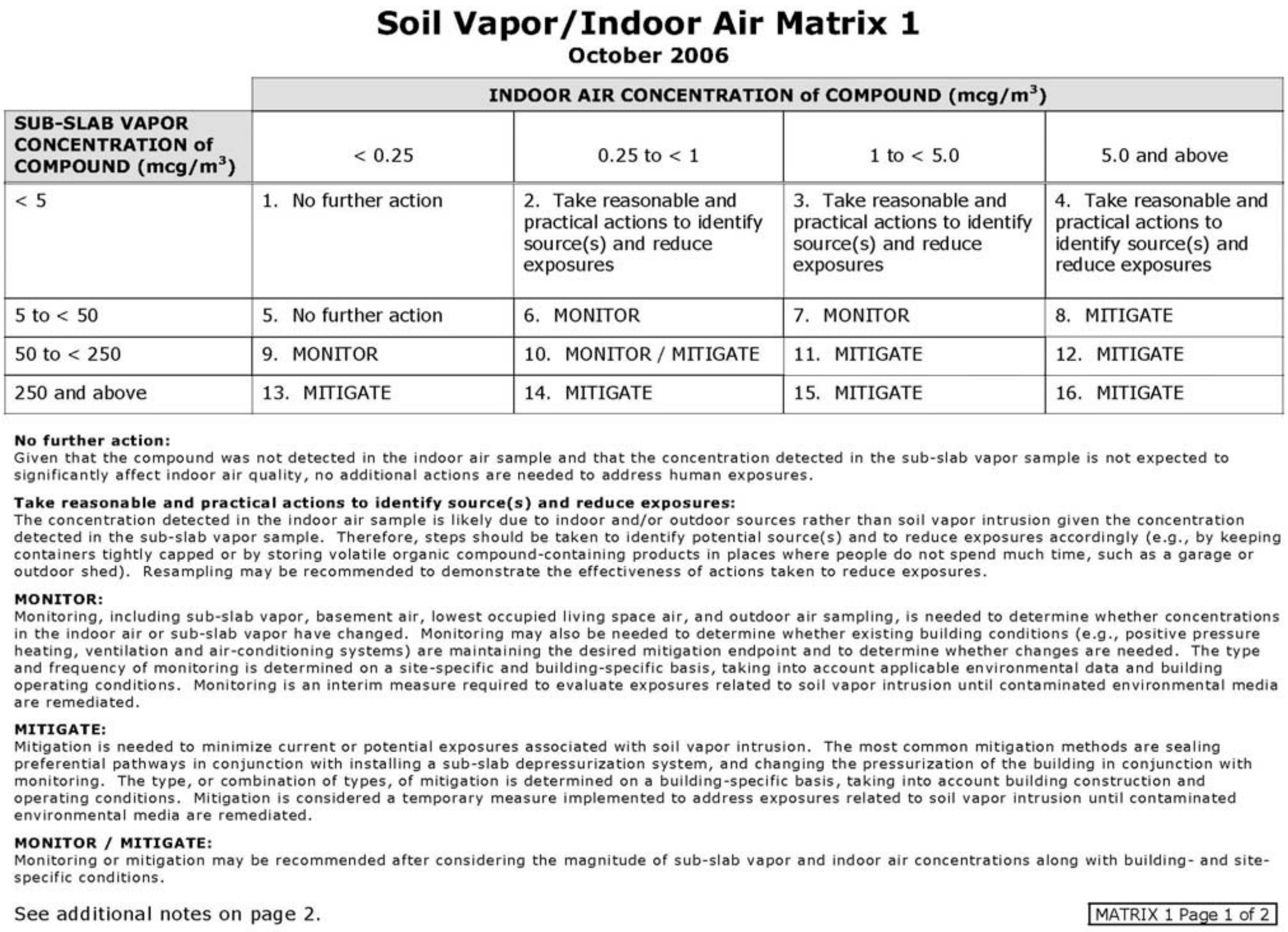
United States Environmental Protection Agency. *EPA Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*. 1988

- Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS). Pp. 15-1 through 15-62.

- Method TO-17, Determination of Volatile Organic Compounds in Ambient Air using Active Sampling on Sorbent Tubes. Pp. 17-1 through 17-49.

- Compendium of Methods for the Determination of Air Pollutants in Indoor Air, EPA/600/4-90-010.

FIGURE 1



Soil Vapor/Indoor Air Matrix 1

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 0.25	0.25 to < 1	1 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
5 to < 50	5. No further action	6. MONITOR	7. MONITOR	8. MITIGATE
50 to < 250	9. MONITOR	10. MONITOR / MITIGATE	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

MATRIX 1 Page 1 of 2

ADDITIONAL NOTES FOR MATRIX 1

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

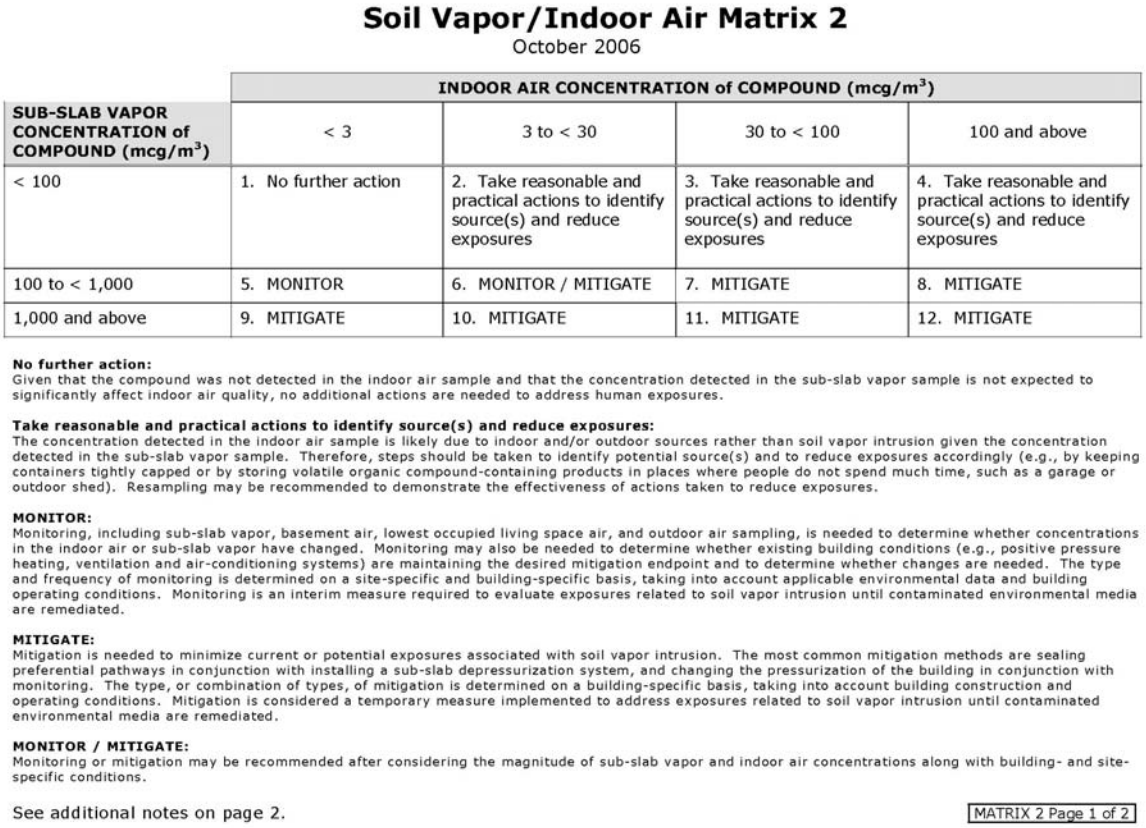
[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended for buildings with full slab foundations, and 1 microgram per cubic meter for buildings with less than a full slab foundation.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

FIGURE 2



Soil Vapor/Indoor Air Matrix 2

October 2006

	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m^3)			
SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m^3)	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
100 to < 1,000	5. MONITOR	6. MONITOR / MITIGATE	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

No further action:
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

Take reasonable and practical actions to identify source(s) and reduce exposures:
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

MONITOR:
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MITIGATE:
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

MONITOR / MITIGATE:
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

MATRIX 2 Page 1 of 2

ADDITIONAL NOTES FOR MATRIX 2

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

[1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).

[2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.

[3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended.

[4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.

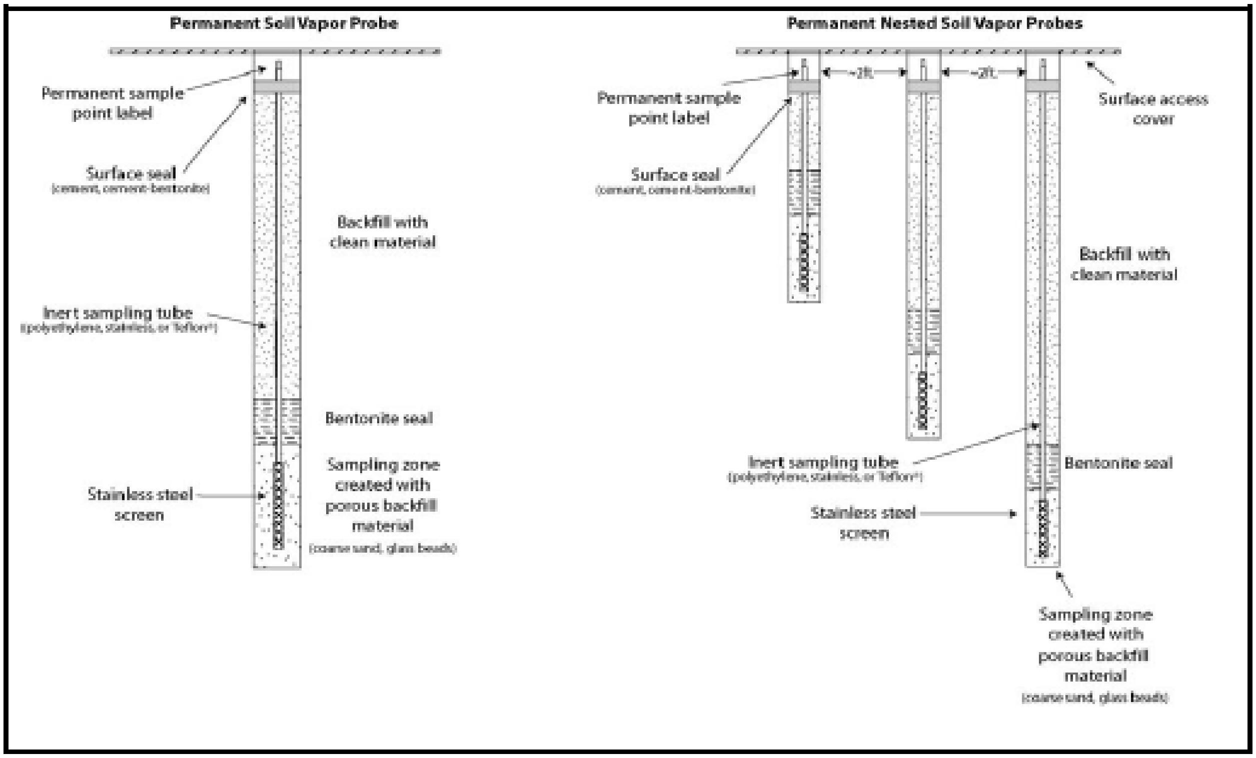
[5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.

[6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

MATRIX 2 Page 2 of 2

FIGURE 3

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



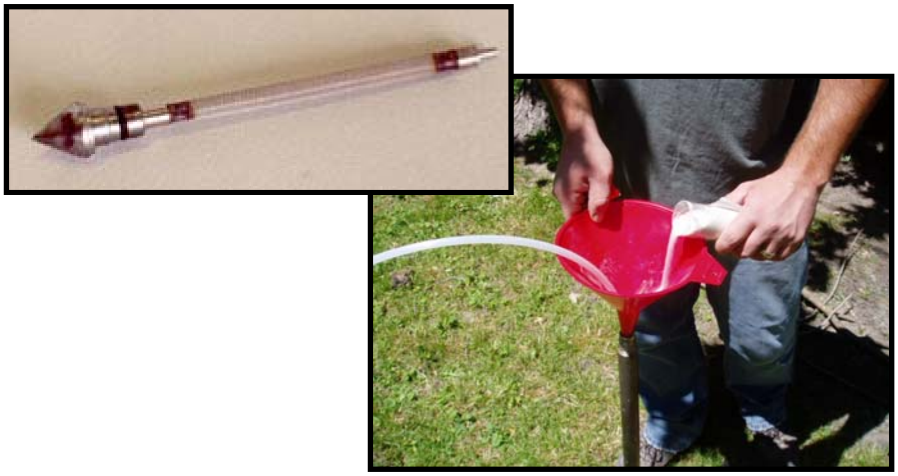
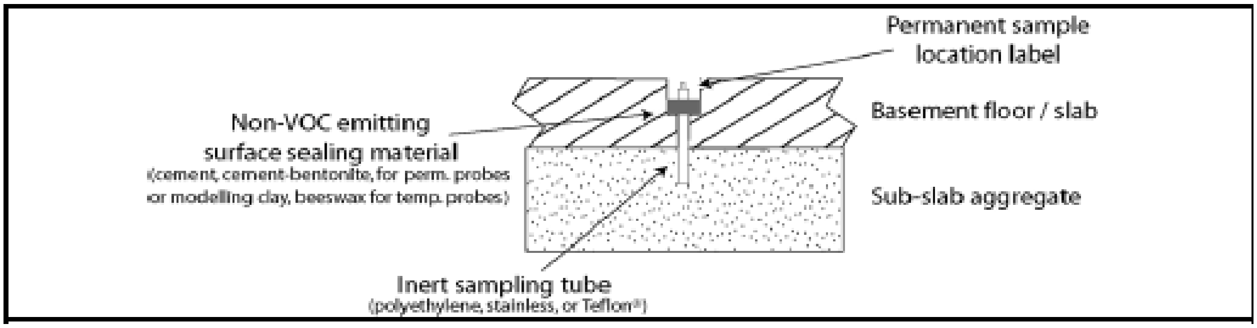


FIGURE 4

Schematic of a sub-slab vapor probe



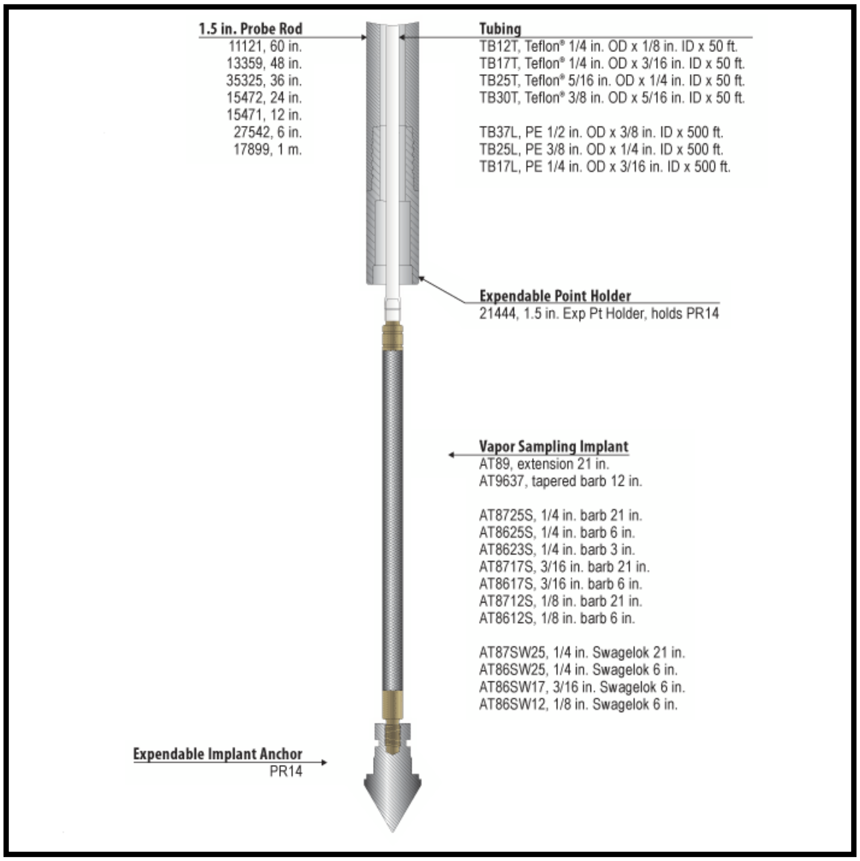
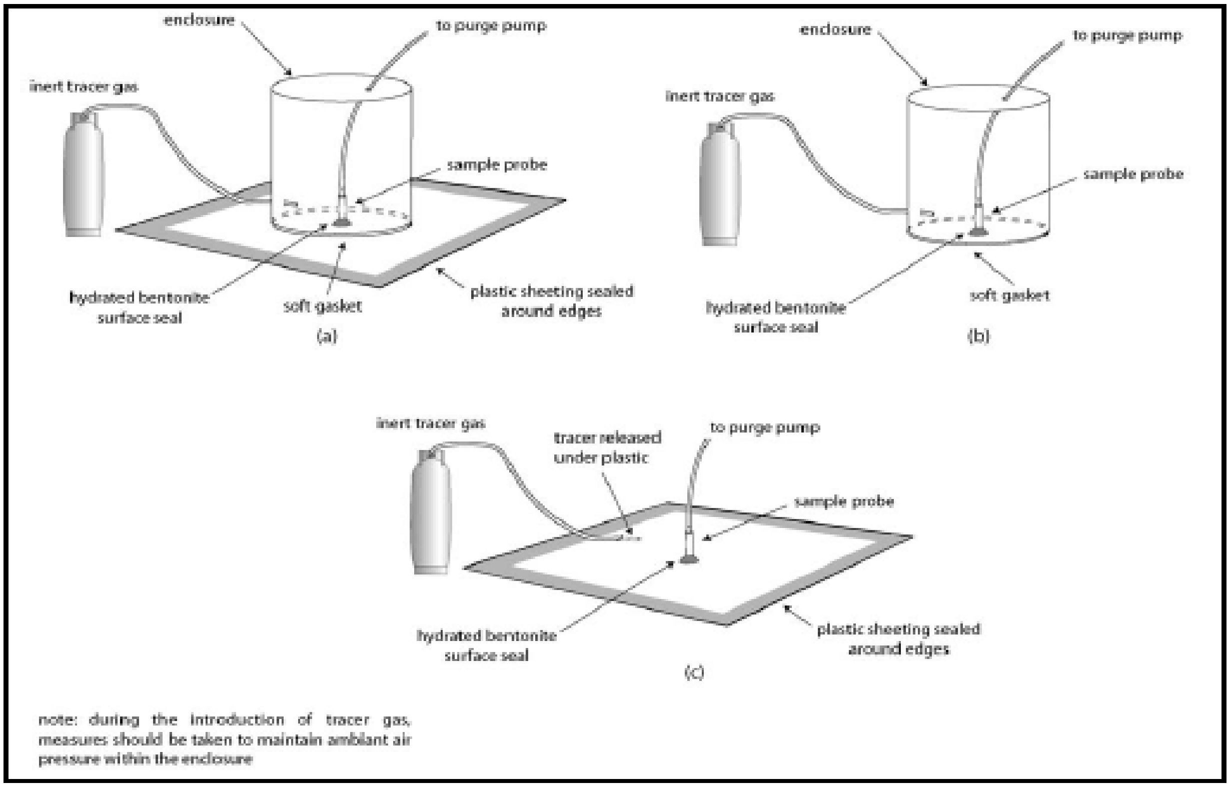


FIGURE 5

Schematics of tracer gas applications



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

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

INDOOR AIR QUALITY QUESTIONNAIRE & BUILDING INVENTORY

Project Name: Project No.
Project Location: Client:
Preparer's Name: Date/Time:
Preparer's Affiliation: Phone No:
Purpose of Investigation:

1. OCCUPANT:

Interviewed: yes no
Last Name: First Name:
Address:
County:
Home Phone: Office Phone:
Number of Occupants/persons at this location: Age of Occupants:

2. OWNER OR LANDLORD: (check if same as occupant ____)

Interviewed: yes no
Last Name: First Name:
Address:
County:
Home Phone: Office Phone:

3. BUILDING CHARACTERISTICS

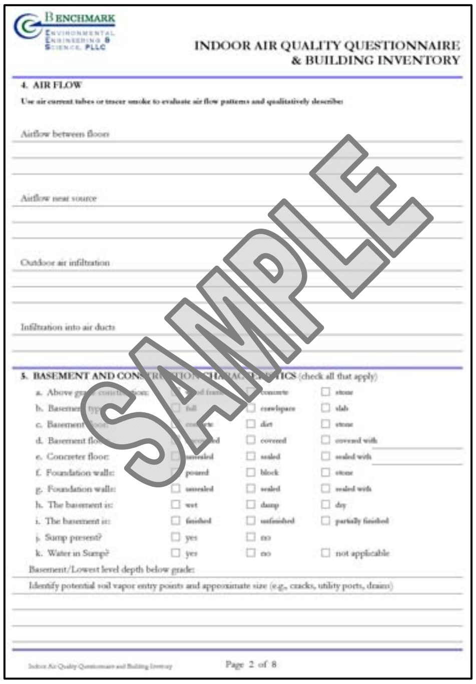
Type of Building: check appropriate response
☐ Residential ☐ School ☐ Commercial/Multi-use
☐ Industrial ☐ Church ☐ Other:

If the property is residential, type? (check appropriate response)
☐ Ranch ☐ 2-Family ☐ 3-Family
☐ Raised Ranch ☐ Split Level ☐ Colonial
☐ Cape Cod ☐ Contemporary ☐ Mobile Home
☐ Duplex ☐ Apartment House ☐ Townhouse/Condo
☐ Modular ☐ Log Home ☐ Other:

If multiple units, how many?
If the property is commercial, type?
Business Type(s):
Does it include residences (i.e., multi-use)? yes no If yes, how many?

Other Characteristics:
Number of floors Builing age
Is the building insulated? yes no How air tight? tight average not tight

Indoor Air Quality Questionnaire and Building Inventory Page 1 of 8



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INDOOR AIR QUALITY QUESTIONNAIRE & BUILDING INVENTORY

4. AIR FLOW

Use air current tubes or tracer smoke to evaluate air flow patterns and qualitatively describe:

Airflow between floors

Airflow near source

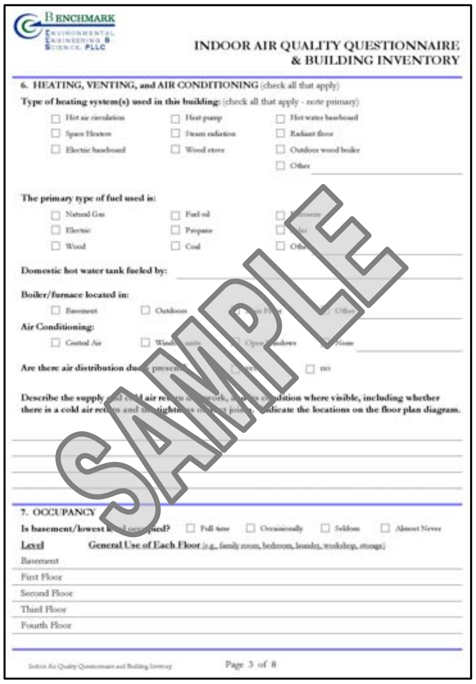
Outdoor air infiltration

Infiltration into air ducts

5. BASEMENT AND CONSTRUCTION CHARACTERISTICS (check all that apply)
a. Above grade construction: ☐ wood frame ☐ concrete ☐ stone
b. Basement type: ☐ full ☐ crawlspace ☐ slab
c. Basement floor: ☐ concrete ☐ dirt ☐ stone
d. Basement floor: ☐ uncovered ☐ covered ☐ covered with
e. Concreter floor: ☐ unsealed ☐ sealed ☐ sealed with
f. Foundation walls: ☐ poured ☐ block ☐ stone
g. Foundation walls: ☐ unsealed ☐ sealed ☐ sealed with
h. The basement is: ☐ wet ☐ damp ☐ dry
i. The basement is: ☐ finished ☐ unfinished ☐ partially finished
j. Sump present? ☐ yes ☐ no
k. Water in Sump? ☐ yes ☐ no ☐ not applicable

Basement/Lowest level depth below grade:
Identify potential soil vapor entry points and appoximate size (e.g., cracks, utility ports, drains)

Indoor Air Quality Questionnaire and Building Inventory Page 2 of 8



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INDOOR AIR QUALITY QUESTIONNAIRE & BUILDING INVENTORY

6. HEATING, VENTING, and AIR CONDITIONING (check all that apply)

Type of heating system(s) used in this building: (check all that apply - note primary)
☐ Hot air circulation ☐ Heat pump ☐ Hot water baseboard
☐ Space Heaters ☐ Steam radiation ☐ Radiant floor
☐ Electric baseboard ☐ Wood stove ☐ Outdoor wood boiler
☐ Other

The primary type of fuel used is:
☐ Natural Gas ☐ Fuel oil ☐ Kerosene
☐ Electric ☐ Propane ☐ Solar
☐ Wood ☐ Coal ☐ Other

Domestic hot water tank fueled by:

Boiler/furnace located in:
☐ Basement ☐ Outdoors ☐ Main Floor ☐ Other

Air Conditioning:
☐ Central Air ☐ Window units ☐ Open Windows ☐ None

Are there air distribution ducts present? ☐ yes ☐ no

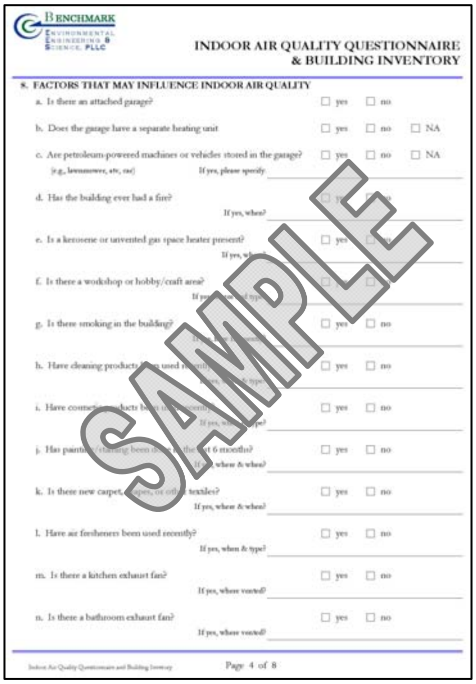
Describe the supply and cold air return ductwork, and its condition where visible, including whether there is a cold air return and the tightness of duct joints. Indicate the locations on the floor plan diagram.

7. OCCUPANCY

Is basement/lowest level occupied? ☐ Full time ☐ Occasionally ☐ Seldom ☐ Almost Never

Level **General Use of Each Floor** (e.g., family room, bedroom, laundry, workshop, storage)
Basement
First Floor
Second Floor
Third Floor
Fourth Floor

Indoor Air Quality Questionnaire and Building Inventory Page 3 of 8



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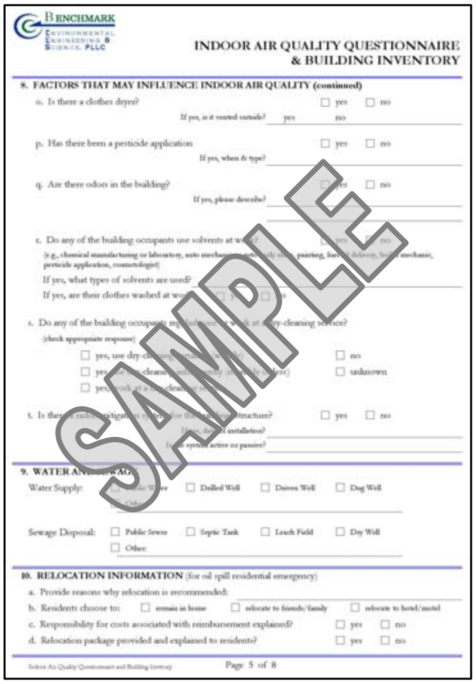
INDOOR AIR QUALITY QUESTIONNAIRE & BUILDING INVENTORY

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY
a. Is there an attached garage? ☐ yes ☐ no
b. Does the garage have a separate heating unit ☐ yes ☐ no ☐ NA
c. Are petroleum-powered machines or vehicles stored in the garage? ☐ yes ☐ no ☐ NA
(e.g., lawnmower, atv, car) If yes, please specify
d. Has the building ever had a fire? ☐ yes ☐ no
If yes, when?
e. Is a kerosene or unvented gas space heater present? ☐ yes ☐ no
If yes, where?
f. Is there a workshop or hobby/craft area? ☐ yes ☐ no
If yes, where and type?
g. Is there smoking in the building? ☐ yes ☐ no
If yes, how frequently?
h. Have cleaning products been used recently? ☐ yes ☐ no
If yes, when & type?
i. Have cosmetic products been used recently? ☐ yes ☐ no
If yes, when & type?
j. Has painting/staining been done in the last 6 months? ☐ yes ☐ no
If yes, where & when?
k. Is there new carpet, drapes, or other textiles? ☐ yes ☐ no
If yes, where & when?
l. Have air fresheners been used recently? ☐ yes ☐ no
If yes, when & type?
m. Is there a kitchen exhaust fan? ☐ yes ☐ no
If yes, where vented?
n. Is there a bathroom exhaust fan? ☐ yes ☐ no
If yes, where vented?

Indoor Air Quality Questionnaire and Building Inventory Page 4 of 8



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INDOOR AIR QUALITY QUESTIONNAIRE
& BUILDING INVENTORY

8. FACTORS THAT MAY INFLUENCE INDOOR AIR QUALITY (continued)

o. Is there a clothes dryer? ☐ yes ☐ no
If yes, is it vented outside? yes no

p. Has there been a pesticide application ☐ yes ☐ no
If yes, when & type? ____

q. Are there odors in the building? ☐ yes ☐ no
If yes, please describe? ____

r. Do any of the building occupants use solvents at work? ☐ yes ☐ no
(e.g., chemical manufacturing or laboratory, auto mechanic or autobody shop, painting, fuel oil delivery, boiler mechanic, pesticide application, cosmetologist)
If yes, what types of solvents are used? ____
If yes, are their clothes washed at work? ☐ yes ☐ no

s. Do any of the building occupants regularly use or work at a dry-cleaning service?
(check appropriate response)
☐ yes, use dry-cleaning regularly (weekly) ☐ no
☐ yes, use dry-cleaning infrequently (monthly or less) ☐ unknown
☐ yes, work at a dry-cleaning service

t. Is there a radon mitigation system for the building/structure? ☐ yes ☐ no
If yes, date of installation? ____
Is the system active or passive? ____

9. WATER AND SEWAGE

Water Supply: ☐ Public Water ☐ Drilled Well ☐ Driven Well ☐ Dug Well
☐ Other: ____

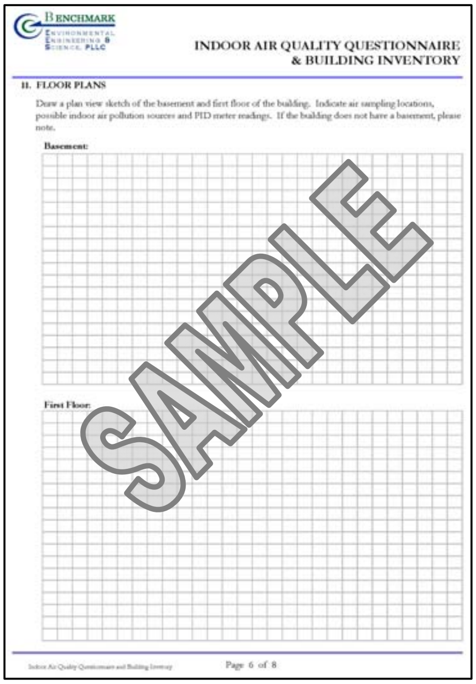
Sewage Disposal: ☐ Public Sewer ☐ Septic Tank ☐ Leach Field ☐ Dry Well
☐ Other: ____

10. RELOCATION INFORMATION (for oil spill residential emergency)

a. Provide reasons why relocation is recommended: ____
b. Residents choose to: ☐ remain in home ☐ relocate to friends/family ☐ relocate to hotel/motel
c. Responsibility for costs associated with reimbursement explained? ☐ yes ☐ no
d. Relocation package provided and explained to residents? ☐ yes ☐ no

Indoor Air Quality Questionnaire and Building Inventory Page 5 of 8

SAMPLE



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INDOOR AIR QUALITY QUESTIONNAIRE
& BUILDING INVENTORY

11. FLOOR PLANS

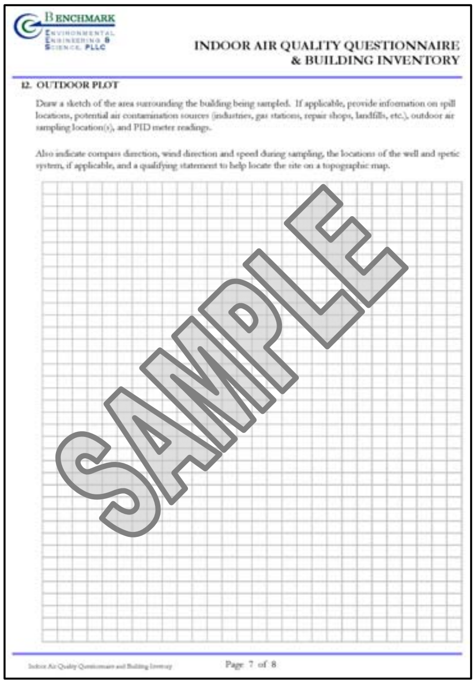
Draw a plan view sketch of the basement and first floor of the building. Indicate air sampling locations, possible indoor air pollution sources and PID meter readings. If the building does not have a basement, please note.

Basement:

First Floor:

Indoor Air Quality Questionnaire and Building Inventory Page 6 of 8

SAMPLE



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INDOOR AIR QUALITY QUESTIONNAIRE
& BUILDING INVENTORY

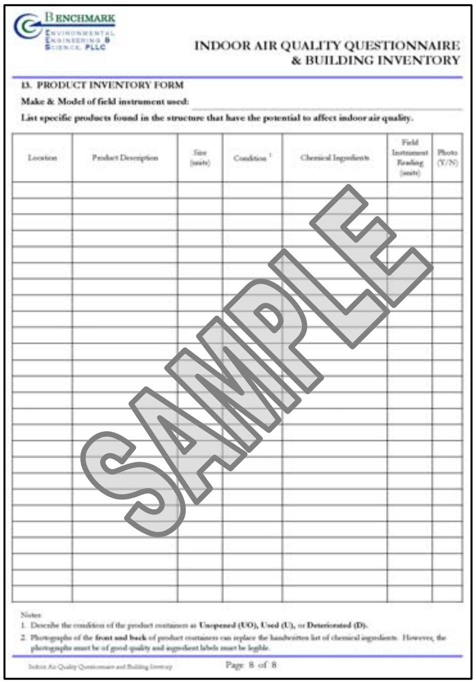
12. OUTDOOR PLOT

Draw a sketch of the area surrounding the building being sampled. If applicable, provide information on spill locations, potential air contamination sources (industries, gas stations, repair shops, landfills, etc.), outdoor air sampling location(s), and PID meter readings.

Also indicate compass direction, wind direction and speed during sampling, the locations of the well and septic system, if applicable, and a qualifying statement to help locate the site on a topographic map.

Indoor Air Quality Questionnaire and Building Inventory Page 7 of 8

SAMPLE



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INDOOR AIR QUALITY QUESTIONNAIRE
& BUILDING INVENTORY

13. PRODUCT INVENTORY FORM

Make & Model of field instrument used: ____

List specific products found in the structure that have the potential to affect indoor air quality.

Location	Product Description	Size (units)	Condition [1]	Chemical Ingredients	Field Instrument Reading (units)	Photo (Y/N)

Notes:
1. Describe the condition of the product containers as **Unopened (UO), Used (U),** or **Deteriorated (D).**
2. Photographs of the **front and back** of product containers can replace the handwritten list of chemical ingredients. However, the photographs must be of good quality and ingredient labels must be legible.

Indoor Air Quality Questionnaire and Building Inventory Page 8 of 8

SAMPLE

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration & Maintenance of Portable Dissolved Oxygen Meter

FOP 007.0

CALIBRATION AND MAINTENANCE OF PORTABLE DISSOLVED OXYGEN METER

PURPOSE

This guideline describes a method for calibration of a portable dissolved oxygen meter. This meter measures the concentration of dissolved oxygen within a water sample. This parameter is of interest both as a general indicator of water quality, and because of its pertinence to fate and transport of organics and inorganics. This guideline presents a method for calibration of this meter, which is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the dissolved oxygen meter will be within ± 1% of full-scale over the temperature range of 23° to 113° F (-5° to +45° C).

PROCEDURE

1. Calibrate the dissolved oxygen meter to ambient air based on probe temperature and true local atmospheric pressure conditions (or feet above sea level). Because procedures vary with different brands and models of meters, refer to the manufacturer's recommended calibration procedures.

2. In the event of a failure to adequately calibrate, follow the corrective action directed by the manufacturer.
3. If calibration cannot be achieved or maintained, obtain a replacement instrument (rental instruments) and/or order necessary repairs/adjustment.

4. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample). Information will include, at a minimum:
    - Time, date, and initials of the field team member performing the calibration
    - The unique identifier for the meter, including manufacturer, model, and serial number
    - The brand and expiration dates of calibration solutions
    - The calibration readings
    - The instrument settings (if applicable)
    - The approximate response time
    - The overall adequacy of calibration including the Pass or fail designation in accordance with the accuracy specifications presented above
    - Corrective action taken (see Step 5 above) in the event of failure to adequately calibrate

MAINTENANCE

- When not in use or between measurements, the dissolved oxygen probe will be kept immersed in or moist with deionized water.

- The meter batteries will be checked prior to each meter's use and will be replaced when the meter cannot be redline adjusted.

- The meter response time and stability will be tracked to determine the need for instrument maintenance. When response time becomes greater than two minutes, probe service is indicated.

ATTACHMENTS

Equipment Calibration Log (sample)

TURNKEY ENVIRONMENTAL RESTORATION, LLC

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name: Date:

Project No.:

Client: Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		µS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID	[illegible]		open air zero		MIBK re factor
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Field pH/Eh Meter

FOP 008.0

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD pH/Eh METER

PURPOSE

This guideline describes a method for calibration of a portable pH/Eh meter. The pH/Eh meter measures the hydrogen ion concentration or acidity of a water sample (pH function), and the oxidation/reduction potential of a water sample (Eh function). Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each day that the instrument is in use. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the pH/Eh meter will be:

pH	± 0.2 pH unit, over the temperature range of ± 0.2 C.
Eh	± 0.2 millivolts (mV) over the range of ± 399.9 mV, otherwise ± 2 mV.

PROCEDURE

Note: Meters produced by different manufacturers may have different calibration procedures. These instructions will take precedence over the procedure provided herein. This procedure is intended to be used as a general guideline, or in the absence of available manufacturer's instructions.

1. Obtain and active the meter to be used. As stated above, initial calibrations will be performed at the beginning of each sampling day.

2. Immerse the sensing probe in a container of certified pH 7.0 buffer solution traceable to the National Bureau of Standards.

3. Measure the temperature of the buffer solution, and adjust the temperature setting accordingly.

4. Compare the meter reading to the known value of the buffer solution while stirring. If the reading obtained by the meter does not agree with the known value of the buffer solution, recalibrate the meter according to the manufacturer's instructions until the desired reading is obtained. This typically involves accessing and turning a dial or adjustment screw while measuring the pH of the buffer solution. The meter is adjusted until the output agrees with the known solution pH.

5. Repeat Steps 2 through 5 with a pH 4.0 and 10.0 buffer solution to provide a three-point calibration. Standards used to calibrate the pH meter will be of concentrations that bracket the expected values of the samples to be analyzed, especially for two-point calibrations (see note below).

Note: Some pH meters only allow two-point calibrations. Two-point calibrations should be within the suspected range of the groundwater to be analyzed. For example, if the groundwater pH is expected to be approximately 8, the two-point calibration should bracket that value. Buffer solutions of 7 and 10 should then be used for the two-point calibration.

6. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample). Information will include, at a minimum:

   - Time, date, and initials of the field team member performing the calibration
   - The unique identifier for the meter, including manufacturer, model, and serial number
   - The brand and expiration dates of buffer solutions
   - The instrument readings
   - The instrument settings (if applicable)

- Pass or fail designation in accordance with the accuracy specifications presented above
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate

MAINTENANCE

- When not in use, or between measurements, keep the pH/Eh probe immersed in or moist with buffer solutions.

- Check the meter batteries at the end of each day and recharge or replace as needed.

- Replace the pH/Eh probe any time that the meter response time becomes greater than two minutes or the meeting system consistently fails to retain its calibrated accuracy for a minimum of ten sample measurements.

- If a replacement of the pH/Eh probe fails to resolve instrument response time and stability problems, obtain a replacement instrument (rental instruments) and/or order necessary repairs/adjustment.

ATTACHMENTS

Equipment Calibration Log (sample)

TurnKey Environmental Restoration, LLC

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name:
Date:
Project No.:
Client:
Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		μS @ 25 ^{o}C		
☐ PID	ppm		Photovac 2020 PID	[illegible]		open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Field Turbidity Meter

FOP 009.0

CALIBRATION AND MAINTENANCE OF PORTABLE FIELD TURBIDITY METER

PURPOSE

This guideline describes the method for calibration of the HACH 2100P portable field turbidity meter. Turbidity is one water quality parameter measured during purging and development of wells. Turbidity is measured as a function of the samples ability to transmit light, expressed as Nephelometric Turbidity Units (NTUs). The turbidity meter is factory calibrated and must be checked daily prior to using the meter in the field. Calibration is performed to verify instrument accuracy and function. This procedure also documents critical maintenance activities for this meter.

ACCURACY

Accuracy shall be ± 2% of reading below 499 NTU or ± 3% of reading above 500 NTU with resolution to 0.01 NTU in the lowest range. The range key provides for automatic or manual range selection for ranges of 0.00 to 9.99, 0.0 to 99.9 and 0 to 1000 NTU. Another key provides for selecting automatic signal averaging. Pressing the key shall toggle signal averaging on or off.

PROCEDURE

Calibration of the 2100P Turbidimeter is based on formazin, the primary standard for turbidity. The instrument's electronic and optical design provides long-term stability and minimizes the need for frequent calibration. The two-detector ratioing system compensates for most fluctuations in lamp output. **A formazin recalibration should be performed at least once every three months,** more often if experience indicates the need. During calibration, use a primary standard such as StablCal™ Stabilized Standards or formazin standards.

Note: Meters produced by different manufacturers may have different calibration check procedures. These manufacturers' instructions will take precedence over the procedure provided here. This procedure is intended to be used as a general guideline, or in the absence of available manufacturer's instructions.

Note: Because the turbidity meter measures light transmission, it is critical that the meter and standards be cared for as precision optical instruments. Scratches, dirt, dust, etc. can all temporarily or permanently affect the accuracy of meter readings.

Preparing StablCal Stabilized Standards in Sealed Vials

Sealed vials that have been sitting undisturbed for longer than a month must be shaken to break the condensed suspension into its original particle size. Start at *step 1* for these standards. If the standards are used on at least a weekly interval, start at *step 3.*

Note: These instructions do not apply to < 0.1 NTU StablCal Standards; < 0.1 NTU StablCal Standards should not be shaken or inverted.

1. Shake the standard vigorously for 2-3 minutes to re-suspend any particles.
2. Allow the standard to stand undisturbed for 5 minutes.
3. Gently invert the vial of StablCal 5 to 7 times.
4. Prepare the vial for measurement using traditional preparation techniques. This usually consists of oiling the vial (see *Section 2.3.2 on page 11 of the manual*)

and marking the vial to maintain the same orientation in the sample cell compartment (see *Section 2.3.3 on page 12 of the manual*). This step will eliminate any optical variations in the sample vial.

5. Let the vial stand for one minute. The standard is now ready for use in the calibration procedure.

Calibration Procedure

1. Turn the meter on.

2. Shake pre-mixed formazin primary standards in accordance with the above procedure.

3. Wipe the outside of the < 0.1 NTU standard and insert the sample cell in the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment.

4. Close the lid and press **I/O**.

5. Press the **CAL** button. The **CAL** and **S0** icons will be displayed and the 0 will flash. The four-digit display will show the value of the **S0** standard for the previous calibration. If the blank value was forced to 0.0, the display will be blank. Press the right arrow key (→) to get a numerical display.

6. Press **READ**. The instrument will count from 60 to 0, read the blank and use it to calculate a correction factor for the 20 NTU standard measurement. If the dilution water is ≥ 0.5 NTU, E 1 will appear when the calibration is calculated (*see Section 3.6.2.3 on page 31 of the manual*). The display will automatically increment to the next standard. Remove the sample cell from the cell compartment

Note: The turbidity of the dilution water can be "forced" to zero by pressing → rather than reading the dilution water. The display will show "S0 NTU" and the ↑ key must be pressed to continue with the next standard.

7. Repeat steps 1 through 7 for the 20, 100 and 800 standards.

8. Following the 800 NTU standard calibration, the display will increment back to the **S0** display. Remove the sample cell from the cell compartment.

9. Press **CAL** to accept the calibration. The instrument will return to measurement mode automatically.

10. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample). Information will include, at a minimum:
    - Time, date, and initials of the field team member performing the calibration
    - The unique identifier for the meter, including manufacturer, model, and serial number
    - The brand of calibration standards
    - The instrument readings
    - The instrument settings (if applicable)
    - Pass or fail designation in accordance with the accuracy specifications presented above
    - Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

Note: Pressing CAL completes the calculation of the calibration coefficients. If calibration errors occurred during calibration, error messages will appear after CAL is pressed. If E 1 or E 2 appear, check the standard preparation and review the calibration; repeat the calibration if necessary. If "CAL?" appears, an error may have

occurred during calibration. If "CAL?" is flashing, the instrument is using the default calibration.

NOTES

- If the **I/O** key is pressed during calibration, the new calibration data is lost and the old calibration will be used for measurements. Once in calibration mode, only the **READ, I/O,** ↑ , and →keys function. Signal averaging and range mode must be selected before entering the calibration mode.

- If **E 1** or **E 2** are displayed, an error occurred during calibration. Check the standard preparation and review the calibration; repeat the calibration if necessary. Press **DIAG** to cancel the error message (**E 1** or **E 2)**. To continue without repeating the calibration, press **I/O** twice to restore the previous calibration. If "**CAL?"** is displayed, an error may have occurred during calibration. The previous calibration may not be restored. Either recalibrate or use the calibration as is.

- To review a calibration, press **CAL** and then ↑ to view the calibration standard values. As long as **READ** is never pressed and **CAL** is not flashing, the calibration will not be updated. Press **CAL** again to return to the measurement mode.

MAINTENANCE

- **Cleaning**: Keep the turbidimeter and accessories as clean as possible and store the instrument in the carrying case when not in use. Avoid prolonged exposure to sunlight and ultraviolet light. Wipe spills up promptly. Wash sample cells with non-abrasive laboratory detergent, rinse with distilled or demineralized water, and air dry. Avoid scratching the cells and wipe all moisture and fingerprints off the cells before inserting them into the instrument. Failure to do so can give inaccurate readings. See *Section 2.3.1 on page 11of the manual* for more information about sample cell care.

- **Battery Replacement**: AA alkaline cells typically last for about 300 tests with the signal-averaging mode off, about 180 tests if signal averaging is used. The "battery" icon flashes when battery replacement is needed. Refer to *Section 1.4.2 on page 5 of the manual* for battery installation instructions. If the batteries are changed within 30 seconds, the instrument retains the latest range and signal average selections. If it takes more than 30 seconds, the instrument uses the default settings. If, after changing batteries, the instrument will not turn off or on and the batteries are good, remove the batteries and reinstall them. If the instrument still won't function, contact Hach Service or the nearest authorized dealer.

- **Lamp Replacement**: The procedure in *Section 4.0 on page 49 of the manual* explains lamp installation and electrical connections. Use a small screwdriver to remove and install the lamp leads in the terminal block. The instrument requires calibration after lamp replacement.

ATTACHMENTS

Equipment Calibration Log (sample)

TurnKey Environmental Restoration, LLC

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name: Date:

Project No.:

Client: Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		μS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID	ED 6FF 301		open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Photoionization Meter

FOP 011.1

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

PURPOSE

This procedure describes a general method for the calibration and maintenance of a portable photoionization detector (PID). The PID detects and initially quantifies a reading of the volatile organic compound (VOC) concentration in air. The PID is used as a field-screening tool for initial evaluation of soil samples and for ambient air monitoring of compounds with ionization potentials (IP) less than the PID lamp electron voltage (eV) rating. The IP is the amount of energy required to move an electron to an infinite distance from the nucleus thus creating a positive ion plus an electron. It should be noted that all of the major components of air (i.e., carbon dioxide, methane, nitrogen, oxygen etc.) have IP's above 12 eV. As a result, they will not be ionized by the 9.8, 10.6, or 11.7 eV lamps typically utilized in field PIDs. The response of the PID will then be the sum of the organic and inorganic compounds in air that are ionized by the appropriate lamp (i.e., 9.8, 10.6 or 11.7 eV). Attached to this FOP is a table summarizing common organic compounds and their respective IPs.

Calibration is performed to verify instrument accuracy and function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer’s specifications, but not less than once each day that the instrument is in use. Compound-specific calibration methods should be selected on a project-by-project basis to increase the accuracy of the instrument. The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter.

Note: The information included below is equipment manufacturer- and model-specific, however, accuracy, calibration, and maintenance procedures for this type of portable equipment are typically similar. The information below pertains to the MiniRAE 2000 Portable VOC Monitor equipped with a 10.6 eV lamp. The actual equipment to be used in the field will be equivalent or similar. The following information is provided for general reference; the equipment-specific manufacturer's manual should be followed with precedence over this FOP.

Note: The PID indicates <u>total</u> VOC concentration readings that are normalized to a calibration standard, so actual quantification of individual compounds is not provided. In addition, the PID response to compounds is highly variable, dependent on ionization potential of the compound, and the presence or absence of other compounds.

ACCURACY

The MiniRAE 2000 is accurate to ± 2 ppm or 10% of the reading for concentrations ranging from 0-2,000 ppm and ± 20% of the reading at concentrations greater than 2,000 ppm. Response time is less than two seconds to 90 percent of full-scale. The operating temperature range is 0 to 45° C and the operating humidity range is 0 to 95 % relative humidity (non-condensing).

CALIBRATION PROCEDURE

The calibration method and correction factor, if applicable, will be selected on a project-by-project basis and confirmed with the Project Manager prior to the start of field work.

1. Calibrate all field test equipment at the beginning of each sampling day. Check and recalibrate the PID according to the manufacture's specifications.

2. Calibrate the PID using a compressed gas cylinder or equivalent containing the calibration standard, a flow regulator, and a tubing assembly. In addition, a compressed gas cylinder containing zero air ("clean" air) may be required if ambient air conditions do not permit calibration to "clean air".

3. Fill two Tedlar® bags equipped with a one-way valve with zero-air (if applicable) and the calibration standard gas.

4. Assemble the calibration equipment and actuate the PID in its calibration mode.

5. Select the appropriate calibration method. Calibration may be completed with two methods: 1) where the calibration standard gas is the same as the measurement gas (no correction factor is applied) or 2) where the calibration standard gas is not the same as the measurement gas and a correction factor will be applied. An isobutylene standard gas must be used as the calibration standard gas for the use of correction factors with the MiniRAE 2000. See below for additional instructions for calibration specific to use with or without correction factors.

<u>Calibrating Without a Correction Factor</u>

Navigate within the menu to select the "cal memory" for the specific calibration standard gas prior to calibration. The default gas selections for the MiniRAE 2000 are as follows:

Cal Memory #0	Isobutylene
Cal Memory #1	Hexane
Cal Memory #2	Xylene
Cal Memory #3	Benzene
Cal Memory #4	Styrene
Cal Memory #5	Toluene
Cal Memory #6	Vinyl Chloride
Cal Memory #7	Custom

The calibration standard gas for Cal Memory #1-7 may be toggled for selection of any of the approximately 100 preprogrammed calibration standard gases for use without an applied correction factor (i.e., the calibration gas must be the same as the measurement gas).

Calibrating With a Correction Factor

Navigate within the menu to select the "Cal Memory".

Select "Cal Memory #0" and toggle for selection of any of the approximately 100 preprogrammed chemicals. During calibration, the unit requests isobutylene gas and displays the isobutylene concentration immediately following calibration, but when the unit is returned to the normal reading mode, it displays the selected chemical and applies the correction factor.

If the pre-programmed list does not include the desired chemical or a user-defined measurement gas and correction factor is desired, toggle Cal Memory #0 to "user defined custom gas". A list of approximately 300 correction factors is attached in Technical Note 106 generated by MiniRAE.

6. Once the PID settings have been verified, connect the PID probe to the zero air calibration bag (or calibrate to ambient air if conditions permit) and wait for a stable indication.

7. Connect the PID probe to the calibration standard bag. Measure an initial reading of the standard and wait for a stable indication.

8. Keep the PID probe connected to the calibration standard bag, calibrate to applicable concentration (typically 100 ppm with isobutylene) with the standard and wait for a stable indication.

9. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish

maintenance schedules and component replacement. Information will include, at a minimum:

- Time, date and initials of the field team member performing the calibration
- The unique identifier for the meter, including manufacturer, model, and serial number
- The calibration standard and concentration
- Correction factors used, if any
- The brand and expiration date of the calibration standard gas
- The instrument readings: before and after calibration
- The instrument settings (if applicable)
- Pass or fail designation in accordance with the accuracy specifications presented above
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

MAINTENANCE

- The probe and dust filter of the PID should be checked before and after every use for cleanliness. Should instrument response become unstable, recalibration should be performed. If this does not resolve the problem, access the photoionization bulb and clean with the manufacturer-supplied abrasive compound, then recalibrate.

- The PID battery must be recharged after each use. Store the PID in its carrying case when not in use. Additional maintenance details related to individual components of the PID are provided in the equipment manufacturer's instruction manual. If calibration or instrument performance is not in accordance with specifications, send the instrument to the equipment manufacturer for repair.

- Maintain a log for each monitoring instrument. Record all maintenance performed on the instrument on this log with date and name of the organization performing the maintenance.

ATTACHMENTS

Table 1; Summary of Ionization Potentials
Equipment Calibration Log (sample)
Technical Note TN-106

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
A		
2-Amino pyridine	8	
Acetaldehyde	10.21	
Acetamide	9.77	
Acetic acid	10.69	X
Acetic anhydride	10	
Acetone	9.69	
Acetonitrile	12.2	X
Acetophenone	9.27	
Acetyl bromide	10.55	
Acetyl chloride	11.02	X
Acetylene	11.41	X
Acrolein	10.1	
Acrylamide	9.5	
Acrylonitrile	10.91	X
Allyl alcohol	9.67	
Allyl chloride	9.9	
Ammonia	10.2	
Aniline	7.7	
Anisidine	7.44	
Anisole	8.22	
Arsine	9.89	
B		
1,3-Butadiene (butadiene)	9.07	
1-Bromo-2-chloroethane	10.63	X
1-Bromo-2-methylpropane	10.09	
1-Bromo-4-fluorobenzene	8.99	
1-Bromobutane	10.13	
1-Bromopentane	10.1	
1-Bromopropane	10.18	
1-Bromopropene	9.3	
1-Butanethiol	9.14	
1-Butene	9.58	
1-Butyne	10.18	
2,3-Butadione	9.23	
2-Bromo-2-methylpropane	9.89	
2-Bromobutane	9.98	
2-Bromopropane	10.08	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Bromothiophene	8.63	
2-Butanone (MEK)	9.54	
3-Bromopropene	9.7	
3-Butene nitrile	10.39	
Benzaldehyde	9.53	
Benzene	9.25	
Benzenethiol	8.33	
Benzonitrile	9.71	
Benzotrifluoride	9.68	
Biphenyl	8.27	
Boron oxide	13.5	X
Boron trifluoride	15.56	X
Bromine	10.54	
Bromobenzene	8.98	
Bromochloromethane	10.77	X
Bromoform	10.48	
Butane	10.63	X
Butyl mercaptan	9.15	
cis-2-Butene	9.13	
m-Bromotoluene	8.81	
n-Butyl acetate	10.01	
n-Butyl alcohol	10.04	
n-Butyl amine	8.71	
n-Butyl benzene	8.69	
n-Butyl formate	10.5	
n-Butyraldehyde	9.86	
n-Butyric acid	10.16	
n-Butyronitrile	11.67	X
o-Bromotoluene	8.79	
p-Bromotoluene	8.67	
p-tert-Butyltoluene	8.28	
s-Butyl amine	8.7	
s-Butyl benzene	8.68	
sec-Butyl acetate	9.91	
t-Butyl amine	8.64	
t-Butyl benzene	8.68	
trans-2-Butene	9.13	
C		

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
1-Chloro-2-methylpropane	10.66	X
1-Chloro-3-fluorobenzene	9.21	
1-Chlorobutane	10.67	X
1-Chloropropane	10.82	X
2-Chloro-2-methylpropane	10.61	X
2-Chlorobutane	10.65	X
2-Chloropropane	10.78	X
2-Chlorothiophene	8.68	
3-Chloropropene	10.04	
Camphor	8.76	
Carbon dioxide	13.79	X
Carbon disulfide	10.07	
Carbon monoxide	14.01	X
Carbon tetrachloride	11.47	X
Chlorine	11.48	X
Chlorine dioxide	10.36	
Chlorine trifluoride	12.65	X
Chloroacetaldehyde	10.61	X
α -Chloroacetophenone	9.44	
Chlorobenzene	9.07	
Chlorobromomethane	10.77	X
Chlorofluoromethane (Freon 22)	12.45	X
Chloroform	11.37	X
Chlorotrifluoromethane (Freon 13)	12.91	X
Chrysene	7.59	
Cresol	8.14	
Crotonaldehyde	9.73	
Cumene (isopropyl benzene)	8.75	
Cyanogen	13.8	X
Cyclohexane	9.8	
Cyclohexanol	9.75	
Cyclohexanone	9.14	
Cyclohexene	8.95	
Cyclo-octatetraene	7.99	
Cyclopentadiene	8.56	
Cyclopentane	10.53	
Cyclopentanone	9.26	
Cyclopentene	9.01	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Cyclopropane	10.06	
m-Chlorotoluene	8.83	
o-Chlorotoluene	8.83	
p-Chlorotoluene	8.7	
D		
1,1-Dibromoethane	10.19	
1,1-Dichloroethane	11.12	X
1,1-Dimethoxyethane	9.65	
1,1-Dimethylhydrazine	7.28	
1,2-Dibromoethene	9.45	
1,2-Dichloro-1,1,2,2-tetrafluoroethane (Freon 114)	12.2	X
1,2-Dichloroethane	11.12	X
1,2-Dichloropropane	10.87	X
1,3-Dibromopropane	10.07	
1,3-Dichloropropane	10.85	X
2,2-Dimethyl butane	10.06	
2,2-Dimethyl propane	10.35	
2,3-Dichloropropene	9.82	
2,3-Dimethyl butane	10.02	
3,3-Dimethyl butanone	9.17	
cis-Dichloroethene	9.65	
Decaborane	9.88	
Diazomethane	9	
Diborane	12	X
Dibromochloromethane	10.59	
Dibromodifluoromethane	11.07	X
Dibromomethane	10.49	
Dibutylamine	7.69	
Dichlorodifluoromethane (Freon 12)	12.31	X
Dichlorofluoromethane	12.39	X
Dichloromethane	11.35	X
Diethoxymethane	9.7	
Diethyl amine	8.01	
Diethyl ether	9.53	
Diethyl ketone	9.32	
Diethyl sulfide	8.43	
Diethyl sulfite	9.68	
Difluorodibromomethane	11.07	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Dihydropyran	8.34	
Diiodomethane	9.34	
Diisopropylamine	7.73	
Dimethoxymethane (methylal)	10	
Dimethyl amine	8.24	
Dimethyl ether	10	
Dimethyl sulfide	8.69	
Dimethylaniline	7.13	
Dimethylformamide	9.18	
Dimethylphthalate	9.64	
Dinitrobenzene	10.71	X
Dioxane	9.19	
Diphenyl	7.95	
Dipropyl amine	7.84	
Dipropyl sulfide	8.3	
Durene	8.03	
m-Dichlorobenzene	9.12	
N,N-Diethyl acetamide	8.6	
N,N-Diethyl formamide	8.89	
N,N-Dimethyl acetamide	8.81	
N,N-Dimethyl formamide	9.12	
o-Dichlorobenzene	9.06	
p-Dichlorobenzene	8.95	
p-Dioxane	9.13	
trans-Dichloroethene	9.66	
E		
Epichlorohydrin	10.2	
Ethane	11.65	X
Ethanethiol (ethyl mercaptan)	9.29	
Ethanolamine	8.96	
Ethene	10.52	
Ethyl acetate	10.11	
Ethyl alcohol	10.48	
Ethyl amine	8.86	
Ethyl benzene	8.76	
Ethyl bromide	10.29	
Ethyl chloride (chloroethane)	10.98	X
Ethyl disulfide	8.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Ethyl ether	9.51	
Ethyl formate	10.61	X
Ethyl iodide	9.33	
Ethyl isothiocyanate	9.14	
Ethyl mercaptan	9.29	
Ethyl methyl sulfide	8.55	
Ethyl nitrate	11.22	X
Ethyl propionate	10	
Ethyl thiocyanate	9.89	
Ethylene chlorohydrin	10.52	
Ethylene diamine	8.6	
Ethylene dibromide	10.37	
Ethylene dichloride	11.05	X
Ethylene oxide	10.57	
Ethylenelmine	9.2	
Ethynylbenzene	8.82	
F		
2-Furaldehyde	9.21	
Fluorine	15.7	X
Fluorobenzene	9.2	
Formaldehyde	10.87	X
Formamide	10.25	
Formic acid	11.05	X
Freon 11 (trichlorofluoromethane)	11.77	X
Freon 112 (1,1,2,2-tetrachloro-1,2-difluoroethane)	11.3	X
Freon 113 (1,1,2-trichloro-1,2,2-trifluororethane)	11.78	X
Freon 114 (1,2-dichloro-1,1,2,2-tetrafluoroethane)	12.2	X
Freon 12 (dichlorodifluoromethane)	12.31	X
Freon 13 (chlorotrifluoromethane)	12.91	X
Freon 22 (chlorofluoromethane)	12.45	X
Furan	8.89	
Furfural	9.21	
m-Fluorotoluene	8.92	
o-Fluorophenol	8.66	
o-Fluorotoluene	8.92	
p-Fluorotoluene	8.79	
H		
1-Hexene	9.46	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
2-Heptanone	9.33	
2-Hexanone	9.35	
Heptane	10.08	
Hexachloroethane	11.1	X
Hexane	10.18	
Hydrazine	8.1	
Hydrogen	15.43	X
Hydrogen bromide	11.62	X
Hydrogen chloride	12.74	X
Hydrogen cyanide	13.91	X
Hydrogen fluoride	15.77	X
Hydrogen iodide	10.38	
Hydrogen selenide	9.88	
Hydrogen sulfide	10.46	
Hydrogen telluride	9.14	
Hydroquinone	7.95	
I		
1-Iodo-2-methylpropane	9.18	
1-Iodobutane	9.21	
1-Iodopentane	9.19	
1-Iodopropane	9.26	
2-Iodobutane	9.09	
2-Iodopropane	9.17	
Iodine	9.28	
Iodobenzene	8.73	
Isobutane	10.57	
Isobutyl acetate	9.97	
Isobutyl alcohol	10.12	
Isobutyl amine	8.7	
Isobutyl formate	10.46	
Isobutyraldehyde	9.74	
Isobutyric acid	10.02	
Isopentane	10.32	
Isophorone	9.07	
Isoprene	8.85	
Isopropyl acetate	9.99	
Isopropyl alcohol	10.16	
Isopropyl amine	8.72	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Isopropyl benzene	8.69	
Isopropyl ether	9.2	
Isovaleraldehyde	9.71	
m-Iodotoluene	8.61	
o-Iodotoluene	8.62	
p-Iodotoluene	8.5	
K		
Ketene	9.61	
L		
2,3-Lutidine	8.85	
2,4-Lutidine	8.85	
2,6-Lutidine	8.85	
M		
2-Methyl furan	8.39	
2-Methyl napthalene	7.96	
1-Methyl napthalene	7.96	
2-Methyl propene	9.23	
2-Methyl-1-butene	9.12	
2-Methylpentane	10.12	
3-Methyl-1-butene	9.51	
3-Methyl-2-butene	8.67	
3-Methylpentane	10.08	
4-Methylcyclohexene	8.91	
Maleic anhydride	10.8	X
Mesityl oxide	9.08	
Mesitylene	8.4	
Methane	12.98	X
Methanethiol (methyl mercaptan)	9.44	
Methyl acetate	10.27	
Methyl acetylene	10.37	
Methyl acrylate	9.9	
Methyl alcohol	10.85	X
Methyl amine	8.97	
Methyl bromide	10.54	
Methyl butyl ketone	9.34	
Methyl butyrate	10.07	
Methyl cellosolve	9.6	
Methyl chloride	11.28	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Methyl chloroform (1,1,1-trichloroethane)	11	X
Methyl disulfide	8.46	
Methyl ethyl ketone	9.53	
Methyl formate	10.82	X
Methyl iodide	9.54	
Methyl isobutyl ketone	9.3	
Methyl isobutyrate	9.98	
Methyl isocyanate	10.67	X
Methyl isopropyl ketone	9.32	
Methyl isothiocyanate	9.25	
Methyl mercaptan	9.44	
Methyl methacrylate	9.7	
Methyl propionate	10.15	
Methyl propyl ketone	9.39	
α -Methyl styrene	8.35	
Methyl thiocyanate	10.07	
Methylal (dimethoxymethane)	10	
Methylcyclohexane	9.85	
Methylene chloride	11.32	X
Methyl-n-amyl ketone	9.3	
Monomethyl aniline	7.32	
Monomethyl hydrazine	7.67	
Morpholine	8.2	
n-Methyl acetamide	8.9	
N		
1-Nitropropane	10.88	X
2-Nitropropane	10.71	X
Naphthalene	8.12	
Nickel carbonyl	8.27	
Nitric oxide, (NO)	9.25	
Nitrobenzene	9.92	
Nitroethane	10.88	X
Nitrogen	15.58	X
Nitrogen dioxide	9.78	
Nitrogen trifluoride	12.97	X
Nitromethane	11.08	X
Nitrotoluene	9.45	
p-Nitrochloro benzene	9.96	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
O		
Octane	9.82	
Oxygen	12.08	X
Ozone	12.08	X
P		
1-Pentene	9.5	
1-Propanethiol	9.2	
2,4-Pentanedione	8.87	
2-Pentanone	9.38	
2-Picoline	9.02	
3-Picoline	9.02	
4-Picoline	9.04	
n-Propyl nitrate	11.07	X
Pentaborane	10.4	
Pentane	10.35	
Perchloroethylene	9.32	
Pheneloic	8.18	
Phenol	8.5	
Phenyl ether (diphenyl oxide)	8.82	
Phenyl hydrazine	7.64	
Phenyl isocyanate	8.77	
Phenyl isothiocyanate	8.52	
Phenylene diamine	6.89	
Phosgene	11.77	X
Phosphine	9.87	
Phosphorus trichloride	9.91	
Phthalic anhydride	10	
Propane	11.07	X
Propargyl alcohol	10.51	
Propiolactone	9.7	
Propionaldehyde	9.98	
Propionic acid	10.24	
Propionitrile	11.84	X
Propyl acetate	10.04	
Propyl alcohol	10.2	
Propyl amine	8.78	
Propyl benzene	8.72	
Propyl ether	9.27	

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Propyl formate	10.54	
Propylene	9.73	
Propylene dichloride	10.87	X
Propylene imine	9	
Propylene oxide	10.22	
Propyne	10.36	
Pyridine	9.32	
Pyrrole	8.2	
Q		
Quinone	10.04	
S		
Stibine	9.51	
Styrene	8.47	
Sulfur dioxide	12.3	X
Sulfur hexafluoride	15.33	X
Sulfur monochloride	9.66	
Sulfuryl fluoride	13	X
T		
o-Terphenyls	7.78	
1,1,2,2-Tetrachloro-1,2-difluoroethane (Freon 112)	11.3	X
1,1,1-Trichloroethane	11	X
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	11.78	X
2,2,4-Trimethyl pentane	9.86	
o-Toluidine	7.44	
Tetrachloroethane	11.62	X
Tetrachloroethene	9.32	
Tetrachloromethane	11.47	X
Tetrahydrofuran	9.54	
Tetrahydropyran	9.25	
Thiolacetic acid	10	
Thiophene	8.86	
Toluene	8.82	
Tribromoethene	9.27	
Tribromofluoromethane	10.67	X
Tribromomethane	10.51	
Trichloroethene	9.45	
Trichloroethylene	9.47	
Trichlorofluoromethane (Freon 11)	11.77	X

TABLE 1

SUMMARY OF IONIZATION POTENTIALS

Chemical Name	Ionization Potential (eV)	Cannot be Read by 10.6 eV PID
Trichloromethane	11.42	X
Triethylamine	7.5	
Trifluoromonobromo-methane	11.4	X
Trimethyl amine	7.82	
Tripropyl amine	7.23	
V		
o-Vinyl toluene	8.2	
Valeraldehyde	9.82	
Valeric acid	10.12	
Vinyl acetate	9.19	
Vinyl bromide	9.8	
Vinyl chloride	10	
Vinyl methyl ether	8.93	
W		
Water	12.59	X
X		
2,4-Xylidine	7.65	
m-Xylene	8.56	
o-Xylene	8.56	
p-Xylene	8.45	

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

EQUIPMENT CALIBRATION LOG

PROJECT INFORMATION:

Project Name: ______________________ Date: ______________

Project No.: ______________________

Client: ______________________ Instrument Source: ☐ BM ☐ Rental

	METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	POST CAL. READING	SETTINGS
☐	pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
							7.00		
							10.01		
☐	Turbidity meter	NTU		Hach 2100P Turbidimeter	9706000145		< 0.4		
							[illegible]		
							[illegible]00		
							800		
☐	Sp. Cond. meter	uS mS		Myron L Company Ultra Meter 6P	[illegible]		______ mS @ 25 °C		
☐	PID	ppm		MinRAE 20			open air zero		MIBK response factor = 1.0
							_____ ppm Iso. Gas		
☐	Dissolved Oxygen	ppm		YSI Model 5	[illegible]				
☐	Particulate meter	mg/m^3					zero air		
☐	Oxygen	%					open air		
☐	Hydrogen sulfide	ppm					open air		
☐	Carbon monoxide	ppm					open air		
☐	LEL	%					open air		
☐	Radiation Meter	uR/H					background area		
☐									

ADDITIONAL REMARKS: ______________________

PREPARED BY: ______________________ **DATE:** ______________

Technical Note TN-106

Revised 08/2010

Correction Factors, Ionization Energies*, And Calibration Characteristics

Correction Factors and Ionization Energies

RAE Systems PIDs can be used for the detection of a wide variety of gases that exhibit different responses. In general, any compound with ionization energy (IE) lower than that of the lamp photons can be measured.* The best way to calibrate a PID to different compounds is to use a standard of the gas of interest. However, correction factors have been determined that enable the user to quantify a large number of chemicals using only a single calibration gas, typically isobutylene. In our PIDs, correction factors can be used in one of three ways:

1) Calibrate the monitor with isobutylene in the usual fashion to read in isobutylene equivalents. Manually multiply the reading by the correction factor (CF) to obtain the concentration of the gas being measured.

2) Calibrate the unit with isobutylene in the usual fashion to read in isobutylene equivalents. Call up the correction factor from the instrument memory or download it from a personal computer and then call it up. The monitor will then read directly in units of the gas of interest.

3) Calibrate the unit with isobutylene, but input an equivalent, "corrected" span gas concentration when prompted for this value. The unit will then read directly in units of the gas of interest.

* *The term "ionization energy" is more scientifically correct and replaces the old term "ionization potential." High-boiling ("heavy") compounds may not vaporize enough to give a response even when their ionization energies are below the lamp photon energy. Some inorganic compounds like* H_2O_2 *and* NO_2 *give weak response even when their ionization energies are well below the lamp photon energy.*

Example 1:

With the unit calibrated to read isobutylene equivalents, the reading is 10 ppm with a 10.6 eV lamp. The gas being measured is butyl acetate, which has a correction factor of 2.6. Multiplying 10 by 2.6 gives an adjusted butyl acetate value of 26 ppm. Similarly, if the gas being measured were trichloroethylene (CF = 0.54), the adjusted value with a 10 ppm reading would be 5.4 ppm.

Example 2:

With the unit calibrated to read isobutylene equivalents, the reading is 100 ppm with a 10.6 eV lamp. The gas measured is m-xylene (CF = 0.43). After downloading this factor, the unit should read about 43 ppm when exposed to the same gas, and thus read directly in m-xylene values.

Example 3:

The desired gas to measure is ethylene dichloride (EDC). The CF is 0.6 with an 11.7 eV lamp. During calibration with 100 ppm isobutylene, insert 0.6 times 100, or 60 at the prompt for the calibration gas concentration. The unit then reads directly in EDC values.

Conversion to mg/m^3

To convert from ppm to mg/m^3, use the following formula:

$$\text{Conc. (mg/m}^3\text{)} = \frac{[\text{Conc.(ppmv) x mol. wt. (g/mole)}]}{\text{molar gas volume (L)}}$$

For air at 25 °C (77 °F), the molar gas volume is 24.4 L/mole and the formula reduces to:

$$\text{Conc.(mg/m}^3\text{)} = \text{Conc.(ppmv) x mol. wt. (g/mole) x 0.041}$$

For example, if the instrument is calibrated with a gas standard in ppmv, such as 100 ppm isobutylene, and the user wants the display to read in mg/m^3 of hexane, whose m.w. is 86 and CF is 4.3, the overall correction factor would be 4.3 x 86 x 0.041 equals 15.2.

Correction Factors for Mixtures

The correction factor for a mixture is calculated from the sum of the mole fractions Xi of each component divided by their respective correction factors CFi:

$$\text{CFmix} = 1 / (X_1/CF_1 + X_2/CF_2 + X_3/CF_3 + ... Xi/CFi)$$

Thus, for example, a vapor phase mixture of 5% benzene and 95% n-hexane would have a CFmix of CFmix = 1 / (0.05/0.53 + 0.95/4.3) = 3.2. A reading of 100 would then correspond to 320 ppm of the total mixture, comprised of 16 ppm benzene and 304 ppm hexane.

For a spreadsheet to compute the correction factor and TLV of a mixture see the appendix at the end of the CF table.

TLVs and Alarm Limits for Mixtures

The correction factor for mixtures can be used to set alarm limits for mixtures. To do this one first needs to calculate the exposure limit for the mixture. The Threshold Limit Value (TLV) often defines exposure limits. The TLV for the mixture is calculated in a manner similar to the CF calculation:

$$\text{TLV mix} = 1 / (X_1/\text{TLV}_1 + X_2/\text{TLV}_2 + X_3/\text{TLV}_3 + \ldots X_i/\text{TLV}_i)$$

In the above example, the 8-h TLV for benzene is 0.5 ppm and for n-hexane 50 ppm. Therefore the TLV of the mixture is TLVmix = 1 / (0.05/0.5 + 0.95/50) = 8.4 ppm, corresponding to 8.0 ppm hexane and 0.4 ppm benzene. For an instrument calibrated on isobutylene, the reading corrsponding to the TLV is:

$$\text{Alarm Reading} = \text{TLVmix} / \text{CFmix} = 8.4 / 3.2 = 2.6 \text{ ppm}$$

A common practice is to set the lower alarm limit to half the TLV, and the higher limit to the TLV. Thus, one would set the alarms to 1.3 and 2.6 ppm, respectively.

Calibration Characteristics

a) Flow Configuration. PID response is essentially independent of gas flow rate as long as it is sufficient to satisfy the pump demand. Four main flow configurations are used for calibrating a PID:

1) **Pressurized gas cylinder (Fixed-flow regulator):** The flow rate of the regulator should match the flow demand of the instrument pump or be slightly higher.
2) **Pressurized gas cylinder (Demand-flow regulator):** A demand-flow regulator better matches pump speed differences, but results in a slight vacuum during calibration and thus slightly high readings.
3) **Collapsible gas bag:** The instrument will draw the calibration gas from the bag at its normal flow rate, as long as the bag valve is large enough. The bag should be filled with enough gas to allow at least one minute of flow (~ 0.6 L for a MiniRAE, ~0.3 L for MultiRAE).
4) **T (or open tube) method:** The T method uses a T-junction with gas flow higher than the pump draw. The gas supply is connected to one end of the T, the instrument inlet is connected to a second end of the T, and excess gas flow escapes through the third, open end of the T. To prevent ambient air mixing, a long tube should be connected to the open end, or a high excess rate should be used. Alternatively, the instrument probe can be inserted into an open tube slightly wider than the probe. Excess gas flows out around the probe.

The first two cylinder methods are the most efficient in terms of gas usage, while the bag and T methods give slightly more accurate results because they match the pump flow better.

b) Pressure. Pressures deviating from atmospheric pressure affect the readings by altering gas concentration and pump characteristics. It is best to calibrate with the instrument and calibration gas at the same pressure as each other and the sample gas. (Note that the cylinder pressure is not relevant because the regulator reduces the pressure to ambient.) If the instrument is calibrated at atmospheric pressure in one of the flow configurations described above, then 1) pressures slightly above ambient are acceptable but high pressures can damage the pump and 2) samples under vacuum may give low readings if air leaks into the sample train.

c) Temperature. Because temperature effects gas density and concentration, the temperature of the calibration gas and instrument should be as close as possible to the ambient temperature where the unit will be used. We recommend that the temperature of the calibration gas be within the instrument's temperature specification (typically 14° to 113° F or -10° to 45° C). Also, during actual measurements, the instrument should be kept at the same or higher temperature than the sample temperature to avoid condensation in the unit.

d) Matrix. The matrix gas of the calibration compound and VOC sample is significant. Some common matrix components, such as methane and water vapor can affect the VOC signal. PIDs are most commonly used for monitoring VOCs in air, in which case the preferred calibration gas matrix is air. For a MiniRAE, methane, methanol, and water vapor reduce the response by about 20% when their concentration is 15,000 ppm and by about 40% at 30,000 ppm. Despite earlier reports of oxygen effects, RAE PID responses with 10.6 eV lamps are independent of oxygen concentration, and calibration gases in a pure nitrogen matrix can be used. H_2 and CO_2 up to 5 volume % also have no effect.

e) Concentration. Although RAE Systems PIDs have electronically linearized output, it is best to calibrate in a concentration range close to the actual measurement range. For example, 100 ppm standard gas for anticipated vapors of 0 to 250 ppm, and 500 ppm standard for expected concentrations of 250 to 1000 ppm. The correction factors in this table were typically measured at 50 to 100 ppm and apply from the ppb range up to about 1000 ppm. Above 1000 ppm the CF may vary and it is best to calibrate with the gas of interest near the concentration of interest.

f) Filters. Filters affect flow and pressure conditions and therefore all filters to be used during sampling should also be in place during calibration. Using a water trap (hydrophobic filter) greatly reduces the chances of drawing water aerosols or dirt particles into the instrument. Regular filter replacements are recommended because dirty filters can adsorb VOCs and cause slower response time and shifts in calibration.

g) Instrument Design. High-boiling ("heavy") or very reactive compounds can be lost by reaction or adsorption onto materials in the gas sample train, such as filters, pumps and other sensors. Multi-gas meters, including EntryRAE, MultiRAE and AreaRAE have the pump and other sensors upstream of the PID and are prone to these losses. Compounds possibly affected by such losses are shown in green in the table, and may give slow response, or in extreme cases, no response at all. In many cases the multi-gas meters can still give a rough indication of the relative concentration, without giving an accurate, quantitative reading. The ppbRAE and MiniRAE series instruments have inert sample trains and therefore do not exhibit significant loss; nevertheless, response may be slow for the very heavy compounds and additional sampling time up to a minute or more should be allowed to get a stable reading.

Table Abbreviations:

CF = Correction Factor (multiply by reading to get corrected value for the compound when calibrated to isobutylene)
NR= No Response
IE = Ionization Energy (values in parentheses are not well established)
C = Confirmed Value indicated by "+" in this column; all others are preliminary or estimated values and are subject to change
ne = Not Established ACGIH 8-hr. TWA
C## = Ceiling value, given where 8-hr.TWA is not available

Disclaimer:

Actual readings may vary with age and cleanliness of lamp, relative humidity, and other factors. For accurate work, the instrument should be calibrated regularly under the operating conditions used. The factors in this table were measured in dry air at room temperature, typically at 50-100 ppm. CF values may vary above about 1000 ppm.

Updates:

The values in this table are subject to change as more or better data become available. Watch for updates of this table on the Internet at **http://www.raesystems.com**

IE data are taken from the CRC Handbook of Chemistry and Physics, 73rd Edition, D.R. Lide (Ed.), CRC Press (1993) and NIST Standard Ref. Database 19A, NIST Positive Ion Energetics, Vers. 2.0, Lias, et.al., U.S. Dept. Commerce (1993). Exposure limits (8-h TWA and Ceiling Values) are from the 2005 ACGIH Guide to Occupational Exposure Values, ACGIH, Cincinnati, OH 2005. Equations for exposure limits for mixtures of chemicals were taken from the 1997 TLVs and BEIs handbook published by the ACGIH (1997).

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Acetaldehyde		75-07-0	C_2H_4O	NR	+	6	+	3.3	+	10.23	C25
Acetic acid	Ethanoic Acid	64-19-7	$C_2H_4O_2$	NR	+	22	+	2.6	+	10.66	10
Acetic anhydride	Ethanoic Acid Anhydride	108-24-7	$C_4H_6O_3$	NR	+	6.1	+	2.0	+	10.14	5
Acetone	2-Propanone	67-64-1	C_3H_6O	1.2	+	1.1	+	1.4	+	9.71	500
Acetone cyanohydrin	2-Hydroxyisobutyronitrile	75-86-5	C_4H_7NO					4	+	11.1	C5
Acetonitrile	Methyl cyanide, Cyanomethane	75-05-8	C_2H_3N					100		12.19	40
Acetylene	Ethyne	74-86-2	C_2H_2					2.1	+	11.40	ne
Acrolein	Propenal	107-02-8	C_3H_4O	42	+	3.9	+	1.4	+	10.10	0.1
Acrylic acid	Propenoic Acid	79-10-7	$C_3H_4O_2$			12	+	2.0	+	10.60	2
Acrylonitrile	Propenenitrile	107-13-1	C_3H_3N			NR	+	1.2	+	10.91	2
Allyl alcohol		107-18-6	C_3H_6O	4.5	+	2.4	+	1.6	+	9.67	2
Allyl chloride	3-Chloropropene	107-05-1	C_3H_5Cl			4.3		0.7		9.9	1
Ammonia		7664-41-7	H_3N	NR	+	9.7	+	5.7	+	10.16	25
Amyl acetate	mix of n-Pentyl acetate & 2-Methylbutyl acetate	628-63-7	$C_7H_{14}O_2$	11	+	2.3	+	0.95	+	<9.9	100
Amyl alcohol	1-Pentanol	75-85-4	$C_5H_{12}O$			5		1.6		10.00	ne
Aniline	Aminobenzene	62-53-3	C_7H_7N	0.50	+	0.48	+	0.47	+	7.72	2
Anisole	Methoxybenzene	100-66-3	C_7H_8O	0.89	+	0.58	+	0.56	+	8.21	ne
Arsine	Arsenic trihydride	7784-42-1	AsH_3			1.9	+			9.89	0.05
Benzaldehyde		100-52-7	C_7H_6O					1		9.49	ne
Benzenamine, N-methyl-	N-Methylphenylamine	100-61-8	C_7H_9N			0.7				7.53	
Benzene		71-43-2	C_6H_6	0.55	+	0.53	+	0.6	+	9.25	0.5
Benzonitrile	Cyanobenzene	100-47-0	C_7H_5N			1.6				9.62	ne
Benzyl alcohol	α-Hydroxytoluene, Hydroxymethylbenzene, Benzenemethanol	100-51-6	C_7H_8O	1.4	+	1.1	+	0.9	+	8.26	ne
Benzyl chloride	α-Chlorotoluene, Chloromethylbenzene	100-44-7	C_7H_7Cl	0.7	+	0.6	+	0.5	+	9.14	1
Benzyl formate	Formic acid benzyl ester	104-57-4	$C_8H_8O_2$	0.9	+	0.73	+	0.66	+		ne
Boron trifluoride		7637-07-2	BF_3	NR		NR		NR		15.5	C1
Bromine		7726-95-6	Br_2	NR	+	1.30	+	0.74	+	10.51	0.1
Bromobenzene		108-86-1	C_6H_5Br			0.6		0.5		8.98	ne
2-Bromoethyl methyl ether		6482-24-2	C_3H_7OBr			0.84	+			~10	ne
Bromoform	Tribromomethane	75-25-2	$CHBr_3$	NR	+	2.5	+	0.5	+	10.48	0.5
Bromopropane,1-	n-Propyl bromide	106-94-5	C_3H_7Br	150	+	1.5	+	0.6	+	10.18	ne
Butadiene	1,3-Butadiene, Vinyl ethylene	106-99-0	C_4H_6	0.8		0.85	+	1.1		9.07	2
Butadiene diepoxide, 1,3-	1,2,3,4-Diepoxybutane	298-18-0	$C_4H_6O_2$	25	+	3.5	+	1.2		~10	ne
Butanal	1-Butanal	123-72-8	C_4H_8O			1.8				9.84	
Butane		106-97-8	C_4H_{10}			67	+	1.2		10.53	800
Butanol, 1-	Butyl alcohol, n-Butanol	71-36-3	$C_4H_{10}O$	70	+	4.7	+	1.4	+	9.99	20
Butanol, t-	tert-Butanol, t-Butyl alcohol	75-65-0	$C_4H_{10}O$	6.9	+	2.9	+			9.90	100
Butene, 1-	1-Butylene	106-98-9	C_4H_8			0.9				9.58	ne
Butoxyethanol, 2-	Butyl Cellosolve, Ethylene glycol monobutyl ether	111-76-2	$C_6H_{14}O_2$	1.8	+	1.2	+	0.6	+	<10	25
Butoxyethanol acetate	Ethanol, 2-(2-butoxyethoxy)-, acetate	124-17-4	$C_{10}H_{20}O_4$			5.6				≤10.6	
Butoxyethoxyethanol	2-(2-Butoxyethoxy)ethanol	112-34-5	$C_8H_{18}O_3$			4.6				≤10.6	
Butyl acetate, n-		123-86-4	$C_6H_{12}O_2$			2.6	+			10	150
Butyl acrylate, n-	Butyl 2-propenoate, Acrylic acid butyl ester	141-32-2	$C_7H_{12}O_2$			1.6	+	0.6	+		10
Butylamine, n-		109-73-9	$C_4H_{11}N$	1.1	+	1.1	+	0.7	+	8.71	C5
Butyl cellosolve	see 2-Butoxyethanol	111-76-2									
Butyl hydroperoxide, t-		75-91-2	$C_4H_{10}O_2$	2.0	+	1.6	+			<10	1
Butyl mercaptan	1-Butanethiol	109-79-5	$C_4H_{10}S$	0.55	+	0.52	+			9.14	0.5
Carbon disulfide		75-15-0	CS_2	4	+	1.2	+	0.44		10.07	10
Carbon tetrachloride	Tetrachloromethane	56-23-5	CCl_4	NR	+	NR	+	1.7	+	11.47	5
Carbonyl sulfide	Carbon oxysulfide	463-58-1	COS							11.18	
Cellosolve see 2-Ethoxyethanol											
CFC-14 see Tetrafluoromethane											
CFC-113 see 1,1,2-Trichloro-1,2,2-trifluoroethane											

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Chlorine		7782-50-5	Cl_2					1.0	+	11.48	0.5
Chlorine dioxide		10049-04-4	ClO_2	NR	+	NR	+	NR	+	10.57	0.1
Chlorobenzene	Monochlorobenzene	108-90-7	C_6H_5Cl	0.44	+	0.40	+	0.39	+	9.06	10
Chlorobenzotrifluoride, 4-	PCBTF, OXSOL 100 p-Chlorobenzotrifluoride	98-56-6	$C_7H_4ClF_3$	0.74	+	0.63	+	0.55	+	<9.6	25
Chloro-1,3-butadiene, 2-	Chloroprene	126-99-8	C_4H_5Cl			3					10
Chloro-1,1-difluoroethane, 1-	HCFC-142B, R-142B	75-68-3	$C_2H_3ClF_2$	NR		NR		NR		12.0	ne
Chlorodifluoromethane	HCFC-22, R-22	75-45-6	$CHClF_2$	NR		NR		NR		12.2	1000
Chloroethane	Ethyl chloride	75-00-3	C_2H_5Cl	NR	+	NR	+	1.1	+	10.97	100
Chloroethanol	Ethylene chlrohydrin	107-07-3	C_2H_5ClO					2.9		10.52	C1
Chloroethyl ether, 2-	bis(2-chloroethyl) ether	111-44-4	$C_4H_8Cl_2O$	8.6	+	3.0	+				5
Chloroethyl methyl ether, 2-	Methyl 2-chloroethyl ether	627-42-9	C_3H_7ClO			3					ne
Chloroform	Trichloromethane	67-66-3	$CHCl_3$	NR	+	NR	+	3.5	+	11.37	10
Chloro-2-methylpropene, 3-	Methallyl chloride, Isobutenyl chloride	563-47-3	C_4H_7Cl	1.4	+	1.2	+	0.63	+	9.76	ne
Chloropicrin		76-06-2	CCl_3NO_2	NR	+	~400	+	7	+	?	0.1
Chlorotoluene, o-	o-Chloromethylbenzene	95-49-8	C_7H_7Cl			0.5		0.6		8.83	50
Chlorotoluene, p-	p-Chloromethylbenzene	106-43-4	C_7H_7Cl					0.6		8.69	ne
Chlorotrifluoroethene	CTFE, Chlorotrifluoroethylene Genetron 1113	79-38-9	C_2ClF_3	6.7	+	3.9	+	1.2	+	9.76	5
Chlorotrimethylsilane		75-77-4	C_3H_9ClSi	NR		NR		0.82	+	10.83	ne
Cresol, m-	m-Hydroxytoluene	108-39-4	C_7H_8O	0.57	+	0.50	+	0.57	+	8.29	5
Cresol, o-	o-Hydroxytoluene	95-48-7	C_7H_8O			1.0				8.50	
Cresol, p-	p-Hydroxytoluene	106-44-5	C_7H_8O			1.4				8.35	
Crotonaldehyde	*trans*-2-Butenal	123-73-9 4170-30-3	C_4H_6O	1.5	+	1.1	+	1.0	+	9.73	2
Cumene	Isopropylbenzene	98-82-8	C_9H_{12}	0.58	+	0.54	+	0.4	+	8.73	50
Cyanogen bromide		506-68-3	$CNBr$	NR		NR		NR		11.84	ne
Cyanogen chloride		506-77-4	$CNCl$	NR		NR		NR		12.34	C0.3
Cyclohexane		110-82-7	C_6H_{12}	3.3	+	1.4	+	0.64	+	9.86	300
Cyclohexanol	Cyclohexyl alcohol	108-93-0	$C_6H_{12}O$	1.5	+	0.9	+	1.1	+	9.75	50
Cyclohexanone		108-94-1	$C_6H_{10}O$	1.0	+	0.9	+	0.7	+	9.14	25
Cyclohexene		110-83-8	C_6H_{10}			0.8	+			8.95	300
Cyclohexylamine		108-91-8	$C_6H_{13}N$			1.2				8.62	10
Cyclopentane 85% 2,2-dimethylbutane 15%		287-92-3	C_5H_{10}	NR	+	15	+	1.1		10.33	600
Cyclopropylamine	Aminocyclpropane	765-30-0	C_3H_7N	1.1	+	0.9	+	0.9	+		ne
Decamethylcyclopentasiloxane		541-02-6	$C_{10}H_{30}O_5Si_5$	0.16	+	0.13	+	0.12	+		ne
Decamethyltetrasiloxane		141-62-8	$C_{10}H_{30}O_3Si_4$	0.17	+	0.13	+	0.12	+	<10.2	ne
Decane		124-18-5	$C_{10}H_{22}$	4.0	+	1.4	+	0.35	+	9.65	ne
Diacetone alcohol	4-Methyl-4-hydroxy-2-pentanone	123-42-2	$C_6H_{12}O_2$			0.7					50
Dibromochloromethane	Chlorodibromomethane	124-48-1	$CHBr_2Cl$	NR	+	5.3	+	0.7	+	10.59	ne
Dibromo-3-chloropropane, 1,2-	DBCP	96-12-8	$C_3H_5Br_2Cl$	NR	+	1.7	+	0.43	+		0.001
Dibromoethane, 1,2-	EDB, Ethylene dibromide, Ethylene bromide	106-93-4	$C_2H_4Br_2$	NR	+	1.7	+	0.6	+	10.37	ne
Dichlorobenzene, o-	1,2-Dichlorobenzene	95-50-1	$C_6H_4Cl_2$	0.54	+	0.47	+	0.38	+	9.08	25
Dichlorodifluoromethane	CFC-12	75-71-8	CCl_2F_2			NR	+	NR	+	11.75	1000
Dichlorodimethylsilane		75-78-5	$C_2H_6Cl_2Si$	NR		NR		1.1	+	>10.7	ne
Dichloroethane, 1,2-	EDC, 1,2-DCA, Ethylene dichloride	107-06-2	$C_2H_4Cl_2$			NR	+	0.6	+	11.04	10
Dichloroethene, 1,1-	1,1-DCE, Vinylidene chloride	75-35-4	$C_2H_2Cl_2$			0.82	+	0.8	+	9.79	5
Dichloroethene, c-1,2-	*c*-1,2-DCE, *cis*-Dichloroethylene	156-59-2	$C_2H_2Cl_2$			0.8				9.66	200
Dichloroethene, t-1,2-	*t*-1,2-DCE, *trans*-Dichloroethylene	156-60-5	$C_2H_2Cl_2$			0.45	+	0.34	+	9.65	200
Dichloro-1-fluoroethane, 1,1-	R-141B	1717-00-6	$C_2H_3Cl_2F$	NR	+	NR	+	2.0	+		ne
Dichloromethane	see Methylene chloride										

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Dichloropentafluoropropane	AK-225, mix of ~45% 3,3-dichloro-1,1,1,2,2-pentafluoro-propane (HCFC-225ca) & ~55% 1,3-Dichloro-1,1,2,2,3-pentafluoropropane (HCFC-225cb)	442-56-0 507-55-1	$C_3HCl_2F_5$	NR	+	NR	+	25	+		ne
Dichloropropane, 1,2-		78-87-5	$C_3H_6Cl_2$					0.7		10.87	75
Dichloro-1-propene, 1,3-		542-75-6	$C_3H_4C_{12}$	1.3	+	0.96	+			<10	1
Dichloro-1-propene, 2,3-		78-88-6	$C_3H_4Cl_2$	1.9	+	1.3	+	0.7	+	<10	ne
Dichloro-1,1,1-trifluoroethane, 2,2-	R-123	306-83-2	$C_2HCl_2F_3$	NR	+	NR	+	10.1	+	11.5	ne
Dichloro-2,4,6-trifluoropyridine, 3,5-	DCTFP	1737-93-5	$C_5Cl_2F_3N$	1.1	+	0.9	+	0.8	+		ne
Dichlorvos *	Vapona; O,O-dimethyl O-dichlorovinyl phosphate	62-73-7	$C_4H_7Cl_2O_4P$			0.9	+			<9.4	0.1
Dicyclopentadiene	DCPD, Cyclopentadiene dimer	77-73-6	$C_{10}H_{12}$	0.57	+	0.48	+	0.43	+	8.8	5
Diesel Fuel		68334-30-5	m.w. 226			0.9	+				11
Diesel Fuel #2 (Automotive)		68334-30-5	m.w. 216	1.3		0.7	+	0.4	+		11
Diethylamine		109-89-7	$C_4H_{11}N$			1	+			8.01	5
Diethylaminopropylamine, 3-		104-78-9	$C_7H_{18}N_2$			1.3					ne
Diethylbenzene	See Dowtherm J										
Diethylmaleate		141-05-9	$C_8H_{12}O_4$			4					ne
Diethyl sulfide	see Ethyl sulfide										
Diglyme	See Methoxyethyl ether	111-96-6	$C_6H_{14}O_3$								
Diisobutyl ketone	DIBK, 2,2-dimethyl-4-heptanone	108-83-8	$C_9H_{18}O$	0.71	+	0.61	+	0.35	+	9.04	25
Diisopropylamine		108-18-9	$C_6H_{15}N$	0.84	+	0.74	+	0.5	+	7.73	5
Diketene	Ketene dimer	674-82-8	$C_4H_4O_2$	2.6	+	2.0	+	1.4	+	9.6	0.5
Dimethylacetamide, N,N-	DMA	127-19-5	C_4H_9NO	0.87	+	0.8	+	0.8	+	8.81	10
Dimethylamine		124-40-3	C_2H_7N			1.5				8.23	5
Dimethyl carbonate	Carbonic acid dimethyl ester	616-38-6	$C_3H_6O_3$	NR	+	~70	+	1.7	+	~10.5	ne
Dimethyl disulfide	DMDS	624-92-0	$C_2H_6S_2$	0.2	+	0.20	+	0.21	+	7.4	ne
Dimethyl ether	see Methyl ether										
Dimethylethylamine	DMEA	598-56-1	$C_4H_{11}N$	1.1	+	1.0	+	0.9	+	7.74	~3
Dimethylformamide, N,N-	DMF	68-12-2	C_3H_7NO	0.7	+	0.7	+	0.8	+	9.13	10
Dimethylhydrazine, 1,1-	UDMH	57-14-7	$C_2H_8N_2$			0.8	+	0.8	+	7.28	0.01
Dimethyl methylphosphonate	DMMP, methyl phosphonic acid dimethyl ester	756-79-6	$C_3H_9O_3P$	NR	+	4.3	+	0.74	+	10.0	ne
Dimethyl sulfate		77-78-1	$C_2H_6O_4S$	~23		~20	+	2.3	+		0.1
Dimethyl sulfide	see Methyl sulfide										
Dimethyl sulfoxide	DMSO, Methyl sulfoxide	67-68-5	C_2H_6OS			1.4	+			9.10	ne
Dioxane, 1,4-		123-91-1	$C_4H_8O_2$			1.3				9.19	25
Dioxolane, 1,3-	Ethylene glycol formal	646-06-0	$C_3H_6O_2$	4.0	+	2.3	+	1.6	+	9.9	20
Dowtherm A see Therminol® *											
Dowtherm J (97% Diethylbenzene) *		25340-17-4	$C_{10}H_{14}$			0.5					
DS-108F Wipe Solvent	Ethyl lactate/Isopar H/ Propoxypropanol ~7:2:1	97-64-3 64742-48-9 1569-01-3	m.w. 118	3.3	+	1.6	+	0.7	+		ne
Epichlorohydrin	ECH Chloromethyloxirane, 1-chloro2,3-epoxypropane	106-89-8	C_2H_5ClO	~200	+	8.5	+	1.4	+	10.2	0.5
Ethane		74-84-0	C_2H_6			NR	+	15	+	11.52	ne
Ethanol	Ethyl alcohol	64-17-5	C_2H_6O			10	+	3.1	+	10.47	1000
Ethanolamine *	MEA, Monoethanolamine	141-43-5	C_2H_7NO	5.6	+	1.6	+			8.96	3
Ethene	Ethylene	74-85-1	C_2H_4			9	+	4.5	+	10.51	ne
Ethoxyethanol, 2-	Ethyl cellosolve	110-80-5	$C_4H_{10}O_2$			1.3				9.6	5
Ethyl acetate		141-78-6	$C_4H_8O_2$			4.6	+	3.5		10.01	400
Ethyl acetoacetate		141-97-9	$C_6H_{10}O_3$	1.4	+	1.2	+	1.0	+	<10	ne
Ethyl acrylate		140-88-5	$C_5H_8O_2$			2.4	+	1.0	+	<10.3	5
Ethylamine		75-04-7	C_2H_7N			0.8				8.86	5

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (Ev)	TWA
Ethylbenzene		100-41-4	C_8H_{10}	0.52	+	0.52	+	0.51	+	8.77	100
Ethyl caprylate	Ethyl octanoate	106-32-1	$C_{10}H_{20}O_2$		+	0.52	+	0.51	+		
Ethylenediamine	1,2-Ethanediamine; 1,2-Diaminoethane	107-15-3	$C_2H_8N_2$	0.9	+	0.8	+	1.0	+	8.6	10
Ethylene glycol *	1,2-Ethanediol	107-21-1	$C_2H_6O_2$			16	+	6	+	10.16	C100
Ethylene glycol, Acrylate	2-hydroxyethyl Acrylate	818-61-1	$C_5H_8O_3$			8.2				≤10.6	
Ethylene glycol dimethyl ether	1,2-Dimethoxyethane, Monoglyme	110-71-4	$C_4H_{10}O_2$	1.1		0.86		0.7		9.2	ne
Ethylene glycol monobutyl ether acetate	2-Butoxyethyl acetate	112-07-2	$C_8H_{16}O_3$			1.3				≤10.6	
Ethylene glycol, monothio	mercapto-2-ethanol	60-24-2	C_2H_6OS			1.5				9.65	
Ethylene oxide	Oxirane, Epoxyethane	75-21-8	C_2H_4O			13	+	3.5	+	10.57	1
Ethyl ether	Diethyl ether	60-29-7	$C_4H_{10}O$			1.1	+	1.7		9.51	400
Ethyl 3-ethoxypropionate	EEP	763-69-9	$C_7H_{14}O_3$	1.2	+	0.75	+				ne
Ethyl formate		109-94-4	$C_3H_6O_2$					1.9		10.61	100
Ethylhexyl □acrylate, 2-	Acrylic acid 2-ethylhexyl ester	103-11-7	$C_{11}H_{20}O_2$			1.1	+	0.5	+		ne
Ethylhexanol	2-Ethyl-1-hexanol	104-76-7	C8H18O			1.9				≤10.6	
Ethylidenenorbornene	5-Ethylidene bicyclo(2,2,1)hept-2-ene	16219-75-3	C_9H_{12}	0.4	+	0.39	+	0.34	+	≤8.8	ne
Ethyl (S)-(-)-lactate see also DS-108F	Ethyl lactate, Ethyl (S)-(-)-hydroxypropionate	687-47-8 97-64-3	$C_5H_{10}O_3$	13	+	3.2	+	1.6	+	~10	ne
Ethyl mercaptan	Ethanethiol	75-08-1	C_2H_6S	0.60	+	0.56	+			9.29	0.5
Ethyl sulfide	Diethyl sulfide	352-93-2	$C_4H_{10}S$			0.5	+			8.43	ne
Formaldehyde	Formalin	50-00-0	CH_2O	NR	+	NR	+	1.6	+	10.87	C0.3
Formamide		75-12-7	CH_3NO			6.9	+	4		10.16	10
Formic acid		64-18-6	CH_2O_2	NR	+	NR	+	9	+	11.33	5
Furfural	2-Furaldehyde	98-01-1	$C_5H_4O_2$			0.92	+	0.8	+	9.21	2
Furfuryl alcohol		98-00-0	$C_5H_6O_2$			0.80	+			<9.5	10
Gasoline #1		8006-61-9	m.w. 72			0.9	+				300
Gasoline #2, 92 octane		8006-61-9	m.w. 93	1.3	+	1.0	+	0.5	+		300
Glutaraldehyde	1,5-Pentanedial, Glutaric dialdehyde	111-30-8	$C_5H_8O_2$	1.1	+	0.8	+	0.6	+		C0.05
Glycidyl methacrylate	2,3-Epoxypropyl methacrylate	106-91-2	$C_7H_{10}O_3$	2.6	+	1.2	+	0.9	+		0.5
Halothane	2-Bromo-2-chloro-1,1,1-trifluoroethane	151-67-7	$C_2HBrClF_3$					0.6		11.0	50
HCFC-22 see Chlorodifluoromethane											
HCFC-123 see 2,2-Dichloro-1,1,1-trifluoroethane											
HCFC-141B see 1,1-Dichloro-1-fluoroethane											
HCFC-142B see 1-Chloro-1,1-difluoroethane											
HCFC-134A see 1,1,1,2-Tetrafluoroethane											
HCFC-225 see Dichloropentafluoropropane											
Heptane, n-		142-82-5	C_7H_{16}	45	+	2.8	+	0.60	+	9.92	400
Heptanol, 4-	Dipropylcarbinol	589-55-9	$C_7H_{16}O$	1.8	+	1.3	+	0.5	+	9.61	ne
Hexamethyldisilazane, 1,1,1,3,3,3- *	HMDS	999-97-3	$C_6H_{19}NSi_2$			0.2	+	0.2	+	~8.6	ne
Hexamethyldisiloxane	HMDSx	107-46-0	$C_6H_{18}OSi_2$	0.33	+	0.27	+	0.25	+	9.64	ne
Hexane, n-		110-54-3	C_6H_{14}	350	+	4.3	+	0.54	+	10.13	50
Hexanol, 1-	Hexyl alcohol	111-27-3	$C_6H_{14}O$	9	+	2.5	+	0.55	+	9.89	ne
Hexene, 1-		592-41-6	C_6H_{12}			0.8				9.44	30
HFE-7100 see Methyl nonafluorobutyl ether											
Histoclear (Histo-Clear)	Limonene/corn oil reagent		m.w. ~136	0.5	+	0.4	+	0.3	+		ne
Hydrazine *		302-01-2	H_4N_2	>8	+	2.6	+	2.1	+	8.1	0.01
Hydrazoic acid	Hydrogen azide		HN_3							10.7	
Hydrogen	Synthesis gas	1333-74-0	H_2	NR	+	NR	+	NR	+	15.43	ne
Hydrogen cyanide	Hydrocyanic acid	74-90-8	HCN	NR	+	NR	+	NR	+	13.6	C4.7
Hydrogen iodide *	Hydriodic acid	10034-85-2	HI			~0.6*				10.39	
Hydrogen peroxide		7722-84-1	H_2O_2	NR	+	NR	+	NR	+	10.54	1
Hydrogen sulfide		7783-06-4	H_2S	NR	+	3.3	+	1.5	+	10.45	10
Hydroxypropyl methacrylate		27813-02-1 923-26-2	$C_7H_{12}O_3$	9.9	+	2.3	+	1.1	+		ne
Iodine *		7553-56-2	I_2	0.1	+	0.1	+	0.1	+	9.40	C0.1

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Iodomethane	Methyl iodide	74-88-4	CH_3I	0.21	+	0.22	+	0.26	+	9.54	2
Isoamyl acetate	Isopentyl acetate	123-92-2	$C_7H_{14}O_2$	10.1		2.1		1.0		<10	100
Isobutane	2-Methylpropane	75-28-5	C_4H_{10}			100	+	1.2	+	10.57	ne
Isobutanol	2-Methyl-1-propanol	78-83-1	$C_4H_{10}O$	19	+	3.8	+	1.5		10.02	50
Isobutene	Isobutylene, Methyl butene	115-11-7	C_4H_8	1.00	+	1.00	+	1.00	+	9.24	Ne
Isobutyl acrylate	Isobutyl 2-propenoate	106-63-8	$C_7H_{12}O_2$			1.5	+	0.60	+		Ne
Isoflurane	1-Chloro-2,2,2-trifluoroethyl difluoromethyl ether, forane	26675-46-7	$C_3H_2ClF_5O$	NR	+	NR	+	48	+	~11.7	Ne
Isooctane	2,2,4-Trimethylpentane	540-84-1	C8H18			1.2				9.86	ne
Isopar E Solvent	Isoparaffinic hydrocarbons	64741-66-8	m.w. 121	1.7	+	0.8	+				Ne
Isopar G Solvent	Photocopier diluent	64742-48-9	m.w. 148			0.8	+				Ne
Isopar K Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 156	0.9	+	0.5	+	0.27	+		Ne
Isopar L Solvent	Isoparaffinic hydrocarbons	64742-48-9	m.w. 163	0.9	+	0.5	+	0.28	+		Ne
Isopar M Solvent	Isoparaffinic hydrocarbons	64742-47-8	m.w. 191			0.7	+	0.4	+		Ne
Isopentane	2-Methylbutane	78-78-4	C_5H_{12}			8.2					Ne
Isophorone		78-59-1	$C_9H_{14}O$					3		9.07	C5
Isoprene	2-Methyl-1,3-butadiene	78-79-5	C_5H_8	0.69	+	0.63	+	0.60	+	8.85	Ne
Isopropanol	Isopropyl alcohol, 2-propanol, IPA	67-63-0	C_3H_8O	500	+	6.0	+	2.7		10.12	200
Isopropyl acetate		108-21-4	$C_5H_{10}O_2$			2.6				9.99	100
Isopropyl ether	Diisopropyl ether	108-20-3	$C_6H_{14}O$			0.8				9.20	250
Jet fuel JP-4	Jet B, Turbo B, F-40 Wide cut type aviation fuel	8008-20-6 + 64741-42-0	m.w. 115			1.0	+	0.4	+		Ne
Jet fuel JP-5	Jet 5, F-44, Kerosene type aviation fuel	8008-20-6 + 64747-77-1	m.w. 167			0.6	+	0.5	+		29
Jet fuel JP-8	Jet A-1, F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 165			0.6	+	0.3	+		30
Jet fuel A-1 (JP-8)	F-34, Kerosene type aviation fuel	8008-20-6 + 64741-77-1	m.w. 145			0.67					34
Jet Fuel TS	Thermally Stable Jet Fuel, Hydrotreated kerosene fuel	8008-20-6 + 64742-47-8	m.w. 165	0.9	+	0.6	+	0.3	+		30
Limonene, D-	(R)-(+)-Limonene	5989-27-5	$C_{10}H_{16}$			0.33	+			~8.2	Ne
Kerosene C10-C16 petro.distillate – see Jet Fuels		8008-20-6									
MDI – see 4,4'-Methylenebis(phenylisocyanate)											
Maleic anhydride	2,5-Furandione	108-31-6	$C_4H_2O_3$							~10.8	0.1
Mesitylene	1,3,5-Trimethylbenzene	108-67-8	C_9H_{12}	0.36	+	0.35	+	0.3	+	8.41	25
Methallyl chloride – see 3-Chloro-2-methylpropene											
Methane	Natural gas	74-82-8	CH_4	NR	+	NR	+	NR	+	12.61	Ne
Methanol	Methyl alcohol, carbinol	67-56-1	CH_4O	NR	+	NR	+	2.5	+	10.85	200
Methoxyethanol, 2-	Methyl cellosolve, Ethylene glycol monomethyl ether	109-86-4	$C_3H_8O_2$	4.8	+	2.4	+	1.4	+	10.1	5
Methoxyethoxyethanol, 2-	2-(2-Methoxyethoxy)ethanol Diethylene glycol monomethyl ether	111-77-3	$C_7H_{16}O$	2.3	+	1.2	+	0.9	+	<10	Ne
Methoxyethyl ether, 2-	bis(2-Methoxyethyl) ether, Diethylene glycol dimethyl ether, Diglyme	111-96-6	$C_6H_{14}O_3$	0.64	+	0.54	+	0.44	+	<9.8	Ne
Methyl acetate		79-20-9	$C_3H_6O_2$	NR	+	6.6	+	1.4	+	10.27	200
Methyl acrylate	Methyl 2-propenoate, Acrylic acid methyl ester	96-33-3	$C_4H_6O_2$			3.7	+	1.2	+	(9.9)	2
Methylamine	Aminomethane	74-89-5	CH_5N			1.2				8.97	5
Methyl amyl ketone	MAK, 2-Heptanone, Methyl pentyl ketone	110-43-0	$C_7H_{14}O$	0.9	+	0.85	+	0.5	+	9.30	50
Methyl bromide	Bromomethane	74-83-9	CH_3Br	110	+	1.7	+	1.3	+	10.54	1
Methyl t-butyl ether	MTBE, *tert*-Butyl methyl ether	1634-04-4	$C_5H_{12}O$			0.9	+			9.24	40
Methyl cellosolve	see 2-Methoxyethanol										
Methyl chloride	Chloromethane	74-87-3	CH_3Cl	NR	+	NR	+	0.74	+	11.22	50
Methylcyclohexane		107-87-2	C_7H_{14}	1.6	+	0.97	+	0.53	+	9.64	400
Methylene bis(phenyl-isocyanate), 4,4'- *	MDI, Mondur M		$C_{15}H_{10}N_2O_2$	Very slow ppb level response							0.005

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Methylene chloride	Dichloromethane	75-09-2	CH_2Cl_2	NR	+	NR	+	0.89	+	11.32	25
Methyl ether	Dimethyl ether	115-10-6	C_2H_6O	4.8	+	3.1	+	2.5	+	10.03	Ne
Methyl ethyl ketone	MEK, 2-Butanone	78-93-3	C_4H_8O	0.86	+	0.9	+	1.1	+	9.51	200
Methylhydrazine	Monomethylhydrazine, Hydrazomethane	60-34-4	$C_2H_6N_2$	1.4	+	1.2	+	1.3	+	7.7	0.01
Methyl isoamyl ketone	MIAK, 5-Methyl-2-hexanone	110-12-3	$C_7H_{14}O$	0.8	+	0.76	+	0.5	+	9.28	50
Methyl isobutyl ketone	MIBK, 4-Methyl-2-pentanone	108-10-1	$C_6H_{12}O$	0.9	+	0.8	+	0.6	+	9.30	50
Methyl isocyanate	CH3NCO	624-83-9	C_2H_3NO	NR	+	4.6	+	1.5		10.67	0.02
Methyl isothiocyanate	CH3NCS	551-61-6	C_2H_3NS	0.5	+	0.45	+	0.4	+	9.25	ne
Methyl mercaptan	Methanethiol	74-93-1	CH_4S	0.65		0.54		0.66		9.44	0.5
Methyl methacrylate		80-62-6	$C_5H_8O_2$	2.7	+	1.5	+	1.2	+	9.7	100
Methyl nonafluorobutyl ether	HFE-7100DL	163702-08-7, 163702-07-6	$C_5H_3F_9O$			NR	+	~35	+		ne
Methyl-1,5-pentanediamine, 2- (coats lamp) *	Dytek-A amine, 2-Methyl pentamethylenediamine	15520-10-2	C6H16N2			~0.6	+			<9.0	ne
Methyl propyl ketone	MPK, 2-Pentanone	107-87-9	$C_5H_{12}O$			0.93	+	0.79	+	9.38	200
Methyl-2-pyrrolidinone, N-	NMP, N-Methylpyrrolidone, 1-Methyl-2-pyrrolidinone, 1-Methyl-2-pyrrolidone	872-50-4	C_5H_9NO	1.0	+	0.8	+	0.9	+	*9.17*	ne
Methyl salicylate	Methyl 2-hydroxybenzoate	119-36-8	C_8H_8O3	1.3	+	0.9	+	0.9	+	~9	ne
Methylstyrene, α-	2-Propenylbenzene	98-83-9	C_9H_{10}			0.5				8.18	50
Methyl sulfide	DMS, Dimethyl sulfide	75-18-3	C_2H_6S	0.49	+	0.44	+	0.46	+	8.69	ne
Mineral spirits	Stoddard Solvent, Varsol 1, White Spirits	8020-83-5 8052-41-3 68551-17-7	m.w. 144	1.0		0.69	+	0.38	+		100
Mineral Spirits - Viscor 120B Calibration Fluid, b.p. 156-207°C		8052-41-3	m.w. 142	1.0	+	0.7	+	0.3	+		100
Monoethanolamine - see Ethanolamine											
Mustard *	HD, Bis(2-chloroethyl) sulfide	505-60-2 39472-40-7 68157-62-0	$C_4H_8Cl_2S$			0.6					0.0005
Naphtha - see VM & P Naptha											
Naphthalene	Mothballs	91-20-3	$C_{10}H_8$	0.45	+	0.42	+	0.40	+	8.13	10
Nickel carbonyl (in CO)	Nickel tetracarbonyl	13463-39-3	C_4NiO_4			0.18				<8.8	0.001
Nicotine		54-11-5	$C_{10}H_{14}N_2$			2.0				≤10.6	
Nitric oxide		10102-43-9	NO	~6		5.2	+	2.8	+	9.26	25
Nitrobenzene		98-95-3	$C_6H_5NO_2$	2.6	+	1.9	+	1.6	+	9.81	1
Nitroethane		79-24-3	$C_2H_5NO_2$					3		10.88	100
Nitrogen dioxide		10102-44-0	NO_2	23	+	16	+	6	+	9.75	3
Nitrogen trifluoride		7783-54-2	NF_3	NR		NR		NR		13.0	10
Nitromethane		75-52-5	CH_3NO_2					4		11.02	20
Nitropropane, 2-		79-46-9	$C_3H_7NO_2$					2.6		10.71	10
Nonane		111-84-2	C_9H_{20}			1.4				9.72	200
Norpar 12	n-Paraffins, mostly C_{10}-C_{13}	64771-72-8	m.w. 161	3.2	+	1.1	+	0.28	+		ne
Norpar 13	n-Paraffins, mostly C_{13}-C_{14}	64771-72-8	m.w. 189	2.7	+	1.0	+	0.3	+		ne
Octamethylcyclotetrasiloxane		556-67-2	$C_8H_{24}O_4Si_4$	0.21	+	0.17	+	0.14	+		ne
Octamethyltrisiloxane		107-51-7	$C_8H_{24}O_2Si_3$	0.23	+	0.18	+	0.17	+	<10.0	ne
Octane, n-		111-65-9	C_8H_{18}	13	+	1.8	+			9.82	300
Octene, 1-		111-66-0	C_8H_{16}	0.9	+	0.75	+	0.4	+	9.43	75
Pentane		109-66-0	C_5H_{12}	80	+	8.4	+	0.7	+	10.35	600
Peracetic acid *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$	NR	+	NR	+	2.3	+		ne
Peracetic/Acetic acid mix *	Peroxyacetic acid, Acetyl hydroperoxide	79-21-0	$C_2H_4O_3$			50	+	2.5	+		ne
Perchloroethene	PCE, Perchloroethylene, Tetrachloroethylene	127-18-4	C_2Cl_4	0.69	+	0.57	+	0.31	+	9.32	25
PGME	Propylene glycol methyl ether, 1-Methoxy-2-propanol	107-98-2	$C_6H_{12}O_3$	2.4	+	1.5	+	1.1	+		100

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
PGMEA	Propylene glycol methyl ether acetate, 1-Methoxy-2-acetoxypropane, 1-Methoxy-2-propanol acetate	108-65-6	$C_6H_{12}O_3$	1.65	+	1.0	+	0.8	+		ne
Phenol	Hydroxybenzene	108-95-2	C_6H_6O	1.0	+	1.0	+	0.9	+	8.51	5
Phosgene	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	8.5	+	11.2	0.1
Phosgene in Nitrogen	Dichlorocarbonyl	75-44-5	CCl_2O	NR	+	NR	+	6.8	+	11.2	0.1
Phosphine (coats lamp)		7803-51-2	PH_3	28		3.9	+	1.1	+	9.87	0.3
Photocopier Toner	Isoparaffin mix					0.5	+	0.3	+		ne
Picoline, 3-	3-Methylpyridine	108-99-6	C_6H_7N			0.9				9.04	ne
Pinene, α-		2437-95-8	$C_{10}H_{16}$			0.31	+	0.47		8.07	ne
Pinene, β-		18172-67-3	$C_{10}H_{16}$	0.38	+	0.37	+	0.37	+	~8	100
Piperylene, isomer mix	1,3-Pentadiene	504-60-9	C_5H_8	0.76	+	0.69	+	0.64	+	8.6	100
Propane		74-98-6	C_3H_8			NR	+	1.8	+	10.95	2500
Propanol, n-	Propyl alcohol	71-23-8	C_3H_8O			5		1.7		10.22	200
Propene	Propylene	115-07-1	C_3H_6	1.5	+	1.4	+	1.6	+	9.73	ne
Propionaldehyde	Propanal	123-38-6	C_3H_6O			1.9				9.95	ne
Propyl acetate, n-		109-60-4	$C_5H_{10}O_2$			3.5		2.3		10.04	200
Propylamine, n-	1-Propylamine, 1-Aminopropane	107-10-8	C_3H_9N	1.1	+	1.1	+	0.9	+	8.78	ne
Propylene carbonate *		108-32-7	$C_4H_6O_3$			62	+	1	+	10.5	ne
Propylene glycol	1,2-Propanediol	57-55-6	$C_3H_8O_2$	18		5.5	+	1.6	+	<10.2	ne
Propylene glycol propyl ether	1-Propoxy-2-propanol	1569-01-3	$C_6H_{14}O_2$	1.3	+	1.0	+	1.6	+		ne
Propylene oxide	Methyloxirane	75-56-9 16088-62-3 15448-47-2	C_3H_6O	~240		6.6	+	2.9	+	10.22	20
Propyleneimine	2-Methylaziridine	75-55-8	C_3H_7N	1.5	+	1.3	+	1.0	+	9.0	2
Propyl mercaptan, 2-	2-Propanethiol, Isopropyl mercaptan	75-33-2	C_3H_8S	0.64	+	0.66	+			9.15	ne
Pyridine		110-86-1	C_5H_5N	0.78	+	0.7	+	0.7	+	9.25	5
Pyrrolidine (coats lamp)	Azacyclohexane	123-75-1	C_4H_9N	2.1	+	1.3	+	1.6	+	~8.0	ne
RR7300 (PGME/PGMEA)	70:30 PGME:PGMEA (1-Methoxy-2-propanol:1-Methoxy-2-acetoxypropane)	107-98-2	$C_4H_{10}O_2$ / $C_6H_{12}O_3$			1.4	+	1.0	+		ne
Sarin	GB, Isopropyl methylphosphonofluoridate	107-44-8 50642-23-4	$C_4H_{10}FO_2P$			~3					
Stoddard Solvent - see Mineral Spirits		8020-83-5									
Styrene		100-42-5	C_8H_8	0.45	+	0.40	+	0.4	+	8.43	20
Sulfur dioxide		7446-09-5	SO_2	NR		NR	+	NR	+	12.32	2
Sulfur hexafluoride		2551-62-4	SF_6	NR		NR		NR		15.3	1000
Sulfuryl fluoride	Vikane	2699-79-8	SO_2F_2	NR		NR		NR		13.0	5
Tabun *	Ethyl N, N-dimethylphosphoramidocyanidate	77-81-6	$C_5H_{11}N_2O_2P$			0.8					15ppt
Tetrachloroethane, 1,1,1,2-		630-20-6	$C_2H_2Cl_4$					1.3		~11.1	ne
Tetrachloroethane, 1,1,2,2-		79-34-5	$C_2H_2Cl_4$	NR	+	NR	+	0.60	+	~11.1	1
Tetrachlorosilane		10023-04-7	$SiCl_4$	NR		NR		15	+	11.79	ne
Tetraethyl lead	TEL	78-00-2	$C_8H_{20}Pb$	0.4		0.3		0.2		~11.1	0.008
Tetraethyl orthosilicate	Ethyl silicate, TEOS	78-10-4	$C_8H_{20}O_4Si$			0.7	+	0.2	+	~9.8	10
Tetrafluoroethane, 1,1,1,2-	HFC-134A	811-97-2	$C_2H_2F_4$			NR		NR			ne
Tetrafluoroethene	TFE, Tetrafluoroethylene, Perfluoroethylene	116-14-3	C_2F_4			~15				10.12	ne
Tetrafluoromethane	CFC-14, Carbon tetrafluoride	75-73-0	CF_4			NR	+	NR	+	>15.3	ne
Tetrahydrofuran	THF	109-99-9	C_4H_8O	1.9	+	1.7	+	1.0	+	9.41	200
Tetramethyl orthosilicate	Methyl silicate, TMOS	681-84-5	$C_4H_{12}O_4Si$	10	+	1.9	+			~10	1
Therminol® D-12 *	Hydrotreated heavy naphtha	64742-48-9	m.w. 160	0.8	+	0.51	+	0.33	+		ne
Therminol® VP-1 *	Dowtherm A, 3:1 Diphenyl oxide: Biphenyl	101-84-8 92-52-4	$C_{12}H_{10}O$ $C_{12}H_{10}$			0.4	+				1
Toluene	Methylbenzene	108-88-3	C_7H_8	0.54	+	0.50	+	0.51	+	8.82	50

Compound Name	Synonym/Abbreviation	CAS No.	Formula	9.8	C	10.6	C	11.7	C	IE (eV)	TWA
Tolylene-2,4-diisocyanate	TDI, 4-Methyl-1,3-phenylene-2,4-diisocyanate	584-84-9	$C_9H_6N_2O_2$	1.4	+	1.4	+	2.0	+		0.002
Trichlorobenzene, 1,2,4-	1,2,4-TCB	120-82-1	$C_6H_3Cl_3$	0.7	+	0.46	+			9.04	C5
Trichloroethane, 1,1,1-	1,1,1-TCA, Methyl chloroform	71-55-6	$C_2H_3Cl_3$			NR	+	1	+	11	350
Trichloroethane, 1,1,2-	1,1,2-TCA	79-00-5	$C_2H_3Cl_3$	NR	+	NR	+	0.9	+	11.0	10
Trichloroethene	TCE, Trichoroethylene	79-01-6	C_2HCl_3	0.62	+	0.54	+	0.43	+	9.47	50
Trichloromethylsilane	Methyltrichlorosilane	75-79-6	CH_3Cl_3Si	NR		NR		1.8	+	11.36	ne
Trichlorotrifluoroethane, 1,1,2-	CFC-113	76-13-1	$C_2Cl_3F_3$			NR		NR		11.99	1000
Triethylamine	TEA	121-44-8	$C_6H_{15}N$	0.95	+	0.9	+	0.65	+	7.3	1
Triethyl borate	TEB; Boric acid triethyl ester	150-46-9	$C_6H_{15}O_3B$			2.2	+	1.1	+	~10	ne
Triethyl phosphate	Ethyl phosphate	78-40-0	$C_6H_{15}O_4P$	~50	+	3.1	+	0.60	+	9.79	ne
Trifluoroethane, 1,1,2-		430-66-0	$C_2H_3F_3$					34		*12.9*	ne
Trimethylamine		75-50-3	C_3H_9N			0.9				7.82	5
Trimethylbenzene, 1,3,5- - see Mesitylene		108-67-8									25
Trimethyl borate	TMB; Boric acid trimethyl ester, Boron methoxide	121-43-7	$C_3H_9O_3B$			5.1	+	1.2	+	10.1	ne
Trimethyl phosphate	Methyl phosphate	512-56-1	$C_3H_9O_4P$			8.0	+	1.3	+	9.99	ne
Trimethyl phosphite	Methyl phosphite	121-45-9	$C_3H_9O_3P$			1.1	+		+	*8.5*	2
Turpentine	Pinenes (85%) + other diisoprenes	8006-64-2	$C_{10}H_{16}$	0.37	+	0.30	+	0.29	+	~8	20
Undecane		1120-21-4	$C_{11}H_{24}$			2				9.56	ne
Varsol – see Mineral Spirits											
Vinyl actetate		108-05-4	$C_4H_6O_2$	1.5	+	1.2	+	1.0	+	9.19	10
Vinyl bromide	Bromoethylene	593-60-2	C_2H_3Br			0.4				9.80	5
Vinyl chloride	Chloroethylene, VCM	75-01-4	C_2H_3Cl			2.0	+	0.6	+	9.99	5
Vinyl-1-cyclohexene, 4-	Butadiene dimer, 4-Ethenylcyclohexene	100-40-3	C_8H_{12}	0.6	+	0.56	+			9.83	0.1
Vinylidene chloride - see 1,1-Dichloroethene											
Vinyl-2-pyrrolidinone, 1-	NVP, N-vinylpyrrolidone, 1-ethenyl-2-pyrrolidinone	88-12-0	C_6H_9NO	1.0	+	0.8	+	0.9	+		ne
Viscor 120B - see Mineral Spirits - Viscor 120B Calibration Fluid											
V. M. & P. Naphtha	Ligroin; Solvent naphtha; Varnish maker's & painter's naptha	64742-89-8	m.w. 111 (C_8-C_9)	1.7	+	0.97	+				300
Xylene, m-	1,3-Dimethylbenzene	108-38-3	C_8H_{10}	0.50	+	0.44	+	0.40	+	8.56	100
Xylene, o-	1,2-Dimethylbenzene	95-47-6	C_8H_{10}	0.56	+	0.46	+	0.43		8.56	100
Xylene, p-	1,4-Dimethylbenzene	106-42-3	C_8H_{10}	0.48	+	0.39	+	0.38	+	8.44	100
None				1		1		1			
Undetectable				1E+6		1E+6		1E+6			

* Compounds indicated in green can be detected using a MiniRAE 2000 or ppbRAE/+ with slow response, but may be lost by adsorption on a MultiRAE or EntryRAE. Response on multi-gas meters can give an indication of relative concentrations, but may not be quantitative and for some chemicals no response is observed.

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Appendix I:
Example of Automatic Calculation of Correction Factors, TLVs and Alarm Limits for Mixtures
(Calculations performed using Excel version of this database, available on request)

Compound	CF 9.8 eV	CF 10.6 eV	CF 11.7eV	Mol. Frac	Conc ppm	TLV ppm	STEL Ppm
Benzene	0.55	0.53	0.6	0.01	1	0.5	2.5
Toluene	0.54	0.5	0.51	0.06	10	50	150
Hexane, n-	300	4.3	0.54	0.06	10	50	150
Heptane, n-	45	2.8	0.6	0.28	50	400	500
Styrene	0.45	0.4	0.42	0.06	10	20	40
Acetone	1.2	1.1	1.4	0.28	50	750	1000
Isopropanol	500	6	2.7	0.28	50	400	500
None	1	1	1	0.00	0	1	
Mixture Value:	2.1	1.5	0.89	1.00	181 ppm	56 ppm	172 ppm
TLV Alarm Setpoint when Calibrated to Isobutylene:	26 ppm	37 ppm	62 ppm				
STEL Alarm Setpoint, same Calibration	86 ppm	115 ppm	193 ppm				

TurnKey
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FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Specific Conductance Meter

FOP 012.0

CALIBRATION AND MAINTENANCE OF PORTABLE SPECIFIC CONDUCTANCE METER

PURPOSE

This guideline describes a method for calibration of a portable specific conductance meter. This meter measures the ability of a water sample to conduct electricity, which is largely a function of the dissolved solids within the water. The instrument has been calibrated by the manufacturer according to factory specifications. This guideline presents a method for checking the factory calibration of a portable specific conductance meter. A calibration check is performed to verify instrument accuracy and function. All field test equipment will be checked at the beginning of each sampling day. This procedure also documents critical maintenance activities for this meter.

ACCURACY

The calibrated accuracy of the specific conductance meter will be within ± 1 percent of full-scale, with repeatability of ± 1 percent. The built-in cell will be automatically temperature compensated from at least 32° to 160° F (0° to 71°C).

PROCEDURE

Note: The information included below is equipment manufacturer- and model-specific, however, accuracy, calibration, and maintenance procedures for this type of portable equipment are typically similar. The information below pertains to the Myron L Company Ultrameter Model 6P. The actual equipment to be used in the field will be equivalent or similar.

1. Calibrate all field test equipment at the beginning of each sampling day. Check and recalibrate the specific conductance meter according to the manufacture's specifications.

2. Use a calibration solution of known specific conductivity and salinity. For maximum accuracy, use a Standard Solution Value closest to the samples to be tested.

3. Rinse conductivity cell three times with proper standard.

4. Re-fill conductivity cell with same standard.

5. Press **COND** or **TDS**, then press **CAL/MCLR**. The "CAL" icon will appear on the display.

6. Press the **↑/MS** or **MR/↓** key to step the displayed value toward the standard's value or hold a key down to cause rapid scrolling of the reading.

7. Press CAL/MCLR once to confirm new value and end the calibration sequence for this particular solution type.

8. Repeat steps 1 through 7 with additional new solutions, as necessary.

9. Document the calibration results and related information in the Project Field Book and on an **Equipment Calibration Log** (see attached sample), indicating the meter readings before and after the instrument has been adjusted. This is important, not only for data validation, but also to establish maintenance schedules and component replacement. Information will include, at a minimum:
    - Time, date and initials of the field team member performing the calibration
    - The unique identifier for the meter, including manufacturer, model, and serial number
    - The brand and expiration date of the calibration standards
    - The instrument readings: before and after calibration

- The instrument settings (if applicable)
- The overall adequacy of calibration including the Pass or fail designation in accordance with the accuracy specifications presented above.
- Corrective action taken (see Maintenance below) in the event of failure to adequately calibrate.

MAINTENANCE

NOTE: Ultrameters should be rinsed with clean water after use. Solvents should be avoided. Shock damage from a fall may cause instrument failure.

Temperature Extremes

Solutions in excess of 160°F/71°C should not be placed in the cell cup area; this may cause damage. Care should be exercised not to exceed rated operating temperature. Leaving the Ultrameter in a vehicle or storage shed on a hot day can easily subject the instrument to over 150°F voiding the warranty.

Battery Replacement

Dry Instrument THOROUGHLY. Remove the four bottom screws. Open instrument carefully; it may be necessary to rock the bottom slightly side to side to release it from the RS-232 connector. Carefully detach battery from circuit board. Replace with 9-volt alkaline battery. Replace bottom, ensuring the sealing gasket is installed in the groove of the top half of case. Re-install screws, tighten evenly and securely.

NOTE: Because of nonvolatile EEPROM circuitry, all data stored in memory and all calibration settings are protected even during power loss or battery replacement.

Cleaning Sensors

The conductivity cell cup should be kept as clean as possible. Flushing with clean water following use will prevent buildup on electrodes. However, if very dirty samples — particularly scaling types — are allowed to dry in the cell cup, a film will form. This film reduces accuracy. When there are visible films of oil, dirt, or scale in the cell cup or on the electrodes, use a foaming non-abrasive household cleaner. Rinse out the cleaner and your Ultrameter is ready for accurate measurements.

NOTE: Maintain a log for each monitoring instrument. Record all maintenance performed on the instrument on this log with date and name of the organization performing the maintenance.

ATTACHMENTS

Equipment Calibration Log (sample)

TurnKey Environmental Restoration, LLC

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name: Date:

Project No.:

Client: Instrument Source: ☐ TK ☐ Rental

METER TYPE	UNITS	TIME	MAKE/MODEL	SERIAL NUMBER	CAL. BY	STANDARD	READING	SETTI
☐ pH meter	units		Myron L Company Ultra Meter 6P	606987		4.00		
						7.00		
						10.01		
☐ Turbidity meter	NTU		Hach 2100P Turbidimeter	970600014560		< 0.4		
						20		
						100		
						800		
☐ Sp. conductance meter	uS/mS		Myron L Company Ultra Meter 6P	606987		µS @ 25 °C		
☐ PID	ppm		Photovac 2020 PID	ED [illegible] 301		open air zero		MIBK re factor =
						_____ ppm Iso. Gas		
☐ Particulate meter	mg/m^3					zero air		
☐ Oxygen	%					open air		
☐ Hydrogen sulfide	ppm					open air		
☐ Carbon monoxide	ppm					open air		
☐ LEL	%					open air		
☐ Radiation Meter	uR/H					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Documentation Requirements for Drilling and Well Installation

FOP 015.0

DOCUMENTATION REQUIREMENTS FOR DRILLING AND WELL INSTALLATION

PURPOSE

The purpose of these documentation requirements is to document the procedures used for drilling and installing wells in order to ensure the quality of the data obtained from these operations. TurnKey field technical personnel will be responsible for developing and maintaining documentation for quality control of field operations. At least one field professional will monitor each major operation (e.g. one person per drilling rig) to document and record field procedures for quality control. These procedures provide a description of the format and information for this documentation.

PROCEDURE

Project Field Book

Personnel assigned by the TurnKey Field Team Leader or Project Manager will maintain a Project Field Book for all site activities. These Field Books will be started upon initiation of any site activities to document the field investigation process. The Field Books will meet the following criteria:

- Permanently bound, with nominal 8.5-inch by 11-inch gridded pages.
- Water resistant paper.
- Pages must be pre-numbered or numbered in the field, front and back.

Notations in the field book will be in black or blue ink that will not smudge when wet. Information that may be recorded in the Field Book includes:

- Time and date of all entries.

- Name and location of project site and project job number.
- Listing of key project, client and agency personnel and telephone numbers.
- Date and time of daily arrivals and departures, name of person keeping the log, names and affiliation of persons on site, purpose of visit (if applicable), weather conditions, outline of project activities to be completed.
- Details of any variations to the procedures/protocols (i.e., as presented in the Work Plan or Field Operating Procedures) and the basis for the change.
- Field-generated data relating to implementation of the field program, including sample locations, sample descriptions, field measurements, instrument calibration, etc.
- Record of all photographs taken in the field, including date, time, photographer, site location and orientation, sequential number of photograph, and roll number.

Upon completion of the site activities, all Field Books will be photocopied and both the original and photocopied versions placed in the project files. In addition, all field notes except those presented on specific field forms will be neatly transcribed into Field Activity Daily Log (FADL) forms (sample attached).

Field Borehole/Monitoring Well Installation Log Form

Examples of the Field Borehole Log and Field Borehole/Monitoring Well Installation Log forms are attached to this Field Operating Procedure. One form will be completed for every boring by the TurnKey field person overseeing the drilling. At a minimum, these forms will include:

- Project name, location, and number.
- Boring number.

- Rig type and drilling method.
- Drilling dates.
- Sampling method.
- Sample descriptions, to meet the requirements of the Unified Soil Classification System (USCS) for soils and the Unified Rock Classification System (URCS) for rock.
- Results of photoionization evaluations (scan and/or headspace determinations).
- Blow counts for sampler penetration (Standard Penetration Test, N-Value).
- Drilling rate, rig chatter, and other drilling-related information, as necessary.

All depths recorded on Boring/Monitoring Well Installation Log forms will be expressed in increments tenths of feet, and not in inches.

Well Completion Detail Form

An example of this form is attached to this Field Operating Procedure. One form will be completed for every boring by the TurnKey field person overseeing the well installation. At a minimum, these forms will include:

- Project name, location, and number.
- Well number.
- Installation dates.
- Dimensions and depths of the various well components illustrated in the Well Completion Detail (attached). These include the screened interval, bottom caps or plugs, centralizers, and the tops and bottoms of the various annular materials.

- Drilling rate, rig chatter, and other drilling related information.

All depths recorded on Field Borehole/Monitoring Well Installation Logs will be expressed in tenths of feet, and not in inches.

Daily Drilling Report Form

An example of this form is attached to this Field Operating Procedure. This form should be used to summarize all drilling activities. One form should be completed for each rig for each day. These forms will include summaries of:

- Footage drilled, broken down by diameter (e.g. 200 feet of 6-inch diameter hole, 50 feet of 10-inch diameter hole).
- Footage of well and screen installed, broken down by diameter.
- Quantities of materials used, including sand, cement, bentonite, centralizers, protective casings, traffic covers, etc. recorded by well or boring location.
- Active time (hours), and activity (drilling, decontamination, development, well installation, surface completions, etc.)
- Down-time (hours) and reason.
- Mobilizations and other events.
- Other quantities that will be the basis for drilling invoices.

The form should be signed daily by both the TurnKey field supervisor and the driller's representative, and provided to the TurnKey Field Team Leader.

Other Project Field Forms

Well purging/well development forms, test pit logs, environmental sampling field data sheets, water level monitoring forms, and well testing (slug test or pumping test) forms. Refer to specific guidelines for form descriptions.

ATTACHMENTS

Field Activity Daily Log (FADL) (sample)
Field Borehole Log (sample)
Field Borehole/Monitoring Well Installation Log (sample)
Stick-up Well/Piezometer Completion Detail (sample)
Flush-mount Well/Piezometer Completion Detail (sample)
Daily Drilling Report (sample)

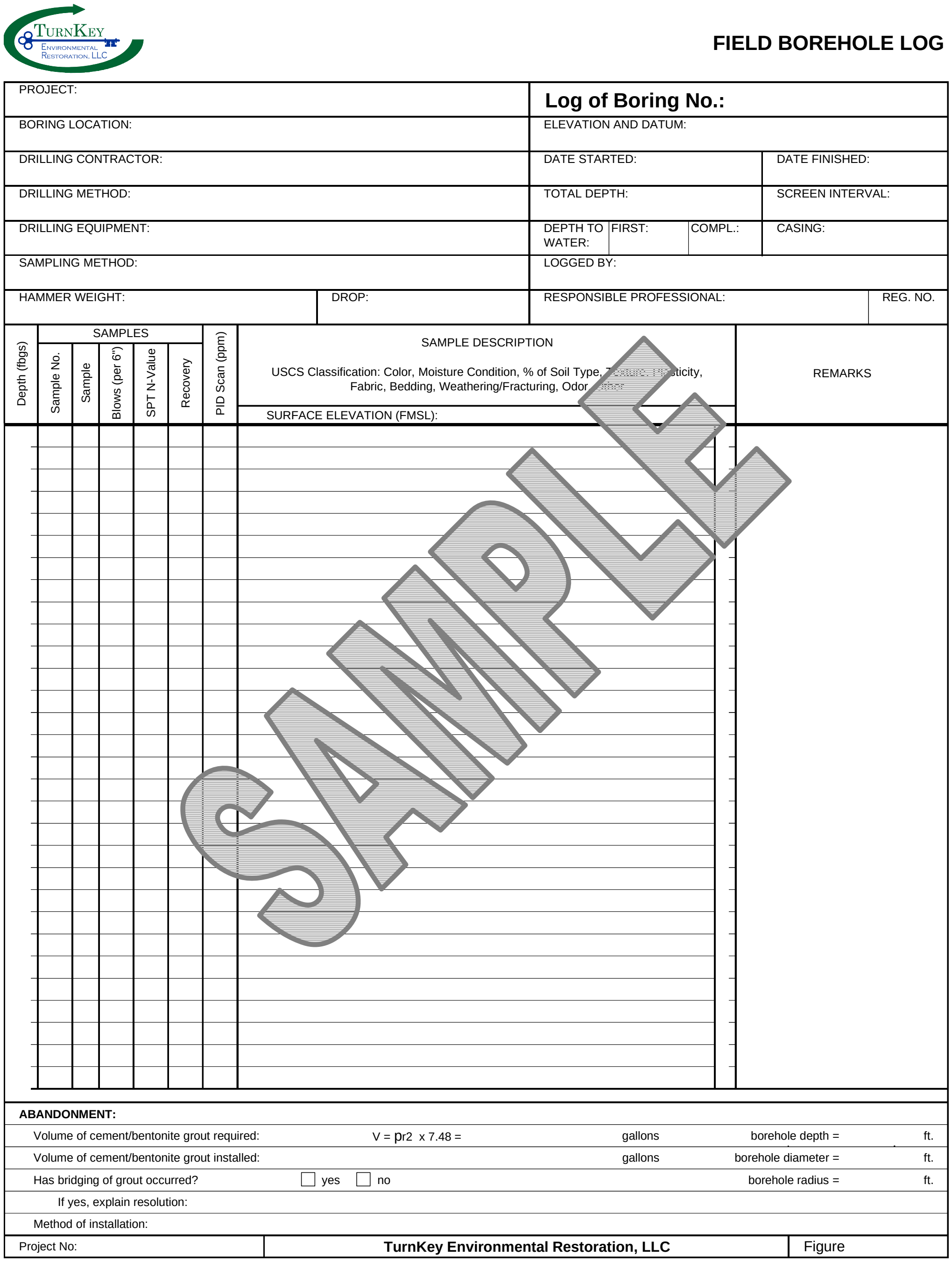
TurnKey Environmental Restoration, LLC

DAILY LOG				
	DATE			
	NO.			
	SHEET	OF		

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY SUBJECT:	
DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:	
TIME	DESCRIPTION

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
WEATHER CONDITIONS: A.M.: P.M.:	IMPORTANT TELEPHONE CALLS:
BM/TK PERSONNEL ON SITE:	
SIGNATURE	DATE:



FIELD BOREHOLE LOG

PROJECT:		**Log of Boring No.:**	
BORING LOCATION:		ELEVATION AND DATUM:	
DRILLING CONTRACTOR:		DATE STARTED:	DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:	SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER: FIRST: COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:	
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:	REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other	REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery		SURFACE ELEVATION (FMSL):	

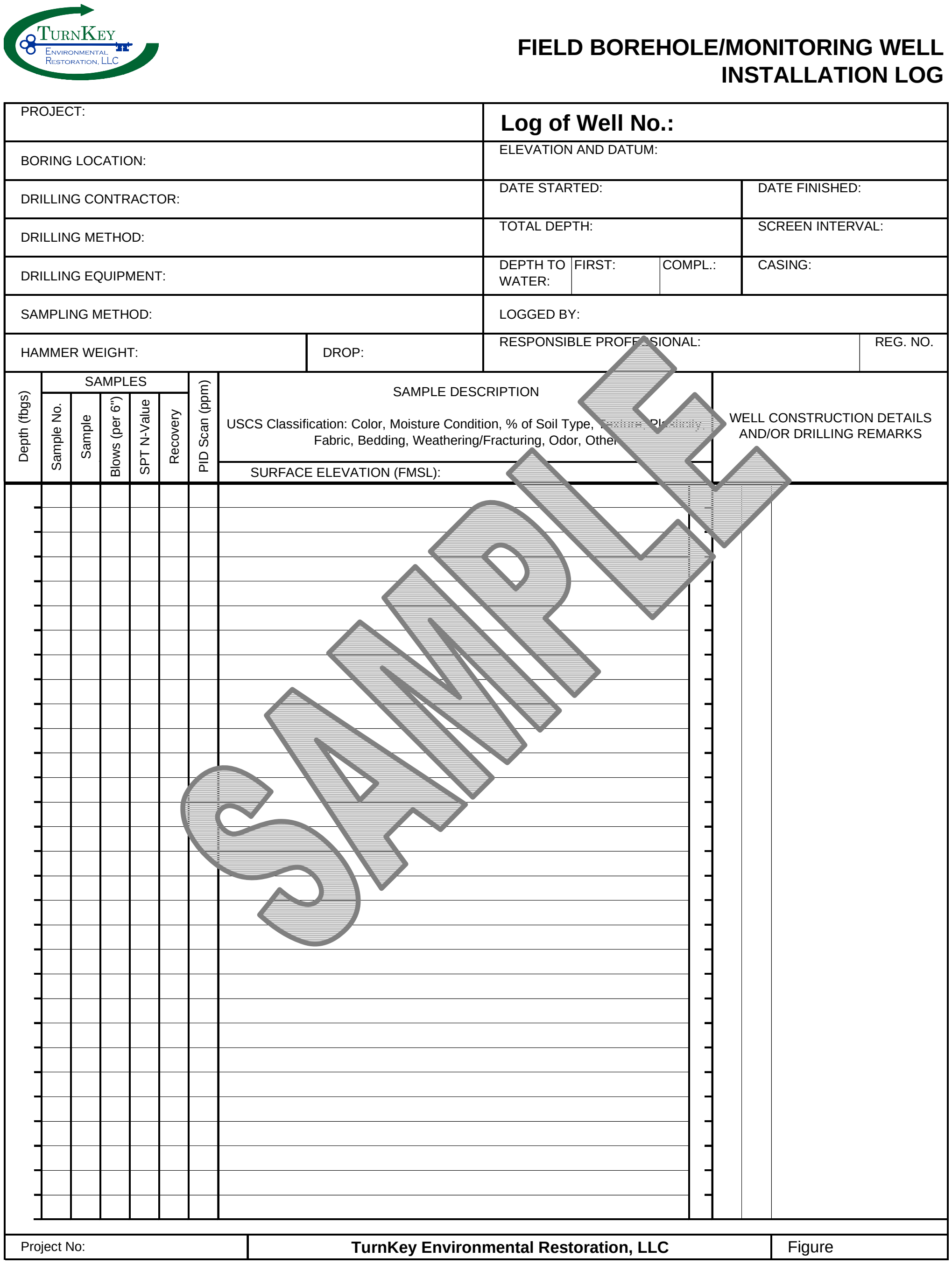
ABANDONMENT:

Volume of cement/bentonite grout required:	V = pr2 x 7.48 =	gallons	borehole depth =	ft.
Volume of cement/bentonite grout installed:		gallons	borehole diameter =	ft.
Has bridging of grout occurred?	☐ yes ☐ no		borehole radius =	ft.

If yes, explain resolution:

Method of installation:

Project No:	**TurnKey Environmental Restoration, LLC**	Figure



TurnKey Environmental Restoration, LLC

FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG

PROJECT:	**Log of Well No.:**			
BORING LOCATION:	ELEVATION AND DATUM:			
DRILLING CONTRACTOR:	DATE STARTED:			DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH:			SCREEN INTERVAL:
DRILLING EQUIPMENT:	DEPTH TO WATER:	FIRST:	COMPL.:	CASING:
SAMPLING METHOD:	LOGGED BY:			
HAMMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL:			REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery			

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

STICK-UP MONITORING WELL COMPLETION DETAIL

Project Name:

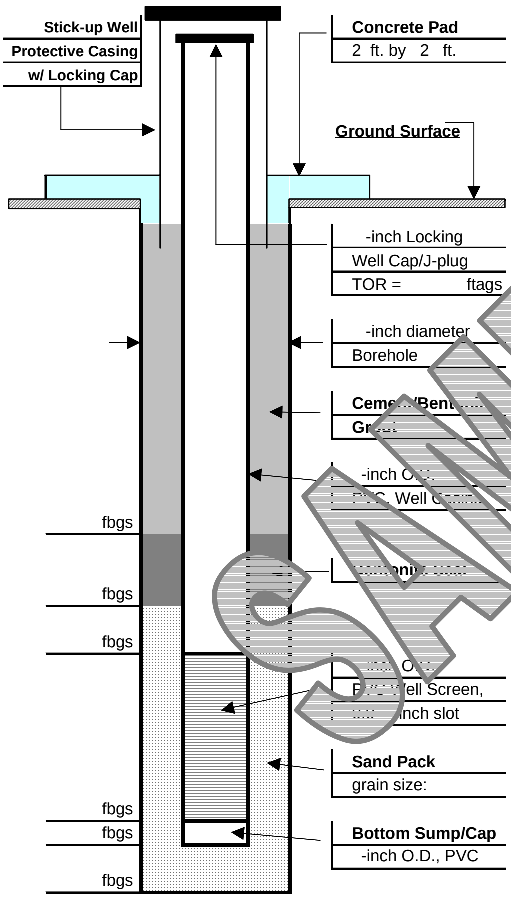
WELL NUMBER:

Client:

Date Installed:

Boring Location:

Project Number:



Driller Information

Company:

Driller:

Helper:

Permit Number:

Drill Rig Type:

Well Information

Land Surface Elevation: fmsl (approximate)

Drilling Method:

Soil Sample Collection Method:

Drilling Fluid:

Fluid Loss During Drilling: gallons (approximate)

Materials of Well Construction

Casing:

Screen:

Sump:

Sand Pack:

Annular Seal:

Well Development

Well Purpose:

Techneque(s):

Date Completed:

BM/TK Personnel:

Total Volume Purge: gallons

Static Water Level (SWL): fbTOR

Pump Depth: bottom of well

Purge Duration: minutes

Yeild: gpm

Specific Capacity: gpm/ft

Comments:

saturated thickness: SWL - stickup = fbgs

Total Depth = fbTOR

Total Depth - SWL = feet

stick-up = feet

Total Depth = fbgs

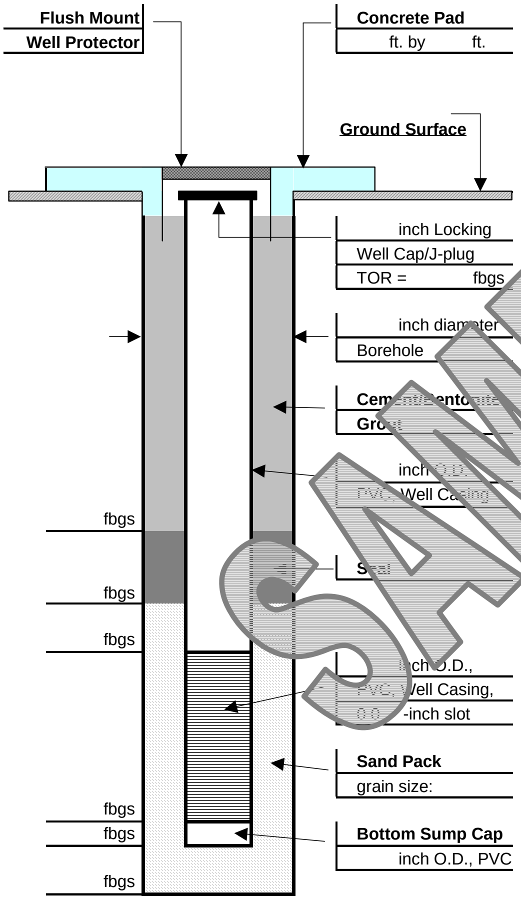
PREPARED BY:

DATE:

FLUSHMOUNT WELL/PIEZOMETER COMPLETION DETAIL

Project Name:
Client:
Boring Location:

WELL NUMBER:
Date Installed:
Project Number:



Driller Information

Company:
Driller:
Helper:
Permit Number:
Drill Rig Type:

Well Information

Land Surface Elevation: fmsl (approximate)
Drilling Method:
Soil Sample Collection Method:
Drilling Fluid:
Fluid Loss During Drilling: gallons (approximate)

Materials of Well Construction

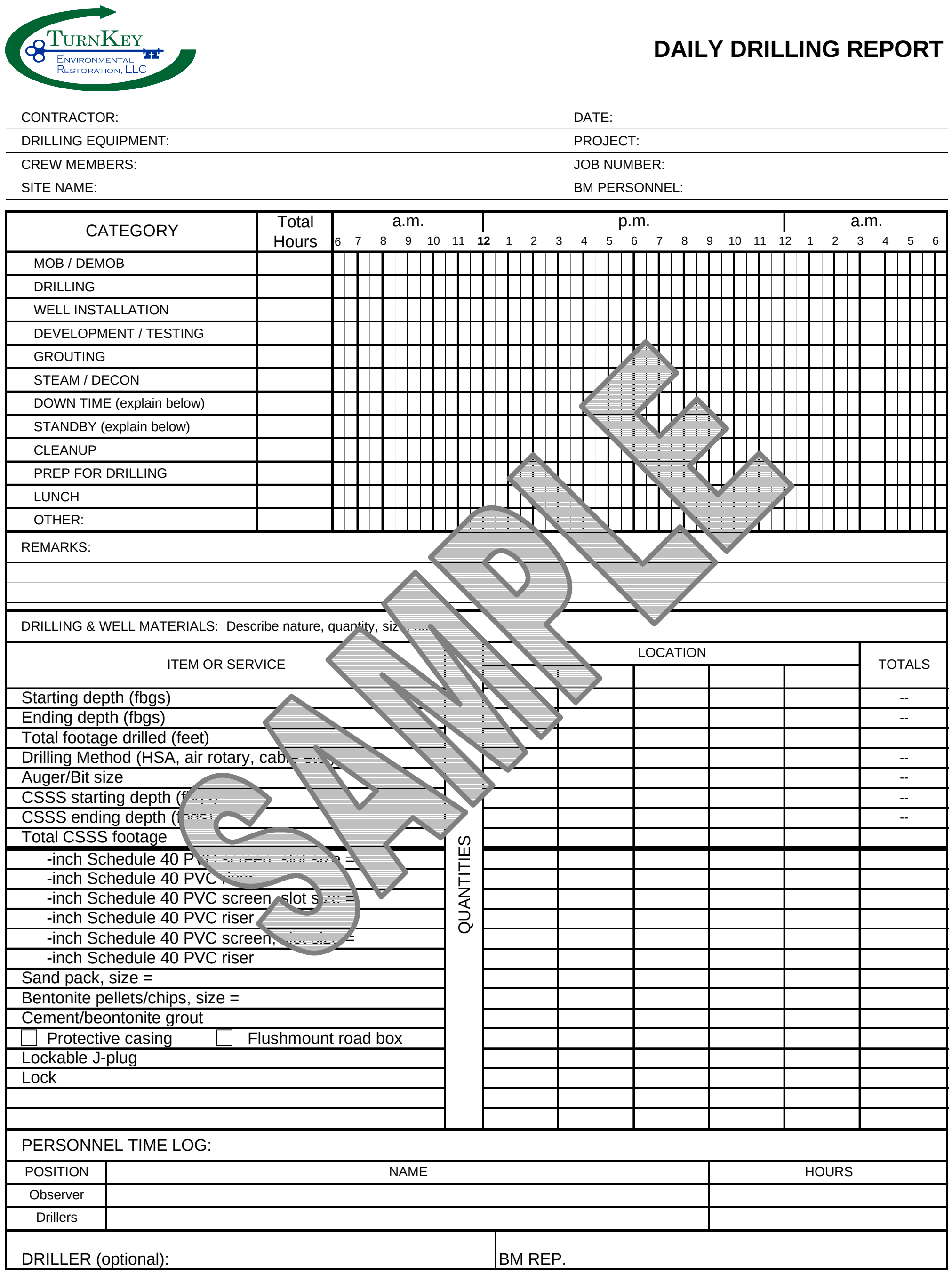
Casing:
Screen:
Sump:
Sand Pack:
Annular Seal:

Well Development

Well Purpose:
Techneque(s):
Date Completed:
BM/TK Personnel:
Total Volume Purge: gallons
Static Water Level: fbTOR
Pump Depth:
Purge Duration: minutes
Yeild: gpm
Specific Capacity: gpm/ft

Comments:

PREAPRED BY: DATE:



TurnKey Environmental Restoration, LLC

DAILY DRILLING REPORT

CONTRACTOR: DATE:
DRILLING EQUIPMENT: PROJECT:
CREW MEMBERS: JOB NUMBER:
SITE NAME: BM PERSONNEL:

CATEGORY	Total Hours	a.m.							p.m.												a.m.					
		6	7	8	9	10	11	**12**	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6
MOB / DEMOB																										
DRILLING																										
WELL INSTALLATION																										
DEVELOPMENT / TESTING																										
GROUTING																										
STEAM / DECON																										
DOWN TIME (explain below)																										
STANDBY (explain below)																										
CLEANUP																										
PREP FOR DRILLING																										
LUNCH																										
OTHER:																										

REMARKS:

DRILLING & WELL MATERIALS: Describe nature, quantity, size, etc.

ITEM OR SERVICE	QUANTITIES	LOCATION						TOTALS
Starting depth (fbgs)								--
Ending depth (fbgs)								--
Total footage drilled (feet)								
Drilling Method (HSA, air rotary, cable etc.)								--
Auger/Bit size								--
CSSS starting depth (fbgs)								--
CSSS ending depth (fbgs)								--
Total CSSS footage								
-inch Schedule 40 PVC screen, slot size =	QUANTITIES							
-inch Schedule 40 PVC riser								
-inch Schedule 40 PVC screen, slot size =								
-inch Schedule 40 PVC riser								
-inch Schedule 40 PVC screen, slot size =								
-inch Schedule 40 PVC riser								
Sand pack, size =								
Bentonite pellets/chips, size =								
Cement/beontonite grout								
☐ Protective casing ☐ Flushmount road box								
Lockable J-plug								
Lock								

PERSONNEL TIME LOG:

POSITION	NAME	HOURS
Observer		
Drillers		

DRILLER (optional): BM REP.

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FIELD OPERATING PROCEDURES

Drill Site Selection Procedure

FOP 017.0

DRILL SITE SELECTION PROCEDURE

PURPOSE

This procedure presents a method for selecting a site location for drilling. Drill site selection should be based on the project objectives, ease of site access, freedom from obstructions and buried metallic objects (drums) and site safety (appropriate set backs from overhead and buried services).

PROCEDURE

The following procedure outlines procedures prior to drilling activities:

1. Review project objectives and tentatively select drilling locations that provide necessary information for achieving objectives (i.e., Work Plan).

2. Clear locations with property owner/operator to ensure that drilling activities will not interfere with site operations and select appropriate access routes.

3. Stake locations in the field, measure distance from locations to recognizable landmarks, such as building or fence lines and plot locations on site plan. Ensure location is relatively flat, free of overhead wires and readily accessible. Survey location if property ownership is in doubt.

4. Obtain clearances from appropriate utilities and if buried waste/metallic objects are suspected, screen location with appropriate geophysical method.

5. Establish a secure central staging area for storage of drilling supplies and for equipment decontamination. Locate a secure storage area for drilling samples, as necessary.

ATTACHMENTS

none

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FIELD OPERATING PROCEDURES

Drilling & Excavation Equipment Decontamination Procedures

FOP 018.0

DRILLING AND EXCAVATION EQUIPMENT DECONTAMINATION PROCEDURES

PURPOSE

This procedure is to be used for the decontamination of drilling and excavation equipment (i.e., drill rigs, backhoes, augers, drill bits, drill rods, buckets, and associated equipment) used during a subsurface investigation. The purpose of this procedure is to remove chemical constituents associated with a particular drilling or excavation location from this equipment. This prevents these constituents from being transferred between drilling or excavation locations, or being transported out of controlled areas.

PROCEDURE

The following procedure will be utilized prior to the use of drilling or excavation equipment at each location, and prior to the demobilization of such equipment from the site:

1. Remove all loose soil and other particulate materials from the equipment at the survey site.

2. Wrap augers, tools, plywood, and other reusable items with a plastic cover prior to transport from the site of use to the decontamination facility.

3. Transport equipment to the decontamination facility. All equipment must be decontaminated at an established decontamination facility. This facility will be placed within a controlled area, and will be equipped with necessary features to contain and collect wash water and entrained materials.

4. Wash equipment thoroughly with pressurized low-volume water or steam, supplied by a pressure washer or steam cleaner.

5. If necessary, use a brush or scraper to remove visible soils adhering to the equipment, and a non-phosphate detergent to remove any oils, grease, and/or hydraulic fluids adhering to the equipment. Continue pressure washing until all visible contaminants are removed.

6. Allow equipment to air dry.

7. Store equipment in a clean area or wrap the equipment in new plastic sheeting as necessary to ensure cleanliness until ready for use.

8. Manage all wash waters and entrained solids as described in the TurnKey Field Operating Procedure for Management of Investigation-Derived Waste.

ATTACHMENTS

none

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FIELD OPERATING PROCEDURES

Establishing Horizontal and Vertical Control

FOP 021.0

ESTABLISHING HORIZONTAL AND VERTICAL CONTROL

PURPOSE

This guideline presents a method for establishing horizontal and vertical controls at a project site. It is imperative that this procedure be performed accurately, as all topographic and site maps, monitoring well locations and test pit locations will be based on these controls.

PROCEDURE

A. Establishing Horizontal Primary and Project Control

1. Research the State Plan Coordinate, USGS or project site applicable horizontal control monuments.
2. At the project site, recover the above-mentioned monuments, two markers minimum being recovered.
3. Establish control points on the project site by bringing in the primary control points recovered in the field.
4. All control points will be tied into a closed traverse to assure the error of closure.
5. Compute closures for obtaining degree of accuracy to adjust traverse points.

B. Establishing Vertical Primary and Project Control

1. Research project or USGS datum for recovering monument(s) for vertical control if different than those previously found.
2. Recover the monuments in the field, two markers minimum being found.
3. Set the projects benchmarks.
4. Run a level line from the monuments to the set project benchmarks and back, setting turning points on all benchmarks set on site.

5. Reduce field notes and compute error of closure to adjust benchmarks set on site.

6. Prepare the recovery sketches and tabulate a list for horizontal and vertical control throughout project site.

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FIELD OPERATING PROCEDURES

Groundwater Level Measurement

FOP 022.0

GROUNDWATER LEVEL MEASUREMENT

PURPOSE

This procedure describes the methods used to obtain accurate and consistent water level measurements in monitoring wells, piezometers and well points. Water levels will be measured at monitoring wells and, if practicable, in supply wells to estimate purge volumes associated with sampling, and to develop a potentiometric surface of the groundwater in order to estimate the direction and velocity of flow in the aquifer. Water levels in monitoring wells will be measured using an electronic water level indicator (e-line) that has been checked for operation prior to mobilization.

PROCEDURE

1. Decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

2. Unlock and remove the well protective cap or cover and place on clean plastic.

3. Lower the probe slowly into the monitoring well until the audible alarm sounds. This indicates the depth to water has been reached.

4. Move the cable up and down slowly to identify the depth at which the alarm just begins to sound. Measure this depth against the mark on the lip of the well riser used as a surveyed reference point (typically the north side of the riser).

5. Read depth from the graduated cable to the nearest 0.01 foot. Do not use inches. If the e-line is not graduated, use a rule or tape measure graduated in 0.01-foot increments to measure from the nearest reference mark on the e-line cable.

6. Record the water level on a Water Level Monitoring Record (sample attached).

7. Remove the probe from the well slowly, drying the cable and probe with a clean paper wipe. Be sure to repeat decontamination before use in another well.

8. Replace well plug and protective cap or cover. Lock in place as appropriate.

ATTACHMENTS

Water Level Monitoring Record (sample)

REFERENCES

<u>TurnKey FOPs:</u>

040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

WATER LEVEL MONITORING RECORD

Project Name:
Client:
Project No.:
Location:
Field Personnel:
Date:
Weather:

Well No.	Time	Top of Riser Elevation (fmsl)	Static Depth to Water (fbTOR)	Groundwater Elevation (fmsl)	Total Depth (fbTOR)	Last Total Depth Measurement (fbTOR)

Comments/Remarks:

PREAPRED BY:
DATE:

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FIELD OPERATING PROCEDURES

Groundwater Purging Procedures Prior to Sample Collection

FOP 023.1

GROUNDWATER PURGING PROCEDURES PRIOR TO SAMPLE COLLECTION

PURPOSE

This procedure describes the methods for monitoring well/piezometer purging prior to groundwater sample collection in order to collect representative groundwater samples. The goal of purging is to remove stagnant, non-representative groundwater from the well and/or prevent stagnant water from entering collected samples. Purging involves the removal of at least three to five volumes of water in wells with moderate yields and at least one well volume from wells with low yields (slow water level recovery).

Purge and sample wells in order of least-to-most contaminated (this is not necessary if dedicated or disposable equipment is used). If you do not know this order, sample the upgradient wells first, then the furthest down-gradient or side-gradient wells, and finally the wells closest to, but down-gradient of the most contaminated area. Sampling should commence immediately following purging or as soon as the well has adequately recharged and not more than 24-hours following end time of evacuation.

PROCEDURE

1. Prepare the electronic water level indicator (e-line) in accordance with the procedures referenced in the TurnKey Field Operating Procedure for Groundwater Level Measurement and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the TurnKey Field Operating Procedure for Non-disposable and Non-dedicated Sampling Equipment Decontamination. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

2. Inspect the interior and exterior of the well/piezometer for signs of vandalism or damage and record condition on the Groundwater Field Form and/or Groundwater Well Inspection Form (samples attached). Specifically, inspect

the integrity of the following: concrete surface seal, lock, protective casing and well cover, well riser and J-plug/cap. Report any irregular findings to the Project Manager.

3. Unlock and remove the well protective cap or cover and place on clean plastic to avoid introducing foreign material into the well.

4. Calibrate the photoionization detector (PID) in accordance with the TurnKey Field Operating Procedure for Calibration and Maintenance of Portable Photoionization Detector.

5. Monitor the well for organic vapors using a PID, as per the Work Plan. If a reading of greater than 5 ppm is recorded, the well should be allowed to vent until levels drop below 5 ppm before proceeding with purging.

6. Lower the e-line probe slowly into the monitoring well and record the initial water level in accordance with the procedures referenced in the TurnKey Field Operating Procedure for Groundwater Level Measurement.

7. Following static water level determinations, slowly lower the e-line to the bottom of the well/piezometer. Record the total depth to the nearest 0.01-foot and compare to the previous total depth measurement. If a significant discrepancy exists, re-measure the total depth. Continue with purging activities observing purge water to determine whether the well/piezometer had become silted due to inactivity or damaged (i.e., well sand within purge water). Upon confirmation of the new total depth and determination of the cause (i.e., siltation or damage), notify the Project Manager following field activities.

8. Calculate the volume of water in the well based on the water level below the top of riser and the total depth of the well using the following equation:

$$V = 0.0408[(B)^2 \times \{(A) - (C)\}]$$

Where,

A = Total Depth of Well (feet below measuring point)
B = Casing diameter (inches)
C = Static Water Level (feet below measuring point)

9. **For wells where the water level is 20 feet or less below the top of riser**, a peristaltic pump may be used to purge the well. Measure the purged volume using a calibrated container (i.e., graduated 5-gallon bucket) and record measurements on the attached Groundwater Well Development and Purge Log. Use new and dedicated tubing for each well. During the evacuation of shallow wells, the intake opening of the pump tubing should be positioned just below the surface of the water. As the water level drops, lower the tubing as needed to maintain flow. For higher yielding wells, the intake level should not be lowered past the top of the screen. Pumping from the top of the water column will ensure proper flushing of the well. Continue pumping until the required volumes are removed (typically three well volumes). For higher yielding wells, adjust the purging rate to maintain the water level above the screen. For lower yielding wells or wells where the screen straddles the water table, maintain purging at a rate that matches the rate of recovery of the well (well yield). If the well purges to dryness and is slow to recharge (greater than 15 minutes), terminate evacuation. **A peristaltic pump and dedicated tubing cannot be used to collect VOC or SVOC project-required samples; only non-organic compounds may be collected using this type of pump.**

10. **For wells where the water level is initially below 20 feet,** or drawn down to this level because of slow recharge rate, conduct purging using one of three devices listed below:

    - <u>Bailer</u> – A bottom filling dedicated polyethylene bailer attached to a length of dedicated hollow-braid polypropylene rope. Purging a well utilizing a bailer should be conducted smoothly and slowly as not to agitate the groundwater or damage the well.

    - <u>Well Wizard Purge Pump (or similar)</u> – This pneumatic bladder pump uses compressed air to push water to the surface. Groundwater is not in contact with the drive air during the pumping process, therefore the pump may be used for sample collection.

- Submersible Pump (12 or 24 volt, or similar) – These submersible pumps are constructed of PVC or stainless steel and are capable of pumping up to 70 feet from ground surface using a 12 volt battery (standard pump) and standard low flow controller. For depths up to 200 feet from ground surface, a high performance power booster controller is used with a 12 volt battery. Unless these pumps are dedicated to the monitoring well location, decontamination between locations is necessary and an equipment blank may be required.

- Waterra™ Pump – This manually operated pump uses dedicated polyethylene tubing and a check valve that can be used as an optional method for purging deeper wells. The pump utilizes positive pressure to evacuate the well, therefore the pump may be used for sample collection, and however over-agitation groundwater should be avoided.

Prior to use in a well, non-dedicated bailers, exterior pump bodies and pump tubing should be cleaned in accordance with the TurnKey Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination. Dedicated and/or disposable equipment should be contained within the sealed original manufacturers packaging and certified pre-cleaned by the manufacturer with a non-phosphate laboratory detergent and rinsed using de-ionized water.

8. Purging will continue until a predetermined volume of water has been removed (typically three well volumes) or to dryness. Measurements for pH, temperature, specific conductance, dissolved oxygen (optional), Eh (optional), and turbidity will be recorded following removal of each well volume. Purge the well to dryness or until the readings for indicator parameters listed above (or well-specific indicator parameters) stabilize within the following limits for each parameter measured:

Field Parameter	Stabilization Criteria
Dissolved Oxygen	± 0.3 mg/L
Turbidity	± 10 %
Specific Conductance	± 3 %
Eh	± 10 mV
PH	± 0.1 unit

Stabilization criteria presented within the project Work Plan will take precedence.

DOCUMENTATION AND SAMPLE COLLECTION

This section pertains to the documentation of collected field data during and following purging activities and sample collection.

1. Record all data including the final three stable readings for each indicator parameter on the attached Groundwater Well Purge & Sample Log.
2. Record, at a minimum, the "volume purged," "purging stop-time," "purged dry (Y/N)," "purged below sand pack (Y/N)," and any problems purging on the attached Groundwater Well Purge & Sample Log.
3. Collect groundwater samples in accordance with the TurnKey Field Operating Procedure for Groundwater Sample Collection. Record "sample flow rate" as an average, "time sample collected," and any other pertinent information related to the sampling event on the attached Groundwater Well Purge & Sample Log.
4. Restore the well to its capped/covered and locked condition.

ALTERNATIVE METHODS

Alternative purging and sampling methods and equipment, other than those described herein are acceptable if they provide representative groundwater samples. The purging and sampling method and equipment must not adversely affect sample integrity, chemistry, temperature, and turbidity. In addition, alternative equipment must have minimal or no effect on groundwater geochemistry, aquifer permeability and well materials. Equipment materials must also minimize sorption and leaching. The field team is responsible for documenting and describing any alternative equipment and procedures used to purge a well and collect samples.

ATTACHMENTS

Groundwater Field Form
Groundwater Well Inspection Form

REFERENCES

<u>TurnKey FOPs:</u>
011 Calibration and Maintenance of Portable Photoionization Detector
022 Groundwater Level Measurement
024 Groundwater Sample Collection Procedures
040 Non-disposable and Non-dedicated Sampling Equipment Decontamination

GROUNDWATER FIELD FORM

Project Name: Date:

Location: Project No.: Field Team:

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

REMARKS:

Note: All measurements are in feet, distance from top of riser.

Volume Calculation

Diam.	Vol. (g/ft)
1"	0.041
2"	0.163
4"	0.653
6"	1.469

Stabilization Criteria

Parameter	Criteria
pH	± 0.1 unit
SC	± 3%
Turbidity	± 10%
DO	± 0.3 mg/L
ORP	± 10 mV

PREPARED BY:

GROUNDWATER WELL INSPECTION FORM

Project:
Client:
Job No.:
Date:
Time:

WELL I.D.:

EXTERIOR INSPECTION

Protective Casing:
Lock:
Hinge/Lid:
Concrete Surface Seal:
Bollards:
Label/I.D.:
Other:

INTERIOR INSPECTION

Well Riser:
Annular Space:
Well Cap:
Water Level (fbTOR):
Total Depth (fbTOR):
Other:

Comments/Corrective Actions:

PREPARED BY: DATE:

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Groundwater Sample Collection Procedures

FOP 024.1

GROUNDWATER SAMPLE COLLECTION PROCEDURES

PURPOSE

This procedure describes the methods for collecting groundwater samples from monitoring wells and domestic supply wells following purging and sufficient recovery. This procedure also includes the preferred collection order in which water samples are collected based on the volatilization sensitivity or suite of analytical parameters required.

PROCEDURE

Allow approximately 3 to 10 days following well development before performing purge and sample activities at any well location. Conversely, perform sampling as soon as practical after sample purging at any time after the well has recovered sufficiently to sample, or within 24 hours after evacuation, if the well recharges slowly. If the well does not yield sufficient volume for all required laboratory analytical testing (including quality control), a decision should be made to prioritize analyses based on contaminants of concern at the site. If the well takes longer than 24 hours to recharge, the Project Manager should be consulted. The following two procedures outline sample collection activities for monitoring and domestic type wells.

Monitoring Wells

1. Purge the monitoring well in accordance with the TurnKey FOPs for Groundwater Purging Procedures Prior to Sample Collection or Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedures. Perform sampling as soon as practical after purging at any time after the well has recovered sufficiently to sample, or within 24 hours after evacuation, if the well recharges slowly. If the well does not yield sufficient volume for all required laboratory analytical testing (including quality control), a decision should be made to prioritize analyses based on contaminants of concern at the site. Analyses will be prioritized in the order of the parameters volatilization sensitivity. After volatile organics have been collected, field parameters

must be measured from the next sample collected. If a well takes longer than 24 hours to recharge, the Project Manager should be consulted.

2. Sampling equipment that is not disposable or dedicated to the well will be decontaminated in accordance with the TurnKey Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

3. Calibrate all field meters (i.e., pH/Eh, turbidity, specific conductance, dissolved oxygen, PID etc.) in accordance with the TurnKey Field Operating Procedure for Calibration and Maintenance of the specific field meter.

4. Prepare the electronic water level indicator (e-line) in accordance with the procedures referenced in the TurnKey Field Operating Procedure for Groundwater Level Measurement and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the TurnKey Field Operating Procedure for Non-disposable and Non-dedicated Sampling Equipment Decontamination. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

5. Inspect the well/piezometer for signs of vandalism or damage and record condition on the Groundwater Field Form (sample attached). Specifically, inspect the integrity of the following: concrete surface seal, lock, protective casing and well cover, well casing and J-plug/cap. Report any irregular findings to the Project Manager.

6. Unlock and remove the well protective cap or cover and place on clean plastic to avoid introducing foreign material into the well.

7. Calibrate the photoionization detector (PID) in accordance with the TurnKey Field Operating Procedure for Calibration and Maintenance of Portable Photoionization Detector.

8. Monitor the well for organic vapors using a PID, as per the Work Plan. If a reading of greater than 5 ppm is recorded, the well should be allowed to vent until levels drop below 5 ppm before proceeding with purging. Record PID measurements on a well-specific Groundwater Field Form (sample attached).

9. Lower the e-line probe slowly into the monitoring well and record the measurement on a well-specific Groundwater Field Form (sample attached).

10. Groundwater samples will be collected directly from the sampling valve on the flow through cell (low-flow), discharge port of a standard pump assembly (peristaltic, pneumatic, submersible, or Waterra™ pump) or bailer (stainless steel, PVC or polyethylene) into appropriate laboratory provided containers. In low-yielding wells at which the flow through cell is not used, the samples may be collected using a disposable bailer.

11. If disposable polyethylene bailers are used, the bailer should be lowered *slowly* below the surface of the water to minimize agitation and volatilization. For wells that are known to produce turbid samples (values greater than 50 NTU), the bailer should be lowered and retrieved at a rate that limits surging of the well.

12. Sampling data will be recorded on a Groundwater Field Form (sample attached).

13. Pre-label all sample bottles in the field using a waterproof permanent marker in accordance with the TurnKey Sample Labeling, Storage, and Shipment FOP. The following information, at a minimum, should be included on the label:

    - Project Number;
    - Sample identification code (as per project specifications);
    - Date of sample collection (mm, dd, yy);
    - Time of sample collection (military time only) (hh:mm);
    - Specify "grab" or "composite" sample type;
    - Sampler initials;
    - Preservative(s) (if applicable); and
    - Analytes for analysis (if practicable).

14. Collect a separate sample of approximately 200 ml into an appropriate container prior to collecting the first and following the last groundwater sample collected to measure the following field parameters:

Parameter	Units
Dissolved Oxygen	parts per million (ppm)

Specific Conductance	μmhos/cm or μS or mS
pH	pH units
Temperature	°C or °F
Turbidity	NTU
Eh (*optional*)	mV
PID VOCs (*optional*)	ppm

Record all field measurements on a Groundwater Field Form (sample attached).

15. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required, as designated in the **Sample Collection Order** section below.

16. Lower the e-line probe slowly into the monitoring well and record the measurement on a well-specific Groundwater Field Form (sample attached).

17. The samples will be labeled, stored, and shipped in accordance with the TurnKey Field Operating Procedure for Sample Labeling, Storage, and Shipment Procedures.

Domestic Supply Wells

1. Calculate or estimate the volume of water in the well. It is desirable to purge at least one casing volume before sampling. This is controlled, to some extent, by the depth of the well, well yield and the rate of the existing pump. If the volume of water in the well cannot be calculated, the well should be purged continuously for no less than 15 minutes.

2. Connect a sampling tap to an accessible fitting between the well and the pressure tank where practicable. A hose will be connected to the device and the hose discharge located 25 to 50 feet away. The well will be allowed to pump until the lines and one well volume is removed. Flow rate will be measured with a container of known volume and a stopwatch.

3. Place a clean piece of polyethylene or Teflon™ tubing on the sampling port and collect the samples in the order designated below and in the sample containers supplied by the laboratory for the specified analytes. ***DO NOT*** use standard garden hose to collect samples.

4. Sampling results and measurements will be recorded on a Groundwater Field Form (sample attached) as described in the previous section.

5. Collect samples into pre-cleaned bottles provided by the analytical laboratory with the appropriate preservative(s) added based on the volatilization sensitivity or suite of analytical parameters required, as designated in the **Sample Collection Order** section below.

6. The samples will be labeled, stored, and shipped in accordance with the TurnKey Field Operating Procedure for Sample Labeling, Storage, and Shipment Procedures.

SAMPLE COLLECTION ORDER

All groundwater samples, from monitoring wells and domestic supply wells, will be collected in accordance with the following.

1. Samples will be collected preferentially in recognition of volatilization sensitivity. The preferred order of sampling if no free product is present is:

    - Field parameters
    - Volatile Organic Compounds (VOCs)
    - Purgeable organic carbons (POC)
    - Purgeable organic halogens (POH)
    - Total Organic Halogens (TOX)
    - Total Organic Carbon (TOC)
    - Extractable Organic Compounds (i.e., BNAs, SVOCs, etc.)
    - Total petroleum hydrocarbons (TPH) and oil and grease
    - PCBs and pesticides
    - Total metals (Dissolved Metals)
    - Total Phenolic Compounds

- Cyanide
- Sulfate and Chloride
- Turbidity
- Nitrate (as Nitrogen) and Ammonia
- Preserved inorganics
- Radionuclides
- Unpreserved inorganics
- Bacteria
- Field parameters

2. Document the sampling procedures and related information in the Project Field Book and on a Groundwater Field Form (sample attached).

DOCUMENTATION

The three words used to ensure adequate documentation for groundwater sampling are accountability, controllability, and traceability. Accountability is undertaken in the sampling plan and answers the questions who, what, where, when, and why to assure that the sampling effort meets its goals. Controllability refers to checks (including QA/QC) used to ensure that the procedures used are those specified in the sampling plan. Traceability is documentation of what was done, when it was done, how it was done, and by whom it was done, and is found in the field forms, Project Field Book, and chain-of-custody forms. At a minimum, adequate documentation of the sampling conducted in the field consists of an entry in the Project Field Book (with sewn binding), field data sheets for each well, and a chain-of-custody form.

As a general rule, if one is not sure whether the information is necessary, it should nevertheless be recorded, as it is impossible to over-document one's fieldwork. Years may go by before the documentation comes under close scrutiny, so the documentation must be capable of defending the sampling effort without the assistance or translation of the sampling crew.

The minimum information to be recorded daily with an indelible pen in the Project Field Book and/or field data sheets includes date and time(s), name of the facility, name(s) of the sampling crew, site conditions, the wells sampled, a description of how the sample shipment was handled, and a QA/QC summary. After the last entry for the day in the Project Field Book, the Field Team Leader should sign the bottom of the page under the last entry and then draw a line across the page directly under the signature.

PRECAUTIONS/RECOMMENDATIONS

The following precautions should be adhered to prior to and during sample collection activities:

- Field vehicles should be parked downwind (to avoid potential sample contamination concerns) at a minimum of 15 feet from the well and the engine turned off prior to PID vapor analysis and VOC sample collection.

- Ambient odors, vehicle exhaust, precipitation, or windy/dusty conditions can potentially interfere with obtaining representative samples. These conditions should be minimized and should be recorded in the field notes. Shield sample bottles from strong winds, rain, and dust when being filled.

- The outlet from the sampling device should discharge below the top of the sample's air/water interface, when possible. The sampling plan should specify how the samples will be transferred from the sample collection device to the sample container to minimize sample alterations.

- The order of sampling should be from the least contaminated to the most contaminated well to reduce the potential for cross contamination of sampling equipment (see the Sampling Plan or Work Plan).

- Samples should not be transferred from one sampling container to another.

- Sampling equipment must not be placed on the ground, because the ground may be contaminated and soil contains trace metals. Equipment and supplies should be removed from the field vehicle only when needed.

- Smoking and eating should not be allowed until the well is sampled and hands are washed with soap and water, due to safety and possibly sample contamination concerns. These activities should be conducted beyond a 15-foot radius of the well.

- No heat-producing or electrical instruments should be within 15 feet of the well, unless they are intrinsically safe, prior to PID vapor analysis.

- Minimize the amount of time that the sample containers remain open.

- Do not touch the inside of sample bottles or the groundwater sample as it enters the bottle. Disposable gloves may be a source of phthalates, which could be introduced into groundwater samples if the gloves contact the sample.

- Sampling personnel should use a new pair of disposable gloves for each well sampled to reduce the potential for exposure of the sampling personnel to contaminants and to reduce sample cross contamination. In addition, sampling personnel should change disposable gloves between purging and sampling operations at the same well.

- Sampling personnel should not use perfume, insect repellent, hand lotion, etc., when taking groundwater samples. If insect repellent must be used, then sampling personnel should not allow samples or sampling equipment to contact the repellent, and it should be noted in the documentation that insect repellent was used.

- Complete the documentation of the well. A completed assemblage of paperwork for a sampling event includes the completed field forms, entries in the Project Field Book (with a sewn binding), transportation documentation (if required), and possibly chain-of-custody forms.

ATTACHMENTS

Groundwater Field Form (sample)

REFERENCES

1. Wilson, Neal. *Soil Water and Ground Water Sampling*, 1995

TurnKey FOPs:

007	*Calibration and Maintenance of Portable Dissolved Oxygen Meter*
008	*Calibration and Maintenance of Portable Field pH/Eh Meter*
009	*Calibration and Maintenance of Portable Field Turbidity Meter*
011	*Calibration and Maintenance of Portable Photoionization Detector*
012	*Calibration and Maintenance of Portable Specific Conductance Meter*
022	*Groundwater Level Measurement*
023	*Groundwater Purging Procedures Prior to Sample Collection (optional)*
031	*Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedures (optional)*
040	*Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046	*Sample Labeling, Storage and Shipment Procedures*

GROUNDWATER FIELD FORM

Project Name: Date:

Location: Project No.: Field Team:

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

REMARKS:

Note: All measurements are in feet, distance from top of riser.

Volume Calculation

Diam.	Vol. (g/ft)
1"	0.041
2"	0.163
4"	0.653
6"	1.469

Stabilization Criteria

Parameter	Criteria
pH	± 0.1 unit
SC	± 3%
Turbidity	± 10%
DO	± 0.3 mg/L
ORP	± 10 mV

PREPARED BY:

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Hollow Stem Auger (HSA) Drilling Procedures

FOP 026.1

HOLLOW STEM AUGER (HSA) DRILLING PROCEDURES

PURPOSE

This guideline presents a method for drilling a borehole through unconsolidated materials, including soils or overburden, and consolidated materials, including bedrock.

PROCEDURE

The following procedure will be used to drill a borehole for sampling and/or well installation, using hollow-stem auger methods and equipment.

1. Follow TurnKey's Field Operating Procedure for Drill Site Selection Procedure prior to implementing any drilling activity.
2. Perform drill rig safety checks with the driller by completing the Drilling Safety Checklist form (sample attached).
3. Conduct tailgate health and safety meeting with project team and drillers by completing the Tailgate Safety Meeting Form.
4. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures (i.e., PID, FID, combustible gas meter) or manufacturer's recommendations for calibration of field meters (i.e., DataRAM 4 Particulate Meter).
5. Ensure all drilling equipment (i.e., augers, rods, split-spoons) appear clean and free of soil prior to initiating any subsurface intrusion. Decontamination of drilling equipment should be in accordance with TurnKey's FOP: Drilling and Excavation Equipment Decontamination Procedures.
6. Mobilize the auger rig to the site and position over the borehole.
7. Level and stabilize the rig using the rig jacks, and recheck the rig location against the planned drilling location. If necessary, raise the jacks and adjust the rig position.

8. Place a metal or plywood auger pan over the borehole location to collect the auger cuttings. This auger pan will be equipped with a 12-inch nominal diameter hole for auger passage. As an alternative, a piece of polyethylene tarp may be used as a substitute.

9. Advance augers into the subsurface. For sampling or pilot-hole drilling, nominal 8-inch outside diameter (OD) augers should be used. The boring diameter will be approved by the TurnKey field supervisor.

10. Collect soil samples via split spoon sampler in accordance with TurnKey's Field Operating Procedure for Split Spoon Sampling.

11. Check augers periodically during drilling to ensure the boring is plumb. Adjust rig position as necessary to maintain plumb.

12. Continue drilling until reaching the assigned total depth, or until auger refusal occurs. Auger refusal is when the drilling penetration drops below 0.1 feet per 10 minutes, with the full weight of the rig on the auger bit, and a center bit (not center plug) in place.

13. Plug and abandon boreholes not used for well installation in accordance with TurnKey's Field Operating Procedure for Abandonment of Borehole.

OTHER PROCEDURAL ISSUES

- Slip rings may be used for lifting a sampling or bit string. The string will not be permitted to extend more than 15 feet above the mast crown.

- Borings will not be over drilled (rat holed) without the express permission of the TurnKey field supervisor. All depth measurements should be accurate to the nearest 0.1 foot, to the extent practicable.

- Potable water may be placed in the auger stem if critically necessary for borehole control or to accomplish sampling objectives and must be approved by the TurnKey Project Manager and/or NYSDEC Project Manager. Upon approval, the potable water source and quantity used will be documented in the Project Field Book and subsequent report submittal.

ATTACHMENTS

Drilling Safety Checklist (sample)
Tailgate Safety Meeting Form (sample)

REFERENCES

<u>TurnKey FOPs:</u>

001	*Abandonment of Borehole Procedures*
010	*Calibration and Maintenance of Portable Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
017	*Drill Site Selection Procedure*
018	*Drilling and Excavation Equipment Decontamination Procedures*
058	*Split Spoon Sampling Procedures*

DRILLING SAFETY CHECKLIST

Project:	Date:
Project No.:	Drilling Company:
Client:	Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
“Kill switches” installed by the manufacturer are in operable condition and all workers at the drill site are familiar with their location and how to activate them?		
“Kill switches” are accessible to workers on both sides of the rotating stem? NOTE: Optional based on location and number of switches provided by the manufacturer.		
Cables on drill rig are free of kinks, frayed wires, “bird cages” and worn or missing sections?		
Cables are terminated at the working end with a proper eye splice, either swaged Coupling or using cable clamps?		
Cable clamps are installed with the saddle on the live or load side? Clamps should not be alternated and should be of the correct size and number for the cable size to which it is installed. Clamps are complete with no missing parts?		
Hooks installed on hoist cables are the safety type with a functional latch to prevent accidental separation?		
Safety latches are functional and completely span the entire throat of the hook and have positive action to close the throat except when manually displaced for connecting or disconnecting a load?		
Drive shafts, belts, chain drives and universal joints shall be guarded to prevent accidental insertion of hands and fingers or tools.		
Outriggers shall be extended prior to and whenever the boom is raised off its cradle. Hydraulic outriggers must maintain pressure to continuously support and stabilize the drill rig even while unattended.		
Outriggers shall be properly supported on the ground surface to prevent settling into the soil.		
Controls are properly labeled and have freedom of movement? Controls should not be blocked or locked in an action position.		
Safeties on any device shall not be bypassed or neutralized.		
Controls shall be operated smoothly and cables and lifting devices shall not be jerked or operated erratically to overcome resistance.		
Slings, chokers and lifting devices are inspected before using and are in proper working order? Damaged units are removed from service and are properly tagged?		
Shackles and clevises are in proper working order and pins and screws are fully inserted before placing under a load?		
High-pressure hoses have a safety (chain, cable or strap) at each end of the hose section to prevent whipping in the event of a failure?		
Rotating parts of the drill string shall be free of sharp projections or hooks, which could entrap clothing or foreign objects?		

DRILLING SAFETY CHECKLIST

Project: Date:

ITEMS TO CHECK	OK	ACTION NEEDED
Wire ropes should not be allowed to bend around sharp edges without cushion material.		
The exclusion zone is centered over the borehole and the radius is equal or greater than the boom height?		
The work area around the borehole shall be kept clear of trip hazards and walking surfaces should be free of slippery material.		
Workers shall not proceed higher than the drilling deck without a fall restraining device and must attach the device in a manner to restrict fall to less than 6 feet.		
A fire extinguisher of appropriate size shall be immediately available to the drill crew. The drill crew shall have received annual training on proper use of the fire extinguisher.		
29 CFR 1910.333 © (3) Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to, under, by, or near power lines only in accordance with the following: .333 © (3) (ii) 50 kV or less -minimum clearance is 10 ft. For 50 kV or over - 10ft. Plus ½ in. For each additional kV **TurnKey Policy: Maintain 20 feet clearance**		
29 CFR 1910.333 © (3) (iii) While the rig is in transit with the boom in the down position, clearance from energized power lines will be maintained as follows: Less than 50 kV - 4 feet 50 to 365 kV - 10 feet 365 to 720 kV - 16 feet		

Name: (printed)

Signed: Date:

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:
Project Number: Client:
Work Activities:

HOSPITAL INFORMATION:

Name:
Address: *City:* *State:* *Zip:*
Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:		*PPE Level:*	A	B	C	D
Activity:		*PPE Level:*	A	B	C	D
Activity:		*PPE Level:*	A	B	C	D
Activity:		*PPE Level:*	A	B	C	D
Activity:		*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)
Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

ATTENDEES

Name Printed	Signatures

Meeting conducted by:

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Low-Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedure

LOW FLOW (MINIMAL DRAWDOWN) GROUNDWATER PURGING & SAMPLING PROCEDURES

PURPOSE

This procedure describes the methods used for performing low flow (minimal drawdown) purging, also referred to as micro-purging, at a well prior to groundwater sampling to obtain a representative sample from the water-bearing zone. This method of purging is used to minimize the turbidity of the produced water. This may increase the representativeness of the groundwater samples by avoiding the necessity of filtering suspended solids in the field prior to preservation of the sample.

Well purging is typically performed immediately preceding groundwater sampling. The sample should be collected as soon as the parameters measured in the field (i.e., pH, specific conductance, dissolved oxygen, Eh, temperature, and turbidity) have stabilized.

PROCEDURE

Allow approximately 3 to 10 days following well development for groundwater to return to static conditions before performing low-flow purge and sample activities at any well location. Conversely, perform low-flow sampling as soon as purged groundwater has stabilized. If the well does not yield sufficient volume (i.e., cannot maintain a constant water level during purging) for low-flow purge and sampling, then an alternative method must be performed in accordance with TurnKey's Groundwater Purging Procedures Prior to Sample Collection FOP.

1. Water samples should not be taken immediately following well development. Sufficient time should be allowed to stabilize the groundwater flow regime in

the vicinity of the monitoring well. This lag time will depend on site conditions and methods of installation but may exceed one week.

2. Prepare the electronic water level indicator (e-line) in accordance with the procedures referenced in the TurnKey's Groundwater Level Measurement FOP and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the TurnKey's Non-disposable and Non-dedicated Sampling Equipment Decontamination FOP. Store the e-line in a protected area until use. This may include wrapping the e-line in clean plastic until the time of use.

3. Calibrate all sampling devices and monitoring equipment in accordance with manufacturer's recommendations, the site Quality Assurance Project Plan (QAPP) and/or Field Sampling Plan (FSP). Calibration of field instrumentation should be followed as specified in TurnKey's Calibration and Maintenance FOP for each individual meter.

4. Inspect the well/piezometer for signs of vandalism or damage and record condition on the Groundwater Field Form (sample attached). Specifically, inspect the integrity of the following: concrete surface seal, lock, protective casing and well cover, well casing and J-plug/cap. Report any irregular findings to the Project Manager.

5. Unlock and remove the well protective cap or cover and place on clean plastic to avoid introducing foreign material into the well.

6. Monitor the well for organic vapors using a PID, as per the Work Plan. If a reading of greater than 5 ppm is recorded, the well should be allowed to vent until levels drop below 5 ppm before proceeding with purging.

7. Lower the e-line probe slowly into the monitoring well and record the initial water level in accordance with the procedures referenced in TurnKey's Groundwater Level Measurement FOP. Refer to the construction diagram for the well to identify the screened depth.

8. Decontaminate all non-dedicated pump and tubing equipment following the procedures referenced in the TurnKey's Non-disposable and Non-dedicated Sampling Equipment Decontamination FOP.

9. Lower the purge pump or tubing (i.e., low-flow electrical submersible, peristaltic, etc.) slowly into the well until the pump/tubing intake is approximately in the middle of the screened interval. Rapid insertion of the pump will increase the turbidity of well water, and can increase the required purge time. This step can be eliminated if dedicated tubing is already within the well.

   Placement of the pump close to the bottom of the well will cause increased entrainment of solids, which may have settled in the well over time. Low-flow purging has the advantage of minimizing mixing between the overlying stagnant casing water and water within the screened interval. The objective of low-flow purging is to maintain a purging rate, which minimizes stress (drawdown) of the water level in the well. 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.

10. Lower the e-line back down the well as water levels will be frequently monitored during purge and sample activities.

11. Begin pumping to purge the well. The pumping rate should be between 100 and 500 milliliters (ml) per minute (0.03 to 0.13 gallons per minute) depending on site hydrogeology. Periodically check the well water level with the e-line adjusting the flow rate as necessary to stabilize drawdown within the well. If possible, a steady flow rate should be maintained that results in a stabilized water level (drawdown of 0.3 feet or less). If the water level exceeds 2 feet below static and declining, slow the purge rate until the water level generally stabilizes. Record each pumping rate and water level during the event. If the water level continues to drop and will not stabilize, the monitoring location is not conducive to low-flow sampling and conventional purge and sample methods should be performed.

The low flow rate determined during purging will be maintained during the collection of analytical samples. At some sites where geologic heterogeneities are sufficiently different within the screened interval, high conductivity zones may be preferentially sampled.

12. Measure and record field parameters (pH, specific conductance, Eh, dissolved oxygen (DO), temperature, and turbidity) during purging activities. In lieu of measuring all of the parameters, a minimum subset could be limited to pH, specific conductance, and turbidity or DO. A reduction in the field parameter list must be approved by the Project Manager and/or the NYSDEC Project Manager.

    Water quality indicator parameters should be used to determine purging needs prior to sample collection in each well. Stabilization of indicator parameters should be used to determine when formation water is first encountered during purging. In general, the order of stabilization is pH, temperature, and specific conductance, followed by Eh, DO and turbidity. Performance criteria for determination of stabilization should be based on water-level drawdown, pumping rate and equipment specifications for measuring indicator parameters. An in-line flow through cell to continuously measure the above parameters may be used. The in-line device should be disconnected or bypassed during sample collection.

13. Purging will continue until parameters of water quality have stabilized. Record measurements for field indicator parameters (including water levels) at regular intervals during purging. The stability of these parameters with time can be used to guide the decision to discontinue purging. Proper adjustments must be made to stabilize the flow rate as soon as possible.

14. Record well purging and sampling data in the Project Field Book or on the Groundwater Field Form (sample attached). Measurements should be taken approximately every three to five minutes, or as merited given the rapidity of change.

15. Purging is complete when field indicator parameters stabilize. Stabilization is achieved after all field parameters have stabilized for three successive readings. Three successive readings should be within ± 0.1 units for pH, ± 3% for specific conductance, ± 10 mV for Eh, and ± 10% for turbidity and dissolved oxygen. These stabilization guidelines are provided for rough estimates only, actual site-specific knowledge may be used to adjust these requirements higher or lower.

    An in-line water quality measurement device (e.g., flow-through cell) should be used to establish the stabilization time for several field parameters 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.

16. Collect all project-required samples from the discharge tubing at the flow rate established during purging in accordance with TurnKey's Groundwater Sample Collection Procedures FOP. **A peristaltic pump and dedicated tubing cannot be used to collect VOC or SVOC project-required samples; only non-organic compounds may be collected using this type of pump.** Continue to maintain a constant flow rate such that the water level is not drawn down as described above. Fill sample containers with minimal turbulence by allowing the ground water to flow from the tubing along the inside walls of the container.

17. If field filtration is recommended as a result of increased turbidity greater than 50 NTU, an in-line filter equipped with a 0.45-micron filter should be utilized. Collection of a filtered sample must be accompanied by an unfiltered sample.

18. Replace the dedicated tubing down the well taking care to avoid contact with the ground surface.

19. Restore the well to its capped/covered and locked condition.

20. Upon purge and sample collection completion, slowly lower the e-line to the bottom of the well/piezometer. Record the total depth to the nearest 0.01-

foot and compare to the previous total depth measurement. If a significant discrepancy exists, re-measure the total depth. Record observations of purge water to determine whether the well/piezometer had become silted due to inactivity or damaged (i.e., well sand within purge water). Upon confirmation of the new total depth and determination of the cause (i.e., siltation or damage), notify the Project Manager following project field activities.

ATTACHMENTS

Groundwater Field Form (sample)

REFERENCES

United States Environmental Protection Agency, 540/S-95/504, 1995. *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.*

<u>TurnKey FOPs:</u>
007 *Calibration and Maintenance of Portable Dissolved Oxygen Meter*
008 *Calibration and Maintenance of Portable Field pH/Eh Meter*
009 *Calibration and Maintenance of Portable Field Turbidity Meter*
011 *Calibration and Maintenance of Portable Photoionization Detector*
012 *Calibration and Maintenance of Portable Specific Conductance Meter*
022 *Groundwater Level Measurement*
024 *Groundwater Sample Collection Procedures*
040 *Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046 *Sample Labeling, Storage and Shipment Procedures*

TurnKey Environmental Restoration, LLC

GROUNDWATER FIELD FORM

Project Name: Date:
Location: Project No.: Field Team:

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

REMARKS:

Note: All measurements are in feet, distance from top of riser.

Volume Calculation

Diam.	Vol. (g/ft)
1"	0.041
2"	0.163
4"	0.653
6"	1.469

Stabilization Criteria

Parameter	Criteria
pH	± 0.1 unit
SC	± 3%
Turbidity	± 10%
DO	± 0.3 mg/L
ORP	± 10 mV

PREPARED BY:

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Management of Investigation-Derived Waste (IDW)

FOP 032.1

MANAGEMENT OF INVESTIGATION-DERIVED WASTE (IDW)

PURPOSE

The purpose of these guidelines is to ensure the proper holding, storage, transportation, and disposal of materials generated from field investigation activities that may contain hazardous wastes. Investigation-derived waste (IDW) includes the following:

- Drill cuttings, discarded soil samples, drilling mud solids, and used sample containers.
- Well development and purge waters and discarded groundwater samples.
- Decontamination waters and associated solids.
- Soiled disposable personal protective equipment (PPE).
- Used disposable sampling equipment.
- Used plastic sheeting and aluminum foil.
- Other equipment or materials that either contain or have been in contact with potentially impacted environmental media.

Because these materials may contain regulated chemical constituents, they must be managed as a solid waste. This management may be terminated if characterization analytical results indicate the absence of these constituents.

PROCEDURE

1. Contain all investigation-derived wastes in Department of Transportation (DOT)-approved 55-gallon drums, roll-off boxes, or other containers suitable for the wastes.

2. Contain wastes from separate borings or wells in separate containers (i.e. do not combine wastes from several borings/wells in a single container, unless it is a container used specifically for transfer purposes, or unless specific permission to do so has been provided by the TurnKey Field Team Leader. Unused samples from surface sample locations within a given area may be combined.

3. To the extent practicable, separate solids from drilling muds, decontamination waters, and similar liquids. Place solids within separate containers.

4. Transfer all waste containers to a staging area. Access to this area will be controlled. Waste containers must be transferred to the staging area as soon as practicable after the generating activity is complete.

5. Pending transfer, all containers will be covered and secured when not immediately attended.

6. Label all containers with regard to contents, origin, date of generation, using TurnKey's IDW container label (sample attached). Use indelible ink for all labeling.

7. Complete the Investigative Derived Waste Container Log (sample attached) as waste containers are labeled in order to track and inventory project waste. Leave a copy of the log with the site manager or fax copy to the owner/operator as necessary.

8. Collect samples for waste characterization purposes, or use boring/well sample analytical data for characterization.

9. For wastes determined to be hazardous in character, **be aware of accumulation time limitations**. Coordinate the disposal of these wastes with the plant manager/owner/operator, if applicable.

10. Upon Property Owner, Project Manager, and/or NYSDEC Project Manager approval, dispose of investigation-derived wastes as follows:

- Soil, water, and other environmental media for which analysis does not detect organic constituents, and for which inorganic constituents are at levels that meet the Site's cleanup objectives, may be spread on the Property or otherwise treated as a non-waste material. Disposal quantity and on-site location will be documented on Project Field Books and in the project report submittal.

- Soil, water, and other environmental media in which organic compounds are detected or metals are present above the Site's cleanup objectives will be disposed off-site in accordance with applicable state and federal regulations. Disposal quantity and off-site location will be documented on Project Field Books and in the project report submittal.

- Personal protective equipment, disposable bailers, and similar equipment may be disposed as municipal waste, unless waste characterization results mandate otherwise.

WASTE STORAGE MANAGEMENT

Hazardous materials generated on site should be temporarily stored in a secure location that is under the control of the owner/operator or does not allow for vandalism (i.e., within a locked building structure or within a locked fenced in area). A waste-staging area should be designated on-site by the Project Manager in conjunction with the owner/operator.

ATTACHMENTS

Investigation Derived Waste Container Log (sample)
Investigation Derived Waste Container Label (sample)

REFERENCES

None

INVESTIGATION DERIVED WASTE CO

Project Name: Location:
Project Number: Personnel:

Container		Contents	Date		Staging Location	Date Sampled	Co
Number	Description		Started	Ended			

Prepared By:
Signed:

IDW Container Label (sample):

TurnKey Environmental Restoration, LLC

Project Name:

Project Number:

Container I.D.:

Contents/Matrix:

Estimated Quantity:

Date of Generation:

Date of Sample Collection:

Contact Name:

Contact Phone Number:

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FIELD OPERATING PROCEDURES

Monitoring Well Construction for Hollow Stem Auger Boreholes

FOP 033.0

MONITORING WELL CONSTRUCTION FOR HOLLOW STEM AUGER BOREHOLES

PURPOSE

Wells will be installed within selected boreholes for the purpose of evaluating groundwater characteristics. Well installation procedures depend upon the drilling method. This procedure describes well construction and installation for boreholes drilled using the hollow stem auger method. Refer to the TurnKey's Hollow Stem Auger Drilling Procedures FOP. Nominal dimensions and materials for the well are shown in the attached well construction diagram.

PROCEDURE

1. Advance borehole in accordance with the TurnKey's Hollow Stem Auger Drilling Procedure FOP to the required depth. The nominal inside diameter (ID) of the auger stem used should be at least 2 inches larger than the outside diameter (OD) of the riser and screen selected for the well installation. Record the monitoring well construction on the Field Borehole/Monitoring Well Installation Log (sample attached) (see Documentation Requirements for Drilling and Well Installation FOP).

2. Remove the drill rods and center bit/plug from the auger stem and verify borehole depth using weighted measuring tape.

3. In the event of an over drill (i.e. borehole depth is more than one foot greater than desired base of screen depth), use bentonite chips poured through the auger stem to seal the over drilled portion of the borehole. Be sure to note bentonite chip thickness on Field Borehole/Monitoring Well Installation Log.

4. Add a maximum of 6 inches of filter pack material through the auger stem to the base of the borehole. (Note: This step may be avoided if dense non-aqueous phase liquids are suspected to be present and it is desirable to have the screen and/or sump at the base of the borehole.)

5. Measure the length of the well string (i.e. riser and screen), and lower the well string into the well assembly to the desired depth. All measurements during the well installation process will be accurate to 0.1 foot.

6. Surface pour filter pack material into the annulus between the well and the auger stem as the augers are gradually withdrawn from the borehole. Use a weighted tape to confirm that the level of sand is maintained within the augers at all times. Record material volumes used.

7. After filter pack materials are brought to the required level, surface pour bentonite chips or pellets into the annulus between the well and the auger stem to form the filter pack seal. If necessary to avoid bridging, delayed hydration (coated) pellets may be used. Record the volume of material used.

8. Allow the bentonite chips/pellets to adequately hydrate for approximately 30 to 45-minutes. Cap or cover the well top of riser.

9. Mix cement/bentonite grout to a smooth consistency using a centrifugal or reciprocating pump. Do not hand mix. All water used must be potable quality. Record the volume of water used.

10. Fill the remaining annulus between the well and the auger stem with grout by surface pouring or pumping, and begin withdrawal of the auger string. Periodically top the auger string off with additional grout. If groundwater is present within the annulus above the bentonite chip/pellet seal, cement/bentonite grout will be pressure tremie grouted from bottom to top in order to displace groundwater from the borehole.

11. When the auger string is withdrawn, center the upper portion of the well riser within the borehole, and place drums or barricades around the well for protection while the grout cures. Place and lock a security cap (i.e., J-plug) in the opening of the well riser.

12. Leave the well undisturbed for at least 24 hours to allow the grout to cure. If excessive grout fallback occurs, top off as necessary with bentonite chips or additional grout.

13. Construct the surface completion as shown in the attached Typical Monitoring Well Detail (Figure 1). Select flush completions for all locations in active operational or high traffic areas, or in other areas where an above grade completion would be undesirable. Use aboveground completions in all other areas.

14. Place a dedicated lock on the well or protective casing, and keep well locked when not actively attended.

15. Permanently label the well with the appropriate well identifier as determined by the Project Manager or specified in the Work Plan.

16. Permanently mark a survey location on the north side at the top of the casing with a saw cut. Survey all wells for horizontal location and elevation, using a surveyor licensed by the State of New York. Coordinates and elevations will be provided in a coordinate system consistent with previous well surveys at the Site. Information obtained will include location (*x* and *y*) of the well, and elevation (*z*) of the ground surface, the pad, and the top of riser.

17. Develop the well as described in the TurnKey's Field Operating Procedure for Monitoring Well Development.

18. Manage all waste materials generated during well installation and development as described in the TurnKey's Field Operating Procedure for Management of Investigation Derived Waste.

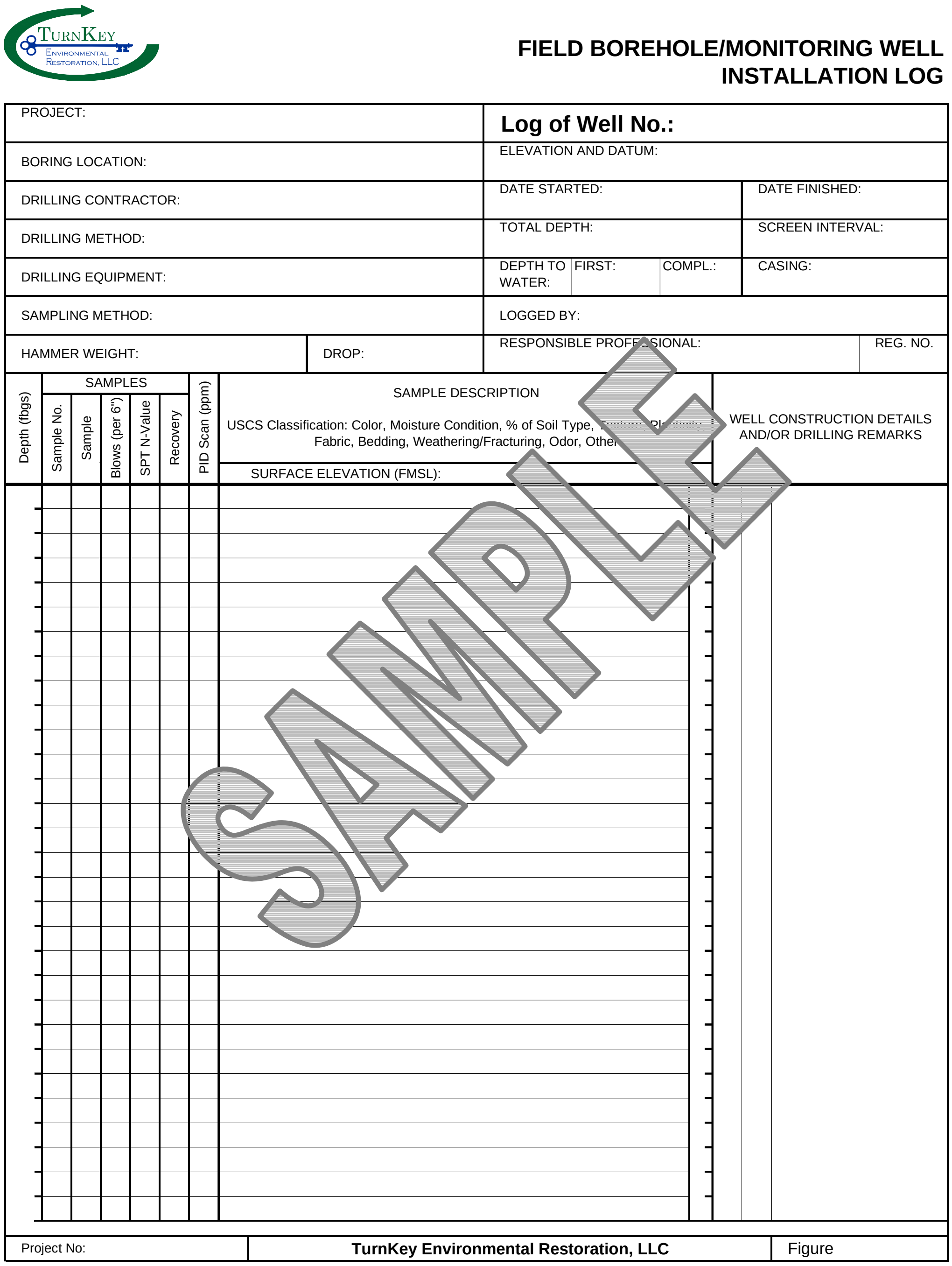
ATTACHMENTS

Field Borehole/Monitoring Well Installation Log (sample)
Typical Monitoring Well Detail (Figure 1)

REFERENCES

TurnKey FOPs:

015	*Documentation Requirements for Drilling and Well Installation*
026	*Hollow Stem Auger Drilling Procedures*
032	*Management of Investigation Derived Waste*
036	*Monitoring Well Development Procedures*



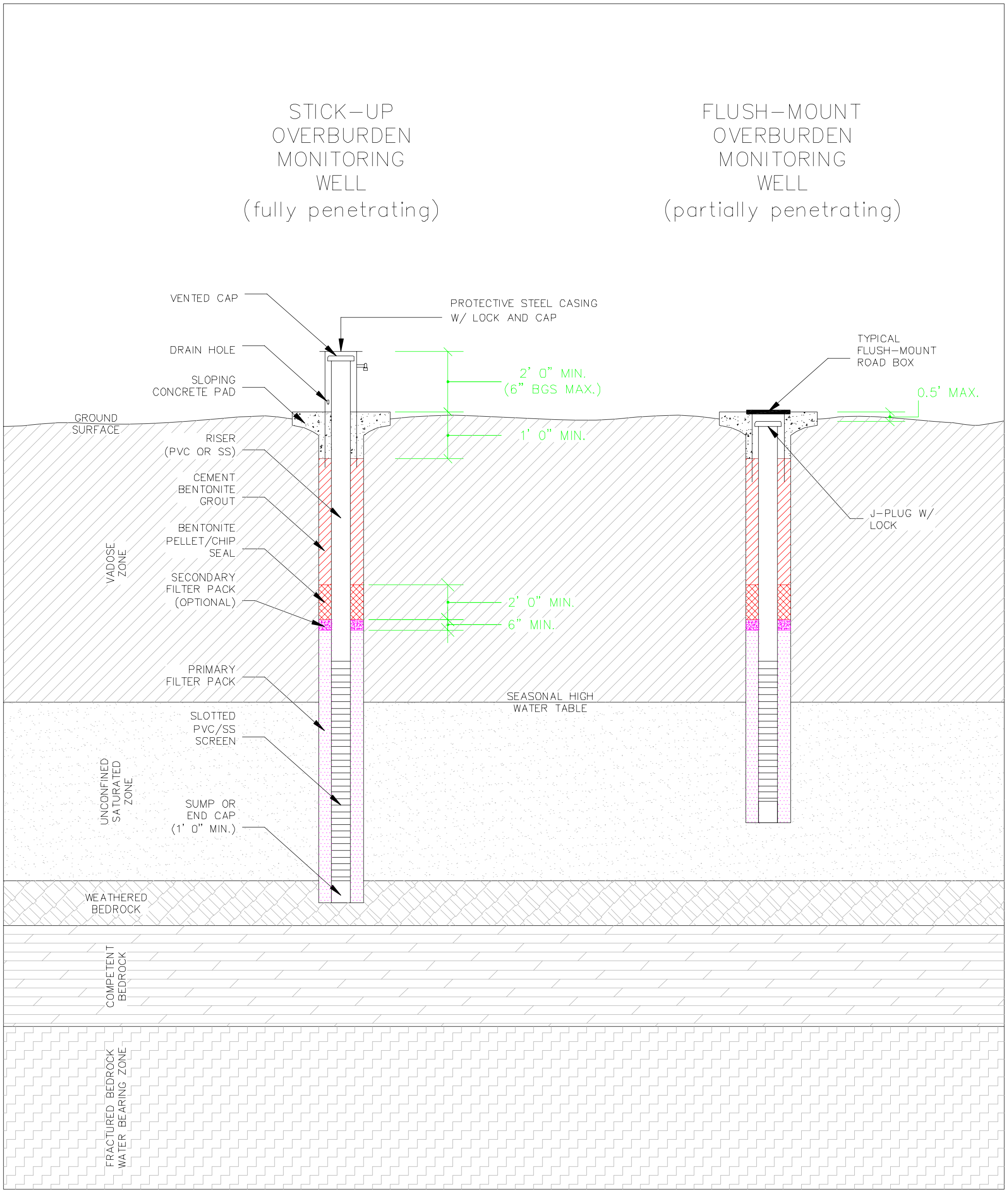
FIELD BOREHOLE/MONITORING WELL INSTALLATION LOG

PROJECT:	**Log of Well No.:**		
BORING LOCATION:	ELEVATION AND DATUM:		
DRILLING CONTRACTOR:	DATE STARTED:		DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH:		SCREEN INTERVAL:
DRILLING EQUIPMENT:	DEPTH TO WATER:	FIRST: COMPL.:	CASING:
SAMPLING METHOD:	LOGGED BY:		
HAMMER WEIGHT: DROP:	RESPONSIBLE PROFESSIONAL:		REG. NO.

Depth (fbgs)	SAMPLES Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery	PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

FIGURE 1


STICK–UP OVERBURDEN MONITORING WELL (fully penetrating)
FLUSH–MOUNT OVERBURDEN MONITORING WELL (partially penetrating)
VENTED CAP
PROTECTIVE STEEL CASING W/ LOCK AND CAP
DRAIN HOLE
SLOPING CONCRETE PAD
GROUND SURFACE
2' 0" MIN. (6" BGS MAX.)
1' 0" MIN.
TYPICAL FLUSH–MOUNT ROAD BOX
0.5' MAX.
RISER (PVC OR SS)
CEMENT BENTONITE GROUT
BENTONITE PELLET/CHIP SEAL
SECONDARY FILTER PACK (OPTIONAL)
J–PLUG W/ LOCK
2' 0" MIN.
6" MIN.
VADOSE ZONE
PRIMARY FILTER PACK
SEASONAL HIGH WATER TABLE
SLOTTED PVC/SS SCREEN
UNCONFINED SATURATED ZONE
SUMP OR END CAP (1' 0" MIN.)
WEATHERED BEDROCK
COMPETENT BEDROCK
FRACTURED BEDROCK WATER BEARING ZONE

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FIELD OPERATING PROCEDURES

Monitoring Well Development Procedures

FOP 036.0

MONITORING WELL DEVELOPMENT PROCEDURES

PURPOSE

This procedure describes the methods for the development of newly installed monitoring wells and re-development of existing monitoring wells that have been inactive for an extended period of time (i.e., one year or more). Monitoring wells are developed after installation in order to remove introduced water and drilling fluids, reduce the turbidity of the water, and improve the hydraulic communication between the well and the water-bearing formation. Well development will not commence until the annular grout seal has cured, but will be performed within ten calendar days of well installation.

PROCEDURE

1. All well development will include surge blocking or false bailing with one or more of the following fluid removal methods. Well development activities may include:

    - Bailing
    - Air Lifting
    - Submersible Pumping
    - Other methods as approved by the TurnKey Field Team Leader.
    - The appropriate water removal method will be selected based on water level depth and anticipated well productivity.

2. Assemble and decontaminate equipment (if necessary), and place in the well. Reference the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

3. Alternate the use of agitation methods with water removal methods, using the former to suspend solids in the well water, and the latter to remove the turbid water. For example, use a vented surge block to agitate the well, moving up and down within the screened interval and then use a pump to clear the well. A bailer may be used for both purposes, by surging with the bailer (false

bailing) for a period within the screened interval, then bailing a volume of water from the well.

4. When using surging methods, initiate this activity gradually, with short (2 to 3 feet) strokes. After several passes across the screened interval, increase the speed and length of the surge strokes.

5. Continue development until the following objectives are achieved:

   - Field parameters stabilize to the following criteria:
     - Dissolved Oxygen: ± 0.3 mg/L
     - Turbidity: ± 10%
     - Specific Conductance: ± 3%
     - ORP: ± 10 mV
     - pH: ± 0.1 units
   - The well will generate non-turbid water during continued pumping typically less than 50 NTU.
   - A minimum of 10 well volumes has been evacuated from the well.
   - In the case of lost water during drilling activities, the volume of water removed exceeds twice the volume of water lost to the formation during the drilling process, as indicated by the water balance.

6. Document the development methods, volumes, field parameter measurements, and other observations on the attached Groundwater Well Development Log (sample attached).

ATTACHMENTS

Groundwater Well Development Log (sample)

REFERENCES

<u>TurnKey FOPs:</u>

040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

GROUNDWATER WELL DEVELOPMENT LOG

Project Name:	WELL NUMBER:
Project Number:	Sample Matrix:
Client:	Weather:

WELL DATA: DATE: TIME:

Casing Diameter (inches):	Casing Material:
Screened interval (fbTOR):	Screen Material:
Static Water Level (fbTOR):	Bottom Depth (fbTOR):
Elevation Top of Well Riser (fmsl):	Datum Ground Surface: Mean Sea Level
Elevation Top of Screen (fmsl):	Stick-up (feet):

PURGING DATA: DATE: START TIME: END TIME:

VOLUME CALCULATION:

(A) Total Depth of Well (fbTOR):	
(B) Casing Diameter (inches):	
(C) Static Water Level (fbTOR):	
One Well Volume (V, gallons): $V = 0.0408 [(B)^2 \times \{ (A) - (C) \}]$	

*Use the table to the right to calculate one well volume.

Field Personnel:

Volume Calculation

Well Diameter	Volume gal/ft
1"	0.041
2"	0.163
3"	0.367
4"	0.653
5"	1.020
6"	1.469
8"	2.611

Stabilization Criteria

Parameter	Criteria
DO	+/- 0.3 mg/L
Turbidity	+/- 10%
SC	+/- 3%
ORP	+/- 10 mV
pH	+/- 0.1 unit

EVACUATION STABILIZATION TEST DATA:

Time	Water Level (fbTOR)	Accumulated Volume (gallons)	pH (units)	Temperature (degrees C)	Specific Conductance (mS/cm)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor

REMARKS:

PREPARED BY:

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

NAPL Detection and Sample Collection Procedure

FOP 039.1

NON-AQUEOUS PHASE LIQUID DETECTION AND SAMPLE COLLECTION PROCEDURE

PURPOSE

This procedure describes the methods to detect the presence and sample collection of Non-Aqueous Phase Liquid (NAPL) in groundwater monitoring wells prior to purging activities. If NAPL is suspected, all activities should be performed with proper personnel protective equipment (PPE).

DETECTION PROCEDURE

Groundwater monitoring wells suspected of containing NAPL will be sounded with an interface probe, or similar device, in accordance with the following.

1. Inspect the well/piezometer for signs of vandalism or damage and record condition on the Groundwater Field Form (sample attached). Specifically, inspect the integrity of the following: concrete surface seal, lock, protective casing and well cover, well casing and J-plug/cap. Report any irregular findings to the Project Manager.
2. Unlock and remove the well protective cap or cover and place on clean plastic to avoid introducing foreign material into the well.
3. Calibrate the photoionization detector (PID) in accordance with the TurnKey Field Operating Procedure for Calibration and Maintenance of Portable Photoionization Detector.
4. Monitor the well for organic vapors using a PID, as per the Work Plan. If a reading of greater than 5 ppm is recorded, the well should be allowed to vent until levels drop below 5 ppm before proceeding with purging. Record PID measurements on the Groundwater Field Form (sample attached).
5. Slowly lower the interface probe down the well, avoiding contact with the well casing. Upon contact with the static liquid level in the well, the interface

probe will signal contact with an audible tone and/or a visible light mounted inside the reel.

Note:

- If the signal is constant, the probe is in contact with groundwater; and
- If the signal oscillates, the probe is in contact with NAPL.

6. Record the depth, type of liquid encountered (if applicable) and any other related information in the Project Field Book and on a Groundwater Field Form (sample attached).
7. Slowly lower the interface probe to the well bottom. Record the depth(s) and type(s) of any additional phases encountered.
8. Slowly raise the interface probe to the surface, avoiding contact with the well casing.
9. Place the interface probe and storage reel in a plastic bag for subsequent decontamination in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

SAMPLE COLLECTION PROCEDURE

All NAPL samples collected from groundwater monitoring wells will be collected in accordance with the following.

1. Place plastic sheeting on the ground around the well to prevent equipment from coming in contact with soil and also to prevent the surface transmission of NAPL.

2. All sampling personnel will don the appropriate PPE in accordance with the site health and safety plan.

3. Measure the static water level and NAPL level(s) using an interface probe as described in the previous section.

4. Determine depth to NAPL layer and thickness. Record appropriate data in the Project Field Book and on a Groundwater Sample Collection Log form (sample attached).

DNAPL SAMPLE COLLECTION

The following procedure should be used in sampling dense, heavier than water NAPL (i.e., with a high specific gravity) (DNAPL).

1. Collect samples using a translucent double check valve bailer (i.e., a bailer with a ball valve on both the top and bottom) constructed of Teflon, polyethylene or PVC which is connected to polypropylene rope for lowering into the well. All non-dedicated equipment shall be decontaminated in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Remove wrapping (i.e., aluminum foil, manufacturers packaging etc.), attach bailer to new polypropylene rope and slowly lower the bailer until it contacts the well bottom.

3. Slowly raise and lower the bailer to create a gentle surging action thereby inducing DNAPL into the bailer past the bottom ball valve.

4. Slowly raise the bailer to the surface. Avoid contact of the bailer line with the well casing and/or ground surface.

5. Observe the DNAPL through the translucent wall of the bailer and check if the immiscible phases have separated. If not, allow the bailer to stand upright until the phases have separated.

6. Carefully attach a bottom-emptying device with stopcock to the bottom of the bailer and discharge the DNAPL gently down the side of the sample bottle to minimize turbulence.

7. Repeat steps 2 through 6 until a sufficient sample volume is obtained.

8. Cap the sample bottle and label, preserve and ship samples in accordance with the TurnKey's Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

9. Place the used plastic sheeting, bailer and polyethylene rope in a plastic bag for subsequent decontamination or disposal.

10. Document the sampling procedures and related information in the Project Field Book and on a Groundwater Sample Collection Log form (sample attached).

LNAPL SAMPLE COLLECTION

The following procedure should be used in sampling lighter than water NAPL (i.e., with a low specific gravity) (LNAPL).

1. Collect samples using a translucent double check valve bailer (i.e., a bailer with a ball valve on both the top and bottom) constructed of Teflon, polyethylene or PVC which is connected to polypropylene rope for lowering into the well. All non-dedicated equipment shall be decontaminated in accordance with the TurnKey's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

2. Remove wrapping (i.e., aluminum foil, manufacturers packaging etc.), attach bailer to new polypropylene rope and slowly lower the bailer down the well into the immiscible phase of LNAPL. Care should be taken to lower the bailer just through the LNAPL layer, but not significantly down into the underlying groundwater.

3. Slowly raise the bailer to the surface. Avoid contact of the bailer line with the well casing and/or ground surface.

4. Observe the LNAPL through the translucent wall of the bailer and check if the immiscible phases have separated. If not, allow the bailer to stand upright until the phases have separated.

5. Carefully attach a bottom-emptying device with stopcock to the bottom of the bailer and decant the denser groundwater portion of the bailer contents into a DOT-approved 55-gallon drum for proper disposal.

6. Discharge the LNAPL gently down the side of the sample bottle to minimize turbulence.

7. Repeat steps 2 through 6 until a sufficient sample volume is obtained.

8. Cap the sample bottle and label, preserve and ship samples in accordance with the TurnKey's Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

9. Place the used plastic sheeting, bailer and polyethylene rope in a plastic bag for subsequent decontamination or disposal.

10. Document the sampling procedures and related information in the Project Field Book and on a Groundwater Sample Collection Log form (sample attached).

ATTACHMENTS

Groundwater Field Form (sample)

REFERENCES

TurnKey FOPs:

011 Calibration and Maintenance of Portable Photoionization Detector
040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination
046 Sample Labeling, Storage and Shipment Procedures

GROUNDWATER FIELD FORM

Project Name: Date:

Location: Project No.: Field Team:

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sampling
Total Depth (fbTOR):	Purge Volume (gal):	Purge Method:

Time	Water Level (fbTOR)	Acc. Volume (gallons)	pH (units)	Temp. (deg. C)	SC (uS)	Turbidity (NTU)	DO (mg/L)	ORP (mV)	Appearance & Odor
	0 Initial								
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
Sample Information:									
	S1								
	S2								

REMARKS:

Note: All measurements are in feet, distance from top of riser.

Volume Calculation

Diam.	Vol. (g/ft)
1"	0.041
2"	0.163
4"	0.653
6"	1.469

Stabilization Criteria

Parameter	Criteria
pH	± 0.1 unit
SC	± 3%
Turbidity	± 10%
DO	± 0.3 mg/L
ORP	± 10 mV

PREPARED BY:

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Sample Labeling, Storage, and Shipment Procedures

FOP 046.0

SAMPLE LABELING, STORAGE & SHIPMENT PROCEDURES

PURPOSE

The collection and analysis of samples of environmental media, including soils, groundwater, surface water, and sediment, are the central activities of the field investigation. These samples must be properly labeled to preserve its identity, and properly stored and shipped in a manner that preserves its integrity and chain of custody. This procedure presents methods for these activities.

SAMPLE LABELING PROCEDURE

1. Assign each sample retained for analysis a unique 9-digit alphanumeric identification code or as indicated in the Project Work Plan. Typically, this code will be formatted as follows:

Sample I.D. Example: GW051402047	
GW	**Sample matrix** GW = groundwater; SW = surface water; SUB = subsurface soil; SS = surface soil; SED = sediment; L = leachate; A = air
05	Month of sample collection
14	Day of sample collection
02	Year of sample collection
047	Consecutive sample number

2. Consecutive sample numbers will indicate the individual sample's sequence in the total set of samples collected during the investigation/sampling event. The sample number above, for example, would indicate the 47th sample retained for analysis during the field investigation, collected on May 14, 2002.

3. Affix a non-removable (when wet) label to each sample container. The following information will be written on the label with black or blue ink that will not smudge when wet:

    - Project number
    - Sample ID (see Step 1 above)
    - Date of sample collection
    - Time of sample collection (military time only)
    - Specify "grab" or "composite" sample with an "X"
    - Sampler initials
    - Preservative(s) (if applicable)
    - Analytes for analysis (if practicable)

4. Record all sample label information in the Project Field Book and on a Sample Summary Collection Log (see attached samples), keyed to the sample identification number. In addition, add information regarding the matrix, sample location, depth, etc. to provide a complete description of the sample.

SAMPLE STORAGE PROCEDURE

1. Immediately after collection, placement in the proper container, and labeling, place samples to be retained for chemical analysis into resealable plastic bags.

2. Place bagged samples into an ice chest filled approximately half-full of double bagged ice. Blue ice is not an acceptable substitute for ice.

3. Maintain samples in an ice chest or in an alternative location (e.g. sample refrigerator) as approved by the TurnKey Field Team Leader until time of shipment. Periodically drain melt-water off coolers and replenish ice as necessary.

4. Ship samples on a daily basis, unless otherwise directed by the TurnKey Field Team Leader.

5. Maintain appropriate custody procedures on coolers and other sample storage containers at all times. These procedures are discussed in detail in the Project Quality Assurance Project Plan, Monitoring Plan or Work Plan.

6. Samples shall be kept in a secure location locked and controlled (i.e., locked building or fenced area) so that only the Project Field Team Leader has access to the location or under the constant visual surveillance of the same.

SAMPLE SHIPPING PROCEDURE

1. Fill out the chain-of-custody form completely (see attached sample) with all relevant information. The white original goes with the samples and should be placed in a resealable plastic bag and taped inside the sample cooler lid; the sampler should retain the copy.

2. Place a layer of inert cushioning material such as bubble pack in the bottom of cooler.

3. Place each bottle in a bubble wrap sleeve or other protective wrap. To the extent practicable, then place each bottle in a resealable plastic bag.

4. Open a garbage bag (or similar) into a cooler and place sample bottles into the garbage bag (or similar) with volatile organic analysis (VOA) vials near the center of the cooler.

5. Pack bottles with ice in plastic bags. At packing completion, cooler should be at least 50 percent ice, by volume. Coolers should be completely filled, so that samples do not move excessively during shipping.

6. Duct tape (or similar) cooler drain closed and wrap cooler completely in two or more locations to secure lid, specifically covering the hinges of the cooler.

7. Place laboratory label address identifying cooler number (i.e., 1 of 4, 2 of 4 etc.) and overnight delivery waybill sleeves on cooler lid or handle sleeve (Federal Express).

8. Sign the custody seal tape with an indelible soft-tip marker and place over the duct tape across the front and back seam between the lid and cooler body.

9. Cover the signed custody seal tape with an additional wrap of transparent strapping tape.

10. Place "Fragile" and "This Side Up" labels on all four sides of the cooler. "This Side Up" labels are yellow labels with a black arrow with the arrowhead pointing toward the cooler lid.

11. For coolers shipped by overnight delivery, retain a copy of the shipping waybill, and attach to the chain-of-custody documentation.

ATTACHMENTS

Soil/Sediment Sample Summary Collection Log (sample)
Groundwater/Surface Water Sample Summary Collection Log (sample)
Wipe Sample Summary Collection Log (sample)
Air Sample Summary Collection Log (sample)
Chain-Of-Custody Form (sample)

REFERENCES

None

SOIL/SEDIMENT
SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, depth changes, important matrix observations or description, gravel thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water over or through decontaminated sampling equipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples collected the same day. RCL Metals can be substituted by only the Metals analyzed for that day (except Hexavalent Chromium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionized water lot # or distilled water manufacturers info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matrix per day. Analyze for all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' section.*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
5. BD - Blind Duplicate - indicate location of duplicate.

GROUNDWATER/SURFACE WATER SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, depth changes, important matrix observations or description, gravel thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water over or through decontaminated sampling equipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples collected the same day. HSL Metals can be substituted by only the Metals analyzed for that day (except Hexavalent Chromium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionized water lot # or distilled water manufacturers info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matrix per day. Analyze for all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' section.*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. FD - Field Duplicate.
5. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
6. BD - Blind Duplicate.

WIPE SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. FD - Field Duplicate.
4. FB - Field Blank.
5. RS - Rinsate.
6. No Matrix Spike, Matrix Spike Duplicate or Matrix Spike Blanks for wipe samples.
7. Rinsates should be taken at a rate of 1 per day during wipe sampling. Only take when reusable equipment is used.
8. Wipe sample FB collected by wiping unused glove (and any other sampling equipment coming into contact with sampled surface) with prepared gauze pad and place in sample jar. Take at a rate of 1 FB per 20 samples.
9. Wipe sample FDs taken adjacent to original sample at a rate of 1 FD per 20 samples.
10. **EH :** Extract and Hold

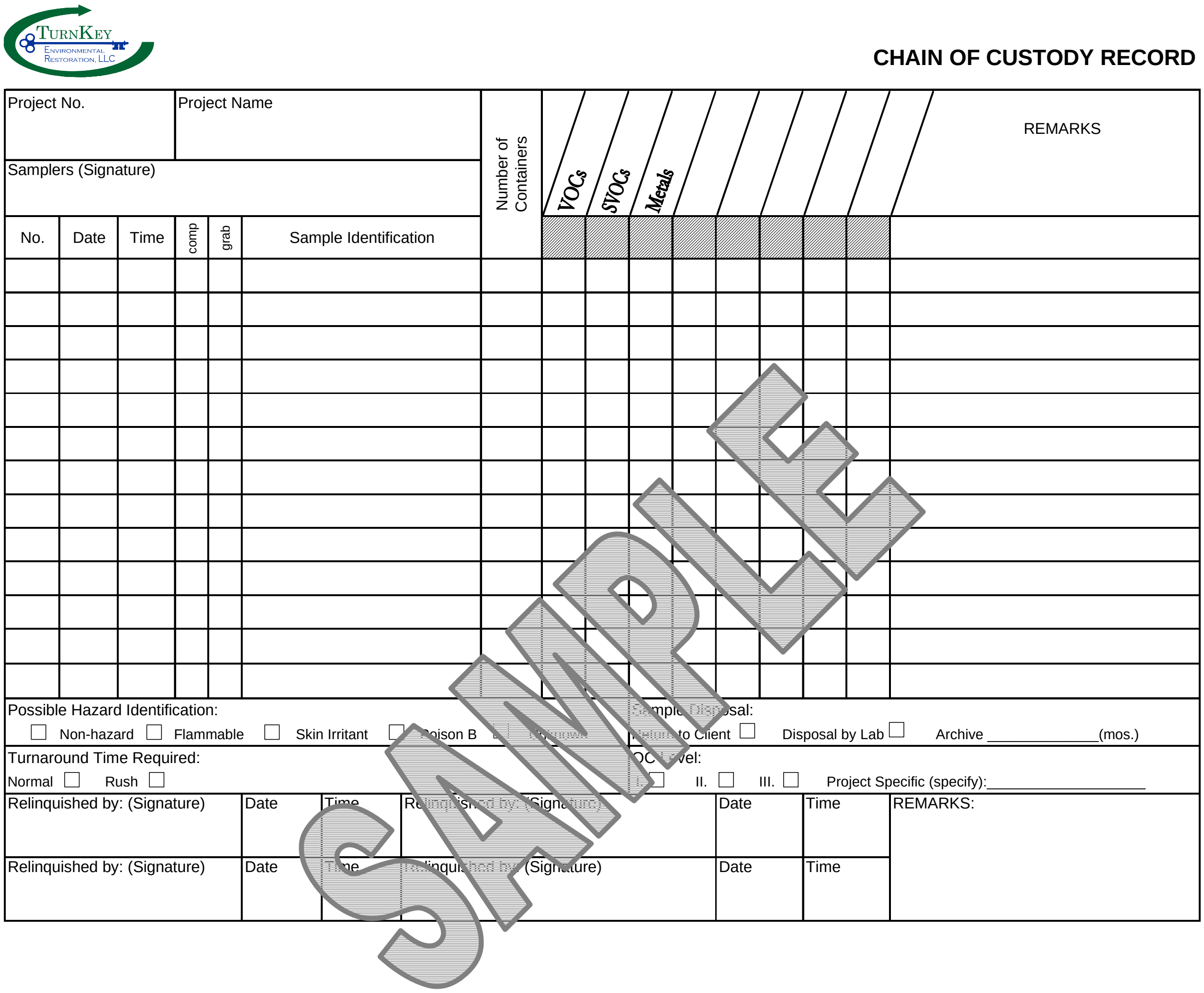
TurnKey Environmental Restoration, LLC

AIR SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, important observations or descriptions, etc.)

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. SC - Summa Canister.
3. TB - Tedlar Bag (quantity).
4. No Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blanks, Field Duplicates, Field Blanks or Rinsates collected for air samples.



CHAIN OF CUSTODY RECORD

Project No.	Project Name					Number of Containers	VOCs	SVOCs	Metals					REMARKS
Samplers (Signature)														
No.	Date	Time	comp	grab	Sample Identification		▨	▨	▨	▨	▨	▨	▨	▨

Possible Hazard Identification:
☐ Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal:
Return to Client ☐ Disposal by Lab ☐ Archive ______________(mos.)

Turnaround Time Required:
Normal ☐ Rush ☐

QC Level:
I. ☐ II. ☐ III. ☐ Project Specific (specify):____________________

Relinquished by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	REMARKS:
Relinquished by: (Signature)	Date	Time	Relinquished by: (Signature)	Date	Time	

TurnKey Environmental Restoration, LLC

FIELD OPERATING PROCEDURES

Screening of Soil Samples for Organic Vapors During Drilling Activities

FOP 047.0

SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING DRILLING ACTIVITIES

PURPOSE

This procedure is used to screen soil samples for the presence of volatile organic constituents (VOCs) using a field organic vapor meter. These meters will be either photoionization detector (PID) or flame-ionization detector (FID) type. This screening is performed at the drilling and sampling location as a procedure for ensuring the health and safety of personnel at the site and to identify potentially contaminated soil samples for laboratory analysis. All soil samples will be field screened to provide a vertical profile of soil contamination by volatile organic substances.

PROCEDURE

1. Calibrate air-monitoring equipment in accordance with the appropriate TurnKey's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

2. Collect split-spoon (or other sampler) samples in accordance with TurnKey's Split Spoon Sampling Procedure FOP.

3. When the split-spoon or other sampler is opened or accessed, shave a thin layer of material from the entire length of the core.

4. Scan the core visually and with the PID or FID noting stratification, visible staining, or other evidence of contamination.

5. Based on this initial scan of the sample, collect approximately 100 milliliters (ml) of soil using a decontaminated or dedicated stainless steel spatula, scoop, or equivalent. Place this soil into a labeled wide-mouth glass jar approximately ½ to ¾ full and seal with aluminum foil and a screw top cap. Alternatively, the soil may be placed into a clean, re-sealable plastic bag and sealed. Be sure to leave some headspace above the soil sample within the sealed container.

6. Place field screening sample (i.e., jar or bag) in a location where the ambient temperature is at least 70° Fahrenheit.

7. Leave the field screening sample bag for at least 30 minutes, but no more than 60 minutes.

8. Carefully remove the screw top cap from the jar and slowly insert the tip of the organic vapor meter (PID or FID) through the aluminum foil seal making the smallest hole possible. Alternatively, unseal a portion of the plastic bag just big enough to insert the probe of a calibrated PID.

9. Record the maximum reading in parts per million by volume (ppmv) on the Field Borehole Log or Field Borehole/Monitoring Well Installation Log form (see attached samples) (see Documentation Requirements for Drilling and Well Installation FOP), at the depth interval corresponding to the depth of sample collection.

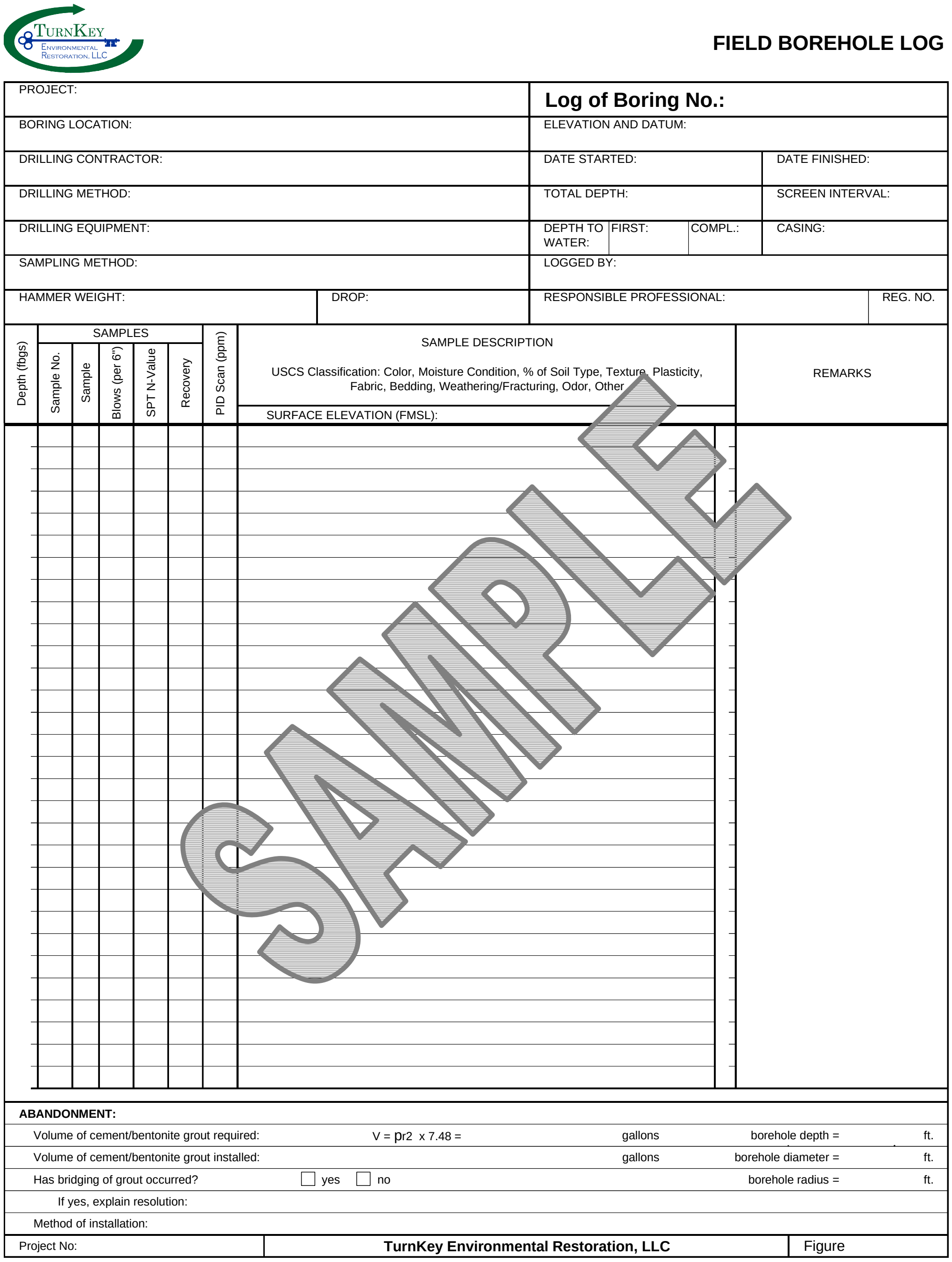
ATTACHMENTS

Field Borehole Log (sample)
Field Borehole/Monitoring Well Installation Log (sample)

REFERENCES

<u>TurnKey FOPs:</u>

010	*Calibration and Maintenance of Portable Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
015	*Documentation Requirements for Drilling and Well Installation*
058	*Split Spoon Sampling Procedures*



TurnKey Environmental Restoration, LLC

FIELD BOREHOLE LOG

PROJECT:		**Log of Boring No.:**			
BORING LOCATION:		ELEVATION AND DATUM:			
DRILLING CONTRACTOR:		DATE STARTED:			DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:			SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER:	FIRST:	COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:			
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:			REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other	REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery		SURFACE ELEVATION (FMSL):	

ABANDONMENT:

Volume of cement/bentonite grout required:	V = pr2 x 7.48 =	gallons	borehole depth =	ft.
Volume of cement/bentonite grout installed:		gallons	borehole diameter =	ft.
Has bridging of grout occurred?	☐ yes ☐ no		borehole radius =	ft.
If yes, explain resolution:				
Method of installation:				

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

FIELD GEOPROBE BOREHOLE \ TEMPORARY WELL INSTALLATION LOG

PROJECT:		**Log of Temp. Well No.:**			
BORING LOCATION:		ELEVATION AND DATUM:			
DRILLING CONTRACTOR:		DATE STARTED:			DATE FINISHED:
DRILLING METHOD:		TOTAL DEPTH:			SCREEN INTERVAL:
DRILLING EQUIPMENT:		DEPTH TO WATER:	FIRST:	COMPL.:	CASING:
SAMPLING METHOD:		LOGGED BY:			
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:			REG. NO.

Depth (fbgs)	SAMPLES					PID Scan (ppm)	SAMPLE DESCRIPTION	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS
	Sample No.	Sample	Blows (per 6")	SPT N-Value	Recovery		USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other SURFACE ELEVATION (FMSL):	

Project No:	**TurnKey Environmental Restoration, LLC**	Figure

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Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Soil Description Procedures Using The Visual-Manual Method

FOP 054.2

SOIL DESCRIPTION PROCEDURES USING THE VISUAL-MANUAL METHOD

PURPOSE

This guideline presents a means for insuring consistent and proper field identification and description of collected soils during a project (via, split-spoon (barrel) sampler, hand auger, test pit etc.). The lithology and moisture content of each soil sample will be physically characterized by visual-manual observation in accordance with ASTM Method D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). When precise classification of soils for engineering purposes is required, the procedures prescribed in ASTM Method D2487 (Standard Practice for Classification of Soils for Engineering Purposes [Unified Soil Classification System, USCS]) will be used. The method of soil characterization presented herein describes soil types based on grain size, liquid and plastic limits, and moisture content based on visual examination and manual tests. When using this FOP to classify soil, the detail of description provided for a particular material should be dictated by the complexity and objectives of the project. However, more often than not, "after the fact" field information is required later in the project, therefore, every attempt to describe the soil as completely as possibly should be made.

Intensely weathered or decomposed rock that is friable and can be reduced to gravel size or smaller by normal hand pressure should be classified as a soil. The soil classification would be followed by the parent rock name in parenthesis. Projects requiring depth to bedrock determinations should always classify weathered or decomposed bedrock as bedrock (i.e., landfill siting). The project manager should always be consulted prior to making this determination.

PROCEDURE

Assemble necessary equipment and discuss program requirements with drilling contractor.

1. Calibrate air-monitoring equipment in accordance with the appropriate TurnKey's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

2. Collect desired soil sample in accordance with appropriate TurnKey FOP (i.e., split-spoon sampling, hand augering, test pitting etc.).

3. Shave a thin layer off the entire length of the sample to expose fresh sample.

4. Photograph and scan the sample with a photoionization detector (PID) at this time, if applicable, in accordance with TurnKey's Screening of Soil Samples for Organic Vapors During Drilling Activities FOP.

5. Describe the sample using terminology presented in the Descriptive Terms section below.

6. Record all pertinent information in the Project Field Book and Field Borehole Log (sample attached) or Field Borehole/Monitoring Well Installation Log (sample attached).

7. After the sample has been described, place a representative portion of the sample in new, precleaned jars or self-sealing plastic bags for archival purposes (if required). Label the jar or bag with the sample identification number, sample interval, date, project number and store in a secure location.

8. If the soil is to be submitted to a laboratory for analysis, collect the soil sample with a dedicated stainless steel sampling tool, place the sample into the appropriate laboratory-supplied containers, and store in an ice-chilled cooler staged in a secure location in accordance with TurnKey's Sample Labeling, Storage and Shipment Procedures FOP.

9. All remaining soil from soil sample collection activities shall be containerized in accordance with TurnKey's Management of Investigative-Derived Waste (IDW) FOP and/or the Project Work Plan.

DESCRIPTIVE TERMS

All field soil samples will be described using the Unified Soil Classification System (USCS) presented in Figures 1 and 2 (attached). In addition to ASTM Method D2488, Method D1586, Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils (a.k.a., Standard Penetration Test, STP), when implemented, can also be used to classify the resistance of soils. In certain instances, it is desirable to supplement the USCS classification with a geologic interpretation of the soil sample that is supported by the soil descriptive terms presented in this section. The project manager should be consulted when making any geologic interpretation. Field test methods are provided to assist field personnel in classifying soil and are identified by a bold blue **FTM** and shaded. Classification of sampled soils will use the following ASTM descriptive terms and criteria:

- **Group Name** (USCS, see Figure 2)
- **Group Symbol** (USCS, see Figure 2) – only use if physical laboratory testing has been performed to substantiate. The USCS can be applied to most unconsolidated materials, and is represented by a two-letter symbol, except Peat (Pt).
    - The first letter includes: G (gravel), S (sand), M (silt), C (clay), and O (organic).
    - The second letter includes: P (poorly graded or uniform particle sizes), W (well graded or diversified particle sizes), H (high plasticity), and L (low plasticity).
    - Examples:
        - GW = well graded gravels and gravel-sand mixtures, little or no fines
        - GP = poorly graded gravels and gravel-sand mixtures, little or no fines
        - GM = silty gravels, gravel-sand-silt mixtures

    - GC = clayey gravels, gravel-sand-clay mixtures
    - SW = well graded sands and gravelly sands, little or no fines
    - SP = poorly graded sands and gravelly sands, little or no fines
    - SM = silty sand, sand-silt mixtures
    - SC = clayey sand sand-clay mixtures
    - ML = inorganic silts, very fine sands, rock flour, silty or clayey fine sands
    - CL = inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
    - OL = organic silts and organic silty clays of low plasticity
    - MH = inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts (very rare)
    - CH = inorganic clays of high plasticity, fat clays
    - OH = organic clays of medium to high plasticity
    - Pt = peat, muck, and other highly organic soils

- **Angularity** (ASTM D2488; Table 1)
  - Angular – particles have sharp edges and relatively planar sides with unpolished surfaces
  - Subangular – particles are similar to angular description but have rounded edges
  - Subrounded – particles have nearly planar sides but have well-rounded corners and edges
  - Rounded – particles have smoothly curved sides and no edges
- **Particle Shape** (ASTM D2488; Table 2)
  - Flat – particles with width/thickness > 3
  - Elongated – particles with length/width > 3
  - Flat and Elongated – particles meet criteria for both flat and elongated
- **Moisture Condition** (ASTM D2488; Table 3)
  - Dry – absence of moisture, dusty, dry to the touch
  - Moist – damp, but no visible water
  - Wet – visible free water, usually soil is below water table
- **Reaction with Hydrochloric Acid (HCL)** (ASTM D2488; Table 4)
  - None – no visible reaction

  - Weak – some reaction, with bubbles forming slowly
  - Strong – violent reaction, with bubbles forming immediately
- **Consistency of Cohesive Soils** (ASTM D2488; Table 5)
  - Very soft – squeezes between fingers when fist is closed; easily penetrated several inches by fist (SPT = 2 or less)
  - Soft – easily molded by fingers; easily penetrated several inches by thumb (SPT = 2 to 4)
  - Firm – molded by strong pressure of fingers; can be penetrated several inches by thumb with moderate effort (SPT = 4 to 8)
  - Stiff – dented by strong pressure of fingers; readily indented by thumb but can be penetrated only with great effort (SPT = 8 to 15)
  - Very stiff – readily indented by thumbnail (SPT = 15 to 30)
  - Hard – indented with difficultly by thumbnail (SPT >30)
- **Cementation** (ASTM D2488; Table 6)
  - Weak – crumbles or breaks with handling or slight finger pressure
  - Moderate – crumbles or breaks with considerable finger pressure
  - Strong – will not crumble or break with finger pressure
- **Structure (Fabric)** (ASTM D2488; Table 7)
  - Varved – alternating 1 mm to 12 mm (0.04 – 0.5 inch) layers of sand, silt and clay
  - Stratified – alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
  - Laminated – alternating layers of varying material or color with the layers less than 6 mm (0.23 inches) thick; note thickness
  - Fissured – contains shears or separations along planes of weakness
  - Slickensided – shear planes appear polished or glossy, sometimes striated

  - Blocky – cohesive soil that can be broken down into small angular lumps which resist further breakdown
  - Lensed – inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
  - Homogeneous or Massive – same color and appearance throughout

- **Inorganic Fine-Grained Soil Characteristics** (ASTM D2488; Table 12)

  Several field tests can be performed to determine the characteristics of fine-grained soils (material passing the No. 40 sieve), such as dry strength, dilatency, and toughness. These field testing methods are described below.

  - **Dry Strength** (ASTM D2488; Table 8)

    FTM (Dry Strength): Select enough material and moisten with water until it can be molded or shaped without sticking to your fingers (slightly below the sticky limit) into a ball about 1 inch in diameter. From this ball, form three balls about ½ inch in diameter and allow to dry in air, or sun, or by artificial means (temperature not to exceed 60° C (140° F). Soil containing natural dry lumps about ½ inch in diameter may be used in place of molded balls, however the dry strengths are usually lower. Test the strength by crushing the dry balls or lumps between your fingers using the descriptions below.

    - None – the dry specimen crumbles with the slightest pressure of handling
    - Low – the dry specimen crumbles with some finger pressure
    - Medium – the dry specimen breaks into pieces or crumbles with considerable finger pressure
    - High – the dry specimen cannot be broken with finger pressure. The specimen will break into pieces between the thumb and a hard surface.
    - Very High – the dry specimen cannot be broken between the thumb and a hard surface

  - **Dilatency** (ASTM D2488; Table 9)

    FTM (Dilatency): Place enough material in your hand to form a ball approximately ½ inch in diameter and moisten with water until it can be molded or shaped without sticking to your fingers (slightly below the sticky limit). Smooth the ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other several times. Note the reaction of water appearing on the surface of the soil. The soil is said to have given a reaction to this test if, when it is shaken, water comes to the surface of the sample producing a smooth, shiny appearance. Squeeze the sample between the thumb and forefinger and note the reaction as follows:

  - None – no visible change in the specimen
  - Slow – water slowly appears on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
  - Rapid – water quickly appears on the surface of the specimen during shaking and disappears upon squeezing

- **Toughness** (ASTM D2488; Table 10)

  FTM (Toughness): Following the dilatency test above, shape the test specimen into an elongated pat and roll by hand on a smooth surface or between palms into a thread about 1/8 inch in diameter. Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch (e.g., near the plastic limit). Note the pressure required to roll the thread near the plastic limit as well as the strength of the thread. After the thread crumbles, lump the pieces together and knead the lump until it crumbles. Describe the toughness as follows:

  - Low – only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and very soft.
  - Medium – medium pressure is required to roll the thread to near the plastic limit. The thread and the lump are soft.
  - High – considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump are firm.

Using the results of the dry strength, dilatency, and toughness test described above, classify the soil according to the following:

Soil Symbol	Dry Strength	Dilatency	Toughness
Silt (ML)	None to low	Slow to rapid	Low or thread cannot be formed
Lean clay (CL)	Medium to high	None to slow	Medium
Elastic Silt (MH)	Low to medium	None to slow	Low to medium
Fat Clay (CH)	High to very high	None	Low to medium high

- **Plasticity** (ASTM D2488; Table 11)

  Two field test methods can be used to determine plasticity of fine-grained soils (material passing the No. 40 sieve): the roll or thread test and the ribbon test. Each test is described below.

  FTM (Roll or Thread Test): As with the toughness test above, mix a representative portion of the soil sample with water until it can be molded or shaped without sticking to your fingers (slightly below the sticky limit). Place an elongated cylindrical sample on a nonabsorbent rolling surface (e.g., glass or was paper on a flat surface) and attempt to roll it into a thread approximately 1/8 inch in diameter. The results of this test are defined below (non-plastic to high plasticity).

  FTM (Ribbon Test): Form a roll from a handful of moist soil (slightly below the sticky limit) about ½ to ¾ inches in diameter and about 3 to 5 inches long. Place the material in the palm of your hand and, starting at one end, flatten the roll between your thumb and forefinger to form the longest and thinnest ribbon possible that can be supported by the cohesive properties of the material before breaking. If the soil sample holds together for a length of 6 to 10 inches without breaking, the material is considered to be both highly plastic and highly compressive (Fat Clay, CH). If the soil cannot be ribboned, it is non-plastic (Silt, ML or MH). If it can be ribboned only with difficulty into short lengths, it has low plasticity (Lean Clay, CL). Use the following terms to describe the plasticity of soil:

  - Nonplastic (ML or MH) – a 3 mm (0.12 inches) thread cannot be rolled at any water content
  - Low Plasticity (CL, ML, or MH) – the thread can barely be rolled, and crumbles easily
  - Medium Plasticity (CL) – the thread is easy to roll and not much time is required to reach the plastic limit before crumbling
  - High Plasticity (CH) – it takes considerable time rolling and kneading to reach the plastic limit; the thread can be rolled several times before crumbling

Note: A soil with as little as 20% clay will behave as a clayey soil. A soil needs 45% to over 60% medium to coarse sand to behave as a sandy soil. In a soil with 20% clay and 80% sand, the soil will behave as a clayey soil.

- **Relative Density of Cohesionless (Granular) Soils**
  - Very loose – easily penetrated 30 cm (1.2 inches) with 13 mm (0.5 inch) rebar pushed by hand (SPT = 0 to 4)
  - Loose – easily penetrated several cm with 13 mm (0.5 inch) rebar pushed by hand (SPT = 4 to 10)
  - Medium dense – easily to moderately penetrated with 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = 10 to 30)
  - Dense – penetrated 0.3 m (1 foot) with difficulty using 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = 30 to 50)
  - Very dense – penetrated only a few cm with 13 mm (0.5 inch) rebar driven by 2.3 kg (6 pound) hammer (SPT = >50)
- **Color** (use Munsel® Color System, as necessary)
- **Particle Size** (see Figure 3)
  - Boulder – larger than a basketball
  - Cobble – grapefruit, orange, volleyball
  - Coarse Gravel – tennis ball, grape

  - Fine Gravel – pea
  - Coarse Sand – rock salt
  - Medium Sand – opening in window screen
  - Fine Sand – sugar, table salt
  - Fines (silt and clay) – cannot visually determine size (unaided)
- **Gradation**
  - Well Graded (GW, SW) – full range and even distribution of grain sizes present
  - Poorly-graded (GP, SP) – narrow range of grain sizes present
  - Uniformly-graded (GP, SP) – consists predominantly of one grain size
  - Gap-graded (GP-SP) – within the range of grain sizes present, one or more sizes are missing
- **Organic Material** – Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread of the toughness test will be spongy.
  - PEAT – 50 to 100 percent organics by volume, primary constituent
  - Organic (soil name) – 15 to 50 percent organics by volume, secondary organic constituent
  - (Soil name) with some organics – 5 to 15 percent organics by volume, additional organic constituents
- **Fill Materials** – All soils should be examined to see if they contain materials indicative of man-made fills. Man-made fill items should be listed in each of the soil descriptions. Common fill indicators include glass, brick, dimensioned lumber, concrete, pavement sections, asphalt, metal, plastics, plaster etc. Other items that could suggest fill include buried vegetation mats, tree limbs, stumps etc. The soil description for a fill material should be followed by the term "FILL", i.e., for a sandy silt with some brick fragments the description would be "SANDY

SILT (ML), with brick fragments (Fill)". The size and distribution of fill indicators should be noted. The limits (depth range) of fill material should be determined and identified at each exploration location.

- **Other Constituents/Characteristics**
  - Additional constituents and/or pertinent soil characteristics not included in the previous categories should be described depending on the scope and objectives of the project. Observations that may be discussed include:
    - Oxide staining
    - Odor
    - Origin
    - Presence of root cast
    - Presence of mica
    - Presence of gypsum
    - Presence of calcium carbonate
    - Percent by volume of cobbles & boulders with size description and appropriate rock classification
  - Other pertinent information from the exploratory program should be recorded, if it would be useful from a biddability/constructability perspective. The conditions that should be listed include caving or sloughing, difficulty in drilling and groundwater infiltration.

SOIL DESCRIPTIONS

Generally, soil descriptions collected during most investigations are not intended for civil engineering (construction) purposes, but rather for hydrogeologic and contaminant transport purposes. As such, the ASTM visual-manual assessments are somewhat limited in that they are only performed in order to indicate important information about potential hydraulic properties of a soil. Soil descriptions should be concise, stressing major constituents and characteristics, and should be given in a consistent order and format. The following order is recommended:

- Soil name. The basic name of the predominant grain size and a single-word modifier indicating the major subordinate grain size (i.e., mostly clay with some silt). The feel test can be used to determine the texture of the soil by rubbing some moist soil between your fingers; sand feels gritty, silt feels smooth, and clays feel sticky. The terms representing percentages of grain size to be used include:
    - Trace – particles are present, but estimated to be less than 5%
    - Few – 5 to 10%
    - Little – 15 to 25%
    - Some – 30 to 45%
    - Mostly – 50 to 100%
- Color (using Munsell® charts, as necessary). Color is an important property in identifying organic soils, and within a given locality it may also be useful in identifying materials of similar geologic origin. It the sample contains layers or patches of varying colors (e.g., mottled), this shall be noted and all representative colors shall be described. The color shall be described for moist samples, however if the color represents a dry condition, it must be stated as such in the log. Generally, colors become darker as the moisture content increases and lighter as the soil dries. Examples include:
    - Some fine-grained soils (OL, OH) with dark drab shades of brown or gray, including almost black, contain organic colloidal matter.
    - In contrast, clean, bright looking shades of gray, olive green, brown, red, yellow, and white are associated with inorganic soils.
    - Gray-blue or gray- and yellow-mottled colors frequently result from poor drainage.
    - Red, yellow, and yellowish brown result from the presence of iron oxides.

  - White to pink may indicate considerable silica, calcium carbonate, or aluminum compounds.

- Field moisture condition as dry, moist, or wet;
- Gradation or Plasticity. Granular soils (i.e., sands or gravels) should be described as well-graded, poorly graded, uniform, or gap-graded, depending on the gradation of the minus 3-inch fraction. Cohesive soils (i.e., silts and clays) should be described as non-plastic, low, medium, or high, depending on the results of the manual evaluation for dry strength, dilatency, toughness, and plasticity discussed previously.
- Consistency/Density. An estimate of consistency of a cohesive soil or density of a granular soil, usually based on the SPT results (see Descriptive Terms section of this FOP);
- Soil Structure or Mineralogy. Description of discontinuities, inclusions, and structures, including joints, fissures, and slickensides.
- Odor. Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample. If the odor is unusual (petroleum, chemical, etc.), it should be noted in the log.
- Other important geologic information such as consolidation, gravel size and shape, visible internal structure, root holes, mica, odors, etc.

The first step when describing soil is to determine if the sample is predominantly fine-grained or coarse-grained (see Figures 3 and 4). Coarse-grained soils are relatively easy to identify, however descriptions of fine-grained soils can be more difficult, requiring additional field tests to assist the field geologist arrive at the proper soils classification (see **FTMs** under Descriptive Terms above). These tests are explained in detail in the ASTM Standard D2488 and briefly herein. Generally, the differentiation between silt and clay is based on plasticity and "texture". However, tests for dry strength and dilatency, along with plasticity, can be very helpful and are recommended in the ASTM Standard. If additional tests are performed, in addition to plasticity, to classify the fines, record them with the soil description on the logs. Doing this will assist the reader (i.e., Project Manager) to follow the logic used to describe a soil (e.g., medium plasticity, low dry strength = elastic silt [MH]; not a lean clay [CL]).

Fines described in the classification should be modified by their plasticity (e.g., non-plastic fines, low plasticity fines, etc.) reserving the words "silt" and "clay" for the soil name.

In summary, adhering to the ASTM Standard and the guidelines outlined in this FOP will provide uniformity in soil descriptions provided by all field personnel. Prior to mobilization to the field, field staff should make sure to have laminated copies of the ASTM Standard flow charts and tables as well as this FOP (as necessary). Some examples of complete soil descriptions are as follows:

Coarse-grained Soil

POORLY GRADED FINE SAND w/ SILT: Dark grey, wet, mostly fine sand with some non-plastic fines, some iron-stained mottling, laminated, medium dense

Fine-grained Soil

LEAN CLAY: Dark reddish/brown, moist, mostly fines, medium plasticity, firm, no dilatency, medium dry strength, root holes.

Soil/Fill (option 1) – visual evidence of fill

FILL: Black, moist, mostly fines with some fine sand, slag, cinders, metal, brick, non-plastic, loose when disturbed, strong odor

Soil/Fill (option 2) – no visual evidence of fill, suspected reworked material

FILL (reworked): Black, moist, mostly fines with some fine sand and few coarse angular gravel, non-plastic, hard, loose when disturbed, mild odor

BORING AND MONITORING WELL INSTALLATION LOGS

Currently, TurnKey utilizes WinLoG software to construct subsurface logs and a template of the log is included in this FOP as an example. One of the most important functions of a boring/monitoring well installation log, besides transmitting the soil description, is to indicate where the "data" (soil samples) were collected, giving the reader an idea of how reliable or representative the description is. On each sample log, depths of attempted and recovered or non-recovered interval are shown. Odor, if noted, should be considered subjective and not necessarily indicative of specific compounds or concentrations.

Remember: all field logs should be NEAT, ACCURATE, and LEGIBLE. Don't forget that the well completion diagram completed for each well requires details of the surface completion (i.e., flush-mount, stick-up etc.). It is the responsibility of the field staff to double-check each log (i.e., soil names, classifications, well construction details etc.) prior to implementing into a final report. A registered professional (i.e., professional engineer, PE or professional geologist, PG) must review each log and will be ultimately responsible for its content and accuracy.

REQUIRED EQUIPMENT

- Knife
- Engineer's rule/measuring tape

- Permanent marker
- Pre-cleaned wide-mouth sample jars (typically provided by the driller)
- Pre-cleaned wide-mouth laboratory sample jars (provided by the laboratory)
- Stainless steel sampling equipment (i.e., spoons, spatulas, bowls etc.)
- 10x hand lens
- Hydrochloric acid
- ASTM D2488 flow charts (preferably laminated)
- ASTM D2488 test procedures (Tables 1 through 12) (preferably laminated)
- Camera (disposable, 35 mm or digital)
- Munsell soil color chart (as necessary)
- Project Field Book/field forms

ATTACHMENTS

Figure 1; Field Guide for Soil and Stratigraphic Analysis
Figure 2; USCS Soil Classification Flow Chart (modified from ASTM D2488)
Figure 3; Illustration of Particle Sizes
Figure 4; Grain-Size Scale (Modified Wentworth Scale)

Field Borehole Log (sample)

REFERENCES

American Society for Testing and Materials, 2008a. *ASTM D1586: Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils.*

American Society for Testing and Materials, 2010. *ASTM D2487: Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).*

American Society for Testing and Materials, 2009a. *ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).*

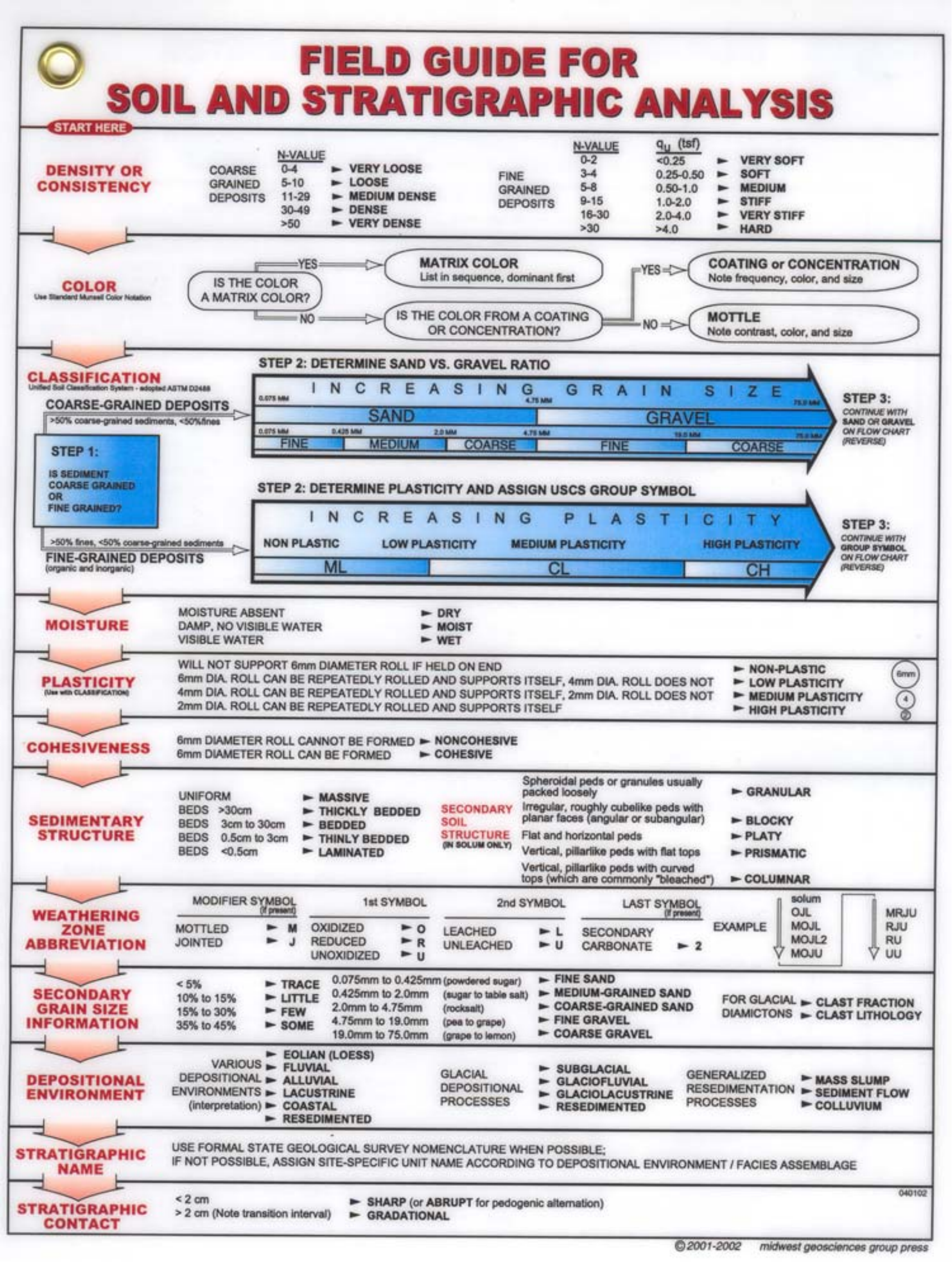
State of California, Department of Transportation, Engineering Service Center, Office of Structural Foundations, August 1996. *Soil & Rock Logging Classification Manual (Field Guide), by Joseph C. de Larios.*

TurnKey FOPs:

010	*Calibration and Maintenance of Portable Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
015	*Documentation Requirements for Drilling and Well Installation*
025	*Hand Augering Procedures*
032	*Management of Investigation-Derived Waste*
046	*Sample Labeling, Storage and Shipment Procedures*
047	*Screening of Soil Samples for Organic Vapors During Drilling Activities*
058	*Split-Spoon Sampling Procedures*
065	*Test Pit Excavation and Logging Procedures*

FIGURE 1

FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS



FIELD GUIDE FOR SOIL AND STRATIGRAPHIC ANALYSIS

START HERE

DENSITY OR CONSISTENCY

COARSE GRAINED DEPOSITS N-VALUE		FINE GRAINED DEPOSITS N-VALUE	q_u (tsf)	
0-4	► VERY LOOSE	0-2	<0.25	► VERY SOFT
5-10	► LOOSE	3-4	0.25-0.50	► SOFT
11-29	► MEDIUM DENSE	5-8	0.50-1.0	► MEDIUM
30-49	► DENSE	9-15	1.0-2.0	► STIFF
>50	► VERY DENSE	16-30	2.0-4.0	► VERY STIFF
		>30	>4.0	► HARD

COLOR
Use Standard Munsell Color Notation

IS THE COLOR A MATRIX COLOR?
YES ▷ MATRIX COLOR — List in sequence, dominant first
NO ▷ IS THE COLOR FROM A COATING OR CONCENTRATION?
YES ▷ COATING or CONCENTRATION — Note frequency, color, and size
NO ▷ MOTTLE — Note contrast, color, and size

CLASSIFICATION
Unified Soil Classification System - adopted ASTM D2488

STEP 1: IS SEDIMENT COARSE GRAINED OR FINE GRAINED?

COARSE-GRAINED DEPOSITS
>50% coarse-grained sediments, <50%fines

STEP 2: DETERMINE SAND VS. GRAVEL RATIO

INCREASING GRAIN SIZE

0.075 MM — SAND — 4.75 MM — GRAVEL — 75.0 MM

0.075 MM FINE 0.425 MM MEDIUM 2.0 MM COARSE 4.75 MM FINE 19.0 MM COARSE 75.0 MM

STEP 3: CONTINUE WITH SAND OR GRAVEL ON FLOW CHART (REVERSE)

FINE-GRAINED DEPOSITS (organic and inorganic)
>50% fines, <50% coarse-grained sediments

STEP 2: DETERMINE PLASTICITY AND ASSIGN USCS GROUP SYMBOL

INCREASING PLASTICITY

NON PLASTIC — LOW PLASTICITY — MEDIUM PLASTICITY — HIGH PLASTICITY

ML — CL — CH

STEP 3: CONTINUE WITH GROUP SYMBOL ON FLOW CHART (REVERSE)

MOISTURE

MOISTURE ABSENT ► DRY
DAMP, NO VISIBLE WATER ► MOIST
VISIBLE WATER ► WET

PLASTICITY
(Use with CLASSIFICATION)

WILL NOT SUPPORT 6mm DIAMETER ROLL IF HELD ON END ► NON-PLASTIC
6mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 4mm DIA. ROLL DOES NOT ► LOW PLASTICITY
4mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF, 2mm DIA. ROLL DOES NOT ► MEDIUM PLASTICITY
2mm DIA. ROLL CAN BE REPEATEDLY ROLLED AND SUPPORTS ITSELF ► HIGH PLASTICITY

COHESIVENESS

6mm DIAMETER ROLL CANNOT BE FORMED ► NONCOHESIVE
6mm DIAMETER ROLL CAN BE FORMED ► COHESIVE

SEDIMENTARY STRUCTURE

UNIFORM ► MASSIVE
BEDS >30cm ► THICKLY BEDDED
BEDS 3cm to 30cm ► BEDDED
BEDS 0.5cm to 3cm ► THINLY BEDDED
BEDS <0.5cm ► LAMINATED

SECONDARY SOIL STRUCTURE (IN SOLUM ONLY)

Spheroidal peds or granules usually packed loosely ► GRANULAR
Irregular, roughly cubelike peds with planar faces (angular or subangular) ► BLOCKY
Flat and horizontal peds ► PLATY
Vertical, pillarlike peds with flat tops ► PRISMATIC
Vertical, pillarlike peds with curved tops (which are commonly "bleached") ► COLUMNAR

WEATHERING ZONE ABBREVIATION

MODIFIER SYMBOL (if present)	1st SYMBOL	2nd SYMBOL	LAST SYMBOL (if present)
MOTTLED ► M	OXIDIZED ► O	LEACHED ► L	SECONDARY CARBONATE ► 2
JOINTED ► J	REDUCED ► R	UNLEACHED ► U	
	UNOXIDIZED ► U		

EXAMPLE
solum
OJL
MOJL
MOJL2
MOJU
MRJU
RJU
RU
UU

SECONDARY GRAIN SIZE INFORMATION

< 5% ► TRACE
10% to 15% ► LITTLE
15% to 30% ► FEW
35% to 45% ► SOME

0.075mm to 0.425mm (powdered sugar) ► FINE SAND
0.425mm to 2.0mm (sugar to table salt) ► MEDIUM-GRAINED SAND
2.0mm to 4.75mm (rocksalt) ► COARSE-GRAINED SAND
4.75mm to 19.0mm (pea to grape) ► FINE GRAVEL
19.0mm to 75.0mm (grape to lemon) ► COARSE GRAVEL

FOR GLACIAL DIAMICTONS ► CLAST FRACTION
► CLAST LITHOLOGY

DEPOSITIONAL ENVIRONMENT

VARIOUS DEPOSITIONAL ENVIRONMENTS (interpretation)
► EOLIAN (LOESS)
► FLUVIAL
► ALLUVIAL
► LACUSTRINE
► COASTAL
► RESEDIMENTED

GLACIAL DEPOSITIONAL PROCESSES
► SUBGLACIAL
► GLACIOFLUVIAL
► GLACIOLACUSTRINE
► RESEDIMENTED

GENERALIZED RESEDIMENTATION PROCESSES
► MASS SLUMP
► SEDIMENT FLOW
► COLLUVIUM

STRATIGRAPHIC NAME

USE FORMAL STATE GEOLOGICAL SURVEY NOMENCLATURE WHEN POSSIBLE;
IF NOT POSSIBLE, ASSIGN SITE-SPECIFIC UNIT NAME ACCORDING TO DEPOSITIONAL ENVIRONMENT / FACIES ASSEMBLAGE

STRATIGRAPHIC CONTACT

< 2 cm ► SHARP (or ABRUPT for pedogenic alternation)
> 2 cm (Note transition interval) ► GRADATIONAL

040102

FIGURE 2

USCS SOIL CLASSIFICATION FLOW CHART (MODIFIED FROM ASTM D2488)

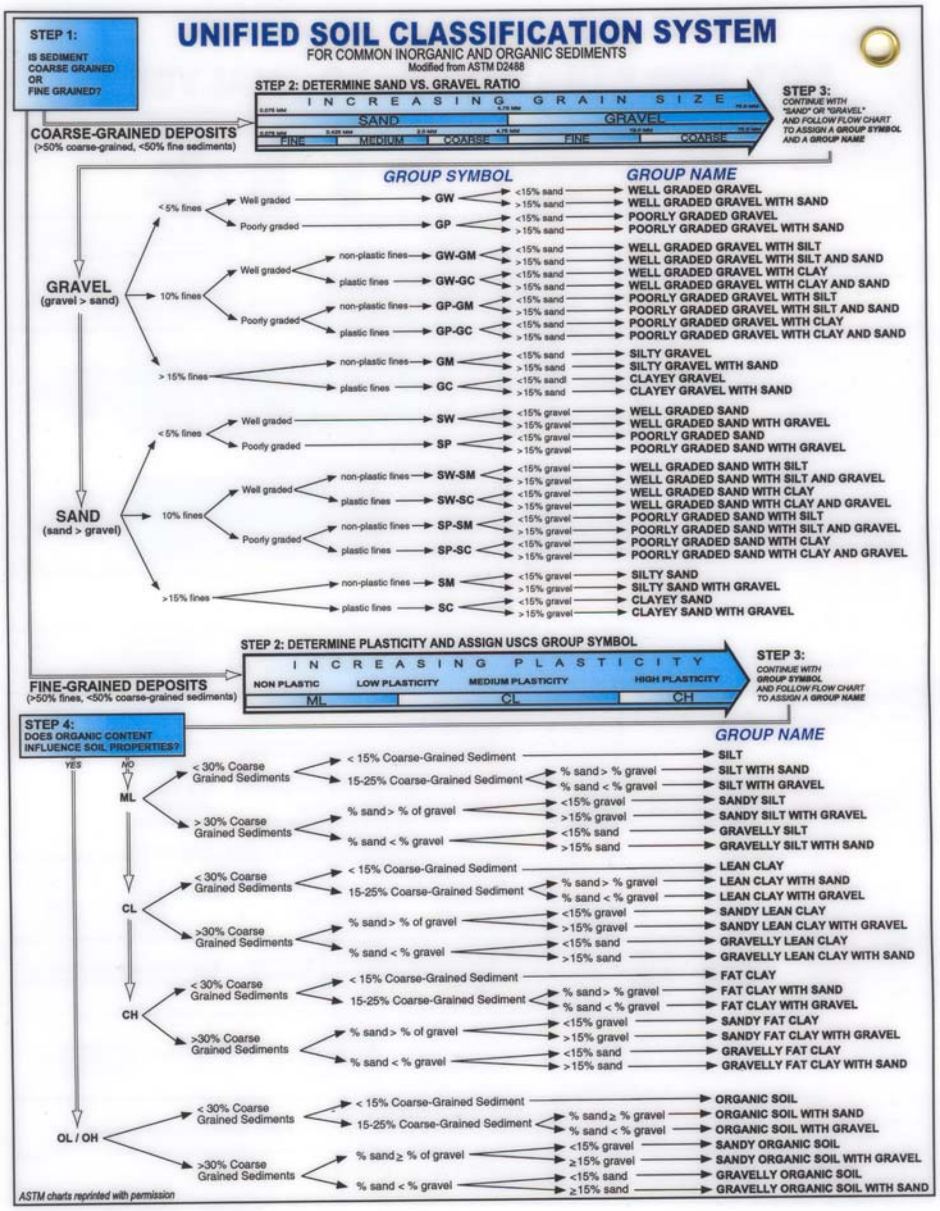


FIGURE 3

ILLUSTRATION OF PARTICLE SIZES

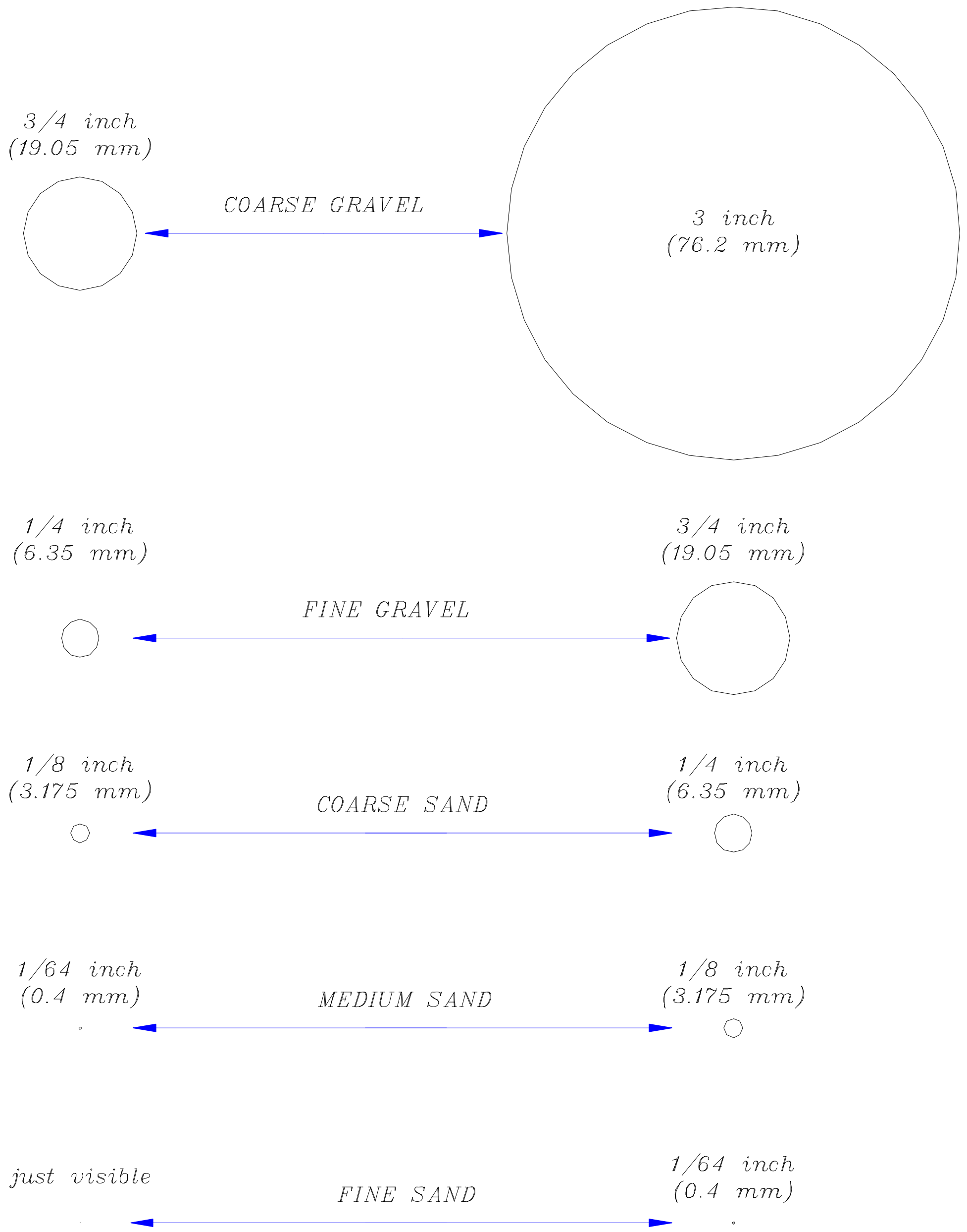


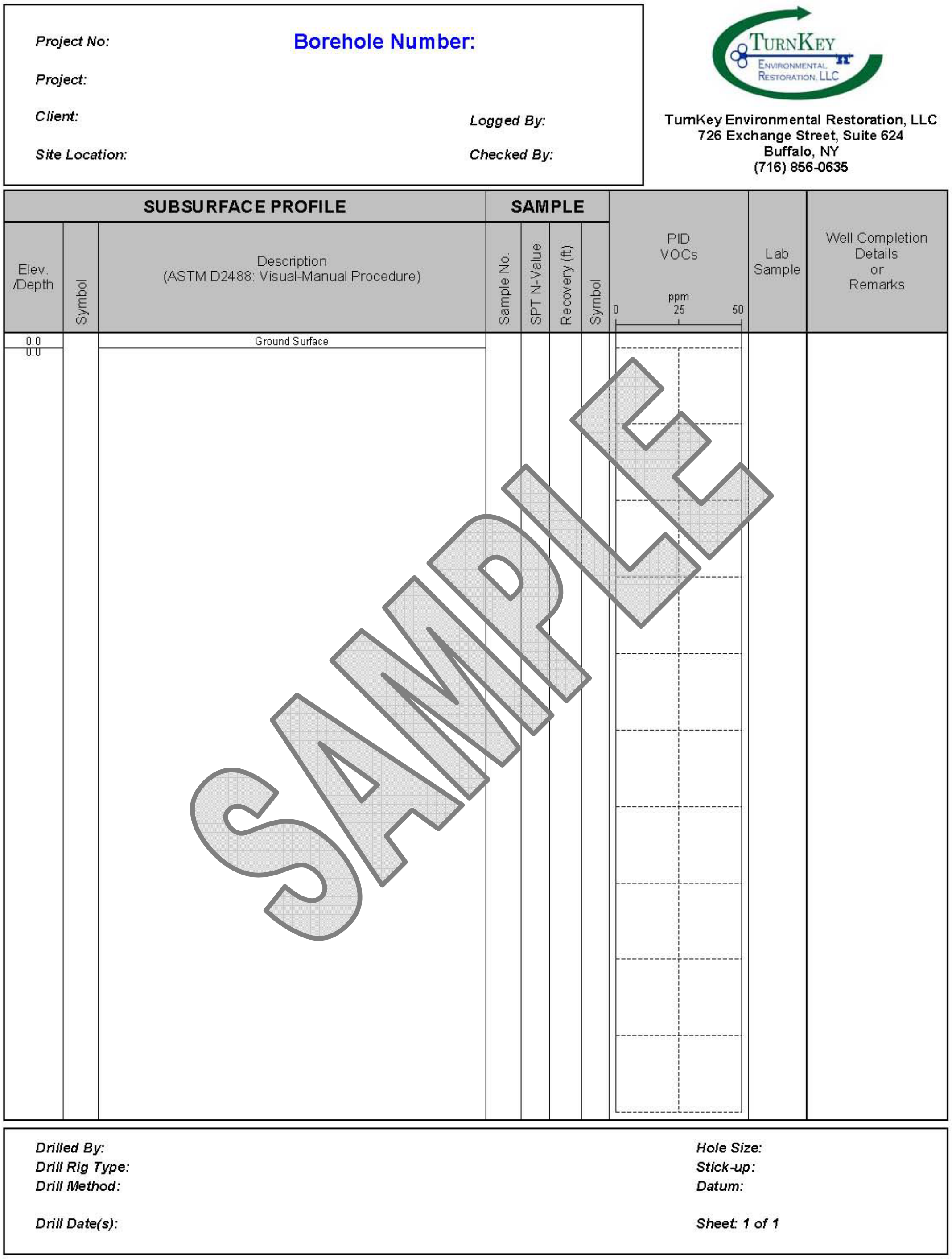
FIGURE 4

GRAIN-SIZE SCALE (MODIFIED WENTWORTH SCALE)

Grain size refers to the physical dimensions of particles of rock or other solid. This is different from the crystallite size, which is the size of a single crystal inside the solid (a grain can be made of several single crystals). Grain sizes can range from very small colloidal particles, through clay, silt, sand, and gravel, to boulders. Size ranges define limits of classes that are given names in the Wentworth scale used in the United States. The Krumbein *phi* (φ) scale, a modification of the Wentworth scale created by W. C. Krumbein, is a logarithmic scale computed by the equation: $\varphi = -\log_2(\text{grain size in mm})$.

φ scale	Size range (metric)	Size range (approx. inches)	Aggregate name (Wentworth Class)
< −8	> 256 mm	> 10.1 in	Boulder
−6 to −8	64–256 mm	2.5–10.1 in	Cobble
−5 to −6	32–64 mm	1.26–2.5 in	Very coarse gravel
−4 to −5	16–32 mm	0.63–1.26 in	Coarse gravel
−3 to −4	8–16 mm	0.31–0.63 in	Medium gravel
−2 to −3	4–8 mm	0.157–0.31 in	Fine gravel
−1 to −2	2–4 mm	0.079–0.157 in	Very fine gravel
0 to −1	1–2 mm	0.039–0.079 in	Very coarse sand
1 to 0	½–1 mm	0.020–0.039 in	Coarse sand
2 to 1	¼–½ mm	0.010–0.020 in	Medium sand
3 to 2	125–250 µm	0.0049–0.010 in	Fine sand
4 to 3	62.5–125 µm	0.0025–0.0049 in	Very fine sand
8 to 4	3.90625–62.5 µm	0.00015–0.0025 in	Silt
> 8	< 3.90625 µm	< 0.00015 in	Clay
<10	< 1 µm	< 0.000039 in	Colloid

In some schemes "gravel" is anything larger than sand (>2.0 mm), and includes "granule", "pebble", "cobble", and "boulder" in the above table. In this scheme, "pebble" covers the size range 4 to 64 mm (−2 to −6 φ).



Project No: **Borehole Number:**

Project:

Client: *Logged By:*

Site Location: *Checked By:*

TurnKey Environmental Restoration, LLC
726 Exchange Street, Suite 624
Buffalo, NY
(716) 856-0635

SUBSURFACE PROFILE			SAMPLE				PID VOCs	Lab Sample	Well Completion Details or Remarks
Elev. /Depth	Symbol	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)	Symbol	ppm 0 25 50		
0.0		Ground Surface							
0.0									

Drilled By:
Drill Rig Type:
Drill Method:

Drill Date(s):

Hole Size:
Stick-up:
Datum:

Sheet: 1 of 1

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Soil Sample Collection for VOC Analysis - EnCore Sampling

FOP 057.0

SOIL SAMPLE COLLECTION FOR VOC ANALYSIS – ENCORE SAMPLING

BACKGROUND AND PURPOSE

This procedure describes the methods for collecting soil samples for VOC analysis to ensure that the sample adequately represents the VOC concentrations in the soil in accordance with SW-846 Method 5035A (effective July 1, 2002). These compounds tend to volatilize from the soil after disturbance or introduction to the atmosphere. Therefore, care must be exercised to ensure that the sample collected is not altered during the collection and storage procedures. A variety of sampling options are allowed and Appendix A of Method 5035A provides details regarding the many options available for sample collection. The collection and preservation procedures are intended to prevent loss of VOCs during sample transport, handling and analysis.

Method 5035A is a method designed for volatile sample collection and analysis of soils and solid wastes for volatile organic compounds. This method is described in Update III to the Third Edition of SW-846, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, and is required for all analytical methods using purge and trap techniques (8021, 8015B, and 8260B). Alternative protocols may be used in some states (including New York), however this method is strongly recommended.

The volatile analysis is performed over two ranges:

	GC/MS (µg/kg)	GC (µg/kg)
Low Level	5 – 300	Not Available
High Level	>250	>20

The different levels require different sampling techniques. The low level method can only handle samples within a specific concentration range (these samples CANNOT be diluted), therefore a high level sample MUST be collected to ensure that all the target analytes can be quantified.

Naturally occurring carbonates in some soils may cause effervescence (foaming) on contact with the sodium bisulfate (NaHSO4) solution used as preservative for the low-level preparation. This interference makes it necessary for the laboratory to use the high-level prep or an alternative technique for low level. Check with the NYSDEC to discuss acceptable options.

Typically, analytical laboratories will support the following options for the two levels:

Option	No. of Containers	Sample Size (g)	Holding Time (days)
A – Low Level EnCore™ Samplers	3*	5	14**
B – High Level EnCore™ Sampler	1*	5	14**
C – High Level Methanol vial w/syringe	1	10	14

* Additional EnCore™ Samplers are required for MS/MSD.

** The sample MUST be extracted and preserved in sodium bisulfate or methanol within 48 hours of collection.

NOTE: The EnCore™ Sampler is disposable – it can only be used ONCE. It CANNOT be cleaned and/or reused. The samplers MUST be used in conjunction with an EnCore™ T-handle.

PROCEDURE

The preferred method for collecting and storing a soil sample for VOC analysis is using the EnCore™ method. This field procedure is described in this FOP.

1. The sampling team should reference the manufacturers' directions prior to sample collection (attached).

    a. Ensure that the EnCore™ Sampler is present at the sampling location before collecting the sample from the borehole or surface sample location. The necessary parts of the EnCore™ Sampler will consist of three disposable coring bodies, three disposable caps, and a reusable stainless steel T-handle.

    b. Retrieve the sampling tool from the borehole or sample location.

    c. Expose a surface of the soil sample. For Shelby tube samples, this would require the extrusion of the sample. For split spoon samples, this would require the spoon be disassembled and opened. If liners are being used in conjunction with a split spoon or solid barrel sampler, this would require the removal of the liners from the sampler, so that the soil at the liner's end is exposed.

    d. Following the manufacturer's directions for the use of the EnCore™ Sampler (attached), collect three aliquots of soil from the exposed soil surface, using the three coring bodies. After the collection of each aliquot, cap and label each aliquot. The manufacturer's direction for use of the EnCore™ Sampler are attached

2. If the use of the EnCore™ Sampler is not possible due to soil texture (e.g. gravels) the sample must be field preserved with acid and methanol in accordance with SW-846 Method 5035A.

3. If the soil material is too coarse for sampling with the EnCore™ Sampler <u>and</u> contains excessive calcium carbonate material that reacts with the acid preservative, the sample will be retained in the brass or stainless steel liner of the split-spoon sampler or similar device. The ends of these liners will be covered with Teflon™ rounds, capped and sealed with tape.

4. Record all information associated with sample collection in the Project Field Book.

5. The samples will be labeled, stored and shipped in accordance with the TurnKey's Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

ATTACHMENTS

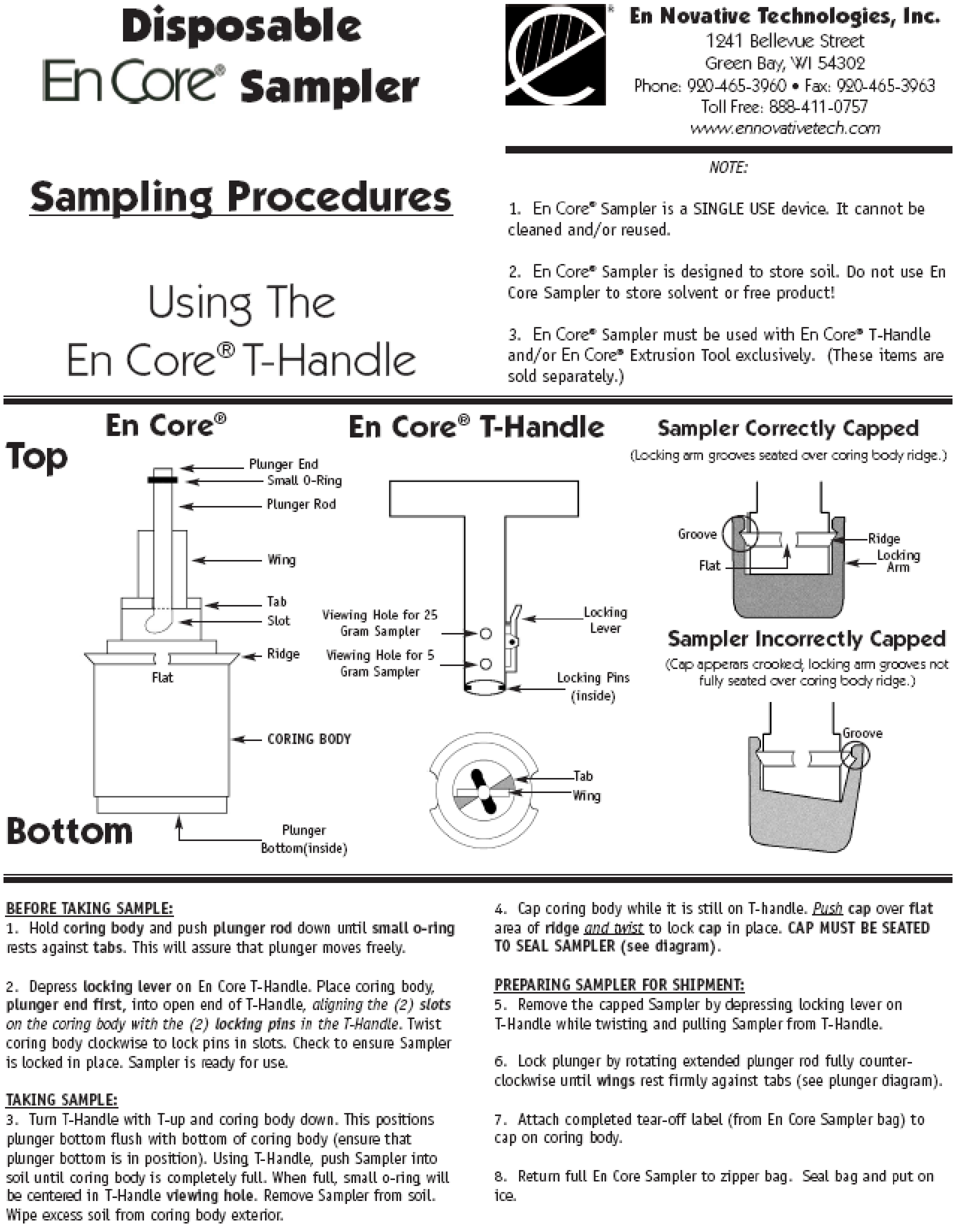
EnCore™ Sampling Procedure (manufacturers instructions)

REFERENCES

<u>TurnKey FOPs:</u>
046 Sample Labeling, Storage and Shipment Procedures

ATTACHMENT

EnCore™ Sampling Procedure (manufacturers instructions)



Disposable En Core® Sampler

En Novative Technologies, Inc.
1241 Bellevue Street
Green Bay, WI 54302
Phone: 920-465-3960 • Fax: 920-465-3963
Toll Free: 888-411-0757
www.ennovativetech.com

Sampling Procedures

Using The En Core® T-Handle

NOTE:

1. En Core® Sampler is a SINGLE USE device. It cannot be cleaned and/or reused.

2. En Core® Sampler is designed to store soil. Do not use En Core Sampler to store solvent or free product!

3. En Core® Sampler must be used with En Core® T-Handle and/or En Core® Extrusion Tool exclusively. (These items are sold separately.)

BEFORE TAKING SAMPLE:

1. Hold **coring body** and push **plunger rod** down until **small o-ring** rests against **tabs**. This will assure that plunger moves freely.

2. Depress **locking lever** on En Core T-Handle. Place coring body, **plunger end first**, into open end of T-Handle, *aligning the (2) slots on the coring body with the (2)* ***locking pins*** *in the T-Handle*. Twist coring body clockwise to lock pins in slots. Check to ensure Sampler is locked in place. Sampler is ready for use.

TAKING SAMPLE:

3. Turn T-Handle with T-up and coring body down. This positions plunger bottom flush with bottom of coring body (ensure that plunger bottom is in position). Using T-Handle, push Sampler into soil until coring body is completely full. When full, small o-ring will be centered in T-Handle **viewing hole**. Remove Sampler from soil. Wipe excess soil from coring body exterior.

4. Cap coring body while it is still on T-handle. *Push* cap over **flat** area of **ridge** *and twist* to lock cap in place. **CAP MUST BE SEATED TO SEAL SAMPLER (see diagram).**

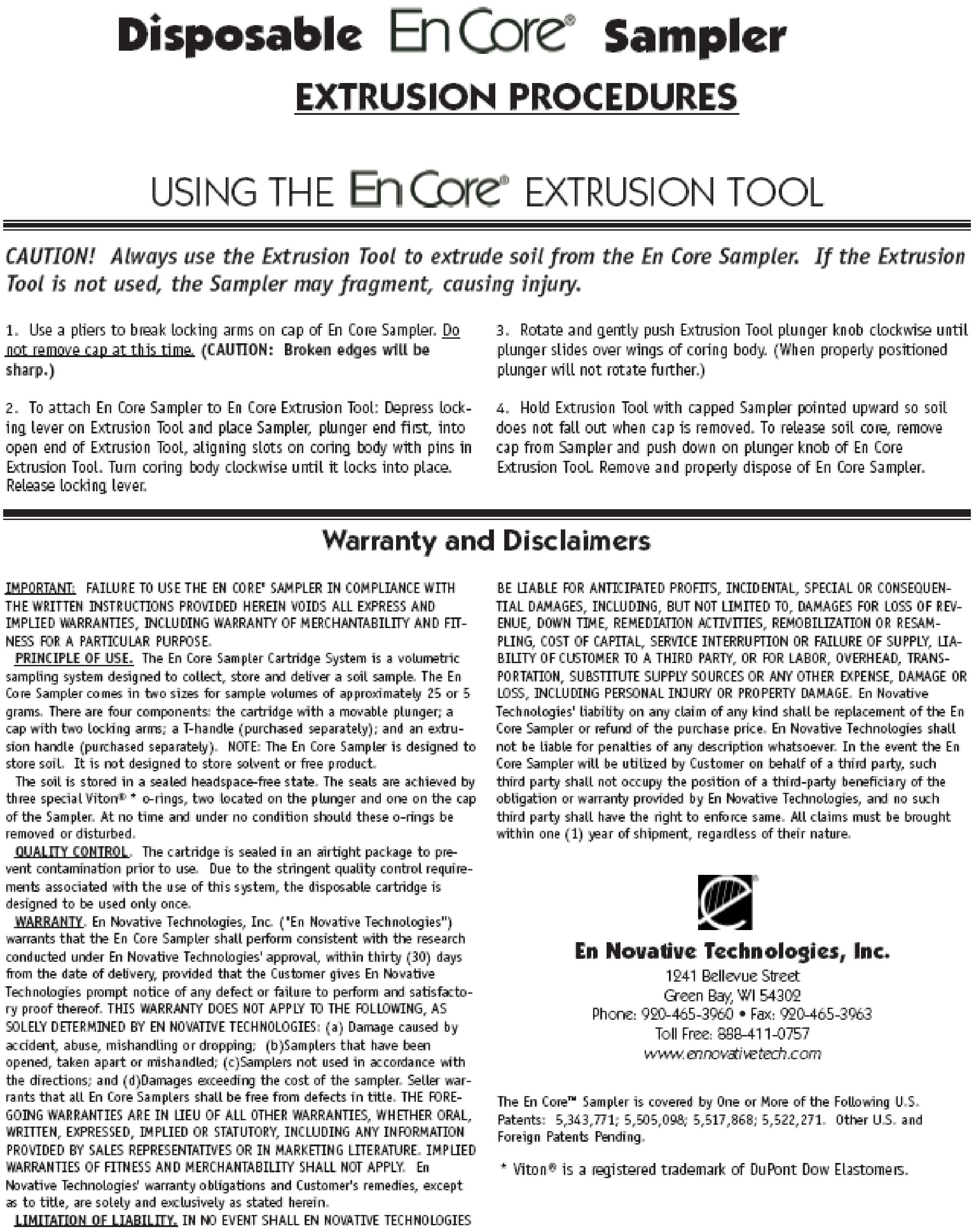
PREPARING SAMPLER FOR SHIPMENT:

5. Remove the capped Sampler by depressing locking lever on T-Handle while twisting and pulling Sampler from T-Handle.

6. Lock plunger by rotating extended plunger rod fully counter-clockwise until **wings** rest firmly against tabs (see plunger diagram).

7. Attach completed tear-off label (from En Core Sampler bag) to cap on coring body.

8. Return full En Core Sampler to zipper bag. Seal bag and put on ice.



Disposable En Core® Sampler

EXTRUSION PROCEDURES

USING THE En Core® EXTRUSION TOOL

CAUTION! Always use the Extrusion Tool to extrude soil from the En Core Sampler. If the Extrusion Tool is not used, the Sampler may fragment, causing injury.

1. Use a pliers to break locking arms on cap of En Core Sampler. Do not remove cap at this time. **(CAUTION: Broken edges will be sharp.)**
2. To attach En Core Sampler to En Core Extrusion Tool: Depress locking lever on Extrusion Tool and place Sampler, plunger end first, into open end of Extrusion Tool, aligning slots on coring body with pins in Extrusion Tool. Turn coring body clockwise until it locks into place. Release locking lever.
3. Rotate and gently push Extrusion Tool plunger knob clockwise until plunger slides over wings of coring body. (When properly positioned plunger will not rotate further.)
4. Hold Extrusion Tool with capped Sampler pointed upward so soil does not fall out when cap is removed. To release soil core, remove cap from Sampler and push down on plunger knob of En Core Extrusion Tool. Remove and properly dispose of En Core Sampler.

Warranty and Disclaimers

IMPORTANT: FAILURE TO USE THE EN CORE® SAMPLER IN COMPLIANCE WITH THE WRITTEN INSTRUCTIONS PROVIDED HEREIN VOIDS ALL EXPRESS AND IMPLIED WARRANTIES, INCLUDING WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

PRINCIPLE OF USE. The En Core Sampler Cartridge System is a volumetric sampling system designed to collect, store and deliver a soil sample. The En Core Sampler comes in two sizes for sample volumes of approximately 25 or 5 grams. There are four components: the cartridge with a movable plunger; a cap with two locking arms; a T-handle (purchased separately); and an extrusion handle (purchased separately). NOTE: The En Core Sampler is designed to store soil. It is not designed to store solvent or free product.

The soil is stored in a sealed headspace-free state. The seals are achieved by three special Viton® * o-rings, two located on the plunger and one on the cap of the Sampler. At no time and under no condition should these o-rings be removed or disturbed.

QUALITY CONTROL. The cartridge is sealed in an airtight package to prevent contamination prior to use. Due to the stringent quality control requirements associated with the use of this system, the disposable cartridge is designed to be used only once.

WARRANTY. En Novative Technologies, Inc. ("En Novative Technologies") warrants that the En Core Sampler shall perform consistent with the research conducted under En Novative Technologies' approval, within thirty (30) days from the date of delivery, provided that the Customer gives En Novative Technologies prompt notice of any defect or failure to perform and satisfactory proof thereof. THIS WARRANTY DOES NOT APPLY TO THE FOLLOWING, AS SOLELY DETERMINED BY EN NOVATIVE TECHNOLOGIES: (a) Damage caused by accident, abuse, mishandling or dropping; (b)Samplers that have been opened, taken apart or mishandled; (c)Samplers not used in accordance with the directions; and (d)Damages exceeding the cost of the sampler. Seller warrants that all En Core Samplers shall be free from defects in title. THE FOREGOING WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, WHETHER ORAL, WRITTEN, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING ANY INFORMATION PROVIDED BY SALES REPRESENTATIVES OR IN MARKETING LITERATURE. IMPLIED WARRANTIES OF FITNESS AND MERCHANTABILITY SHALL NOT APPLY. En Novative Technologies' warranty obligations and Customer's remedies, except as to title, are solely and exclusively as stated herein.

LIMITATION OF LIABILITY. IN NO EVENT SHALL EN NOVATIVE TECHNOLOGIES BE LIABLE FOR ANTICIPATED PROFITS, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, DAMAGES FOR LOSS OF REVENUE, DOWN TIME, REMEDIATION ACTIVITIES, REMOBILIZATION OR RESAMPLING, COST OF CAPITAL, SERVICE INTERRUPTION OR FAILURE OF SUPPLY, LIABILITY OF CUSTOMER TO A THIRD PARTY, OR FOR LABOR, OVERHEAD, TRANSPORTATION, SUBSTITUTE SUPPLY SOURCES OR ANY OTHER EXPENSE, DAMAGE OR LOSS, INCLUDING PERSONAL INJURY OR PROPERTY DAMAGE. En Novative Technologies' liability on any claim of any kind shall be replacement of the En Core Sampler or refund of the purchase price. En Novative Technologies shall not be liable for penalties of any description whatsoever. In the event the En Core Sampler will be utilized by Customer on behalf of a third party, such third party shall not occupy the position of a third-party beneficiary of the obligation or warranty provided by En Novative Technologies, and no such third party shall have the right to enforce same. All claims must be brought within one (1) year of shipment, regardless of their nature.

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The En Core™ Sampler is covered by One or More of the Following U.S. Patents: 5,343,771; 5,505,098; 5,517,868; 5,522,271. Other U.S. and Foreign Patents Pending.

* Viton® is a registered trademark of DuPont Dow Elastomers.

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Surface and Subsurface Soil Sampling Procedures

FOP 063.2

SURFACE AND SUBSURFACE SOIL SAMPLING PROCEDURES

PURPOSE

This procedure describes the methods for sampling surface soil and subsurface soil samples for physical and chemical laboratory analysis during intrusive activities such as test pitting, hand augering, drilling, surface soil sampling etc. Typical health and safety related issues should be addressed in the Project Health and Safety Plan.

PRE-SAMPLING PROCEDURES

1. Review project objectives and the Project Health and Safety Plan (HASP).
2. Conduct tailgate health and safety meeting with project team and/or subcontractor(s) by completing the Tailgate Safety Meeting Form (sample attached).
3. Calibrate air-monitoring equipment in accordance with the appropriate TurnKey's Field Operating Procedures or manufacturers recommendations for calibration of field meters.
4. Commence intrusive activities in accordance with specific TurnKey's FOPs (test pitting, hand augering, drilling etc.) or as directed by the Project Work Plan.
5. Conduct air monitoring as required by the HASP, Project Work Plan or TurnKey's FOP Real-Time Air Monitoring During Intrusive Activities. Record all results on the Real Time Air Monitoring Log (sample attached).
6. Decontaminate all <u>non-dedicated</u> stainless steel (or Pyrex glass) equipment in accordance with TurnKey's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures.
7. Collect soil samples in accordance with the following sections.

SURFACE SOIL/FILL SAMPLING PROCEDURES

Collection of surface soil/fill samples facilitates the evaluation of potential health risks to current site receptors that may be exposed to soil/fill via direct contact, incidental ingestion, or inhalation of airborne particulates. The following procedure is in accordance with NYSDEC sampling protocol of surface soil/fill material.

1. Collect all soil samples using dedicated (or decontaminated non-dedicated) sampling tools (i.e., spoons, trowels, bowls etc.), preferably constructed of stainless steel.

2. If the sample area is vegetated, then collect the surface soil sample from 0 to 2 inches below ground surface (bgs) following removal of the sod.

3. If there is no soil present within the sample area (i.e., only slag, concrete, mixed with fines), excavate an area 12 inches by 12 inches by 6 inches deep, screen the material to less than 1/8 inch (No. 4 sieve), and submit the screened material for analysis. If there is not enough material to completely fill the sample jar, then expand the excavation 3 inches in all four directions screening the additional material. Expand the excavation in this manner until sufficient sample volume is obtained. Volatile organic analysis of surface soil/fill utilizing this method will yield negatively biased results and should not be performed.

SURFACE/SUBSURFACE SOIL SAMPLING PROCEDURES

1. Collect all soil samples using dedicated (or decontaminated non-dedicated) sampling tools (i.e., spoons, trowels, bowls etc.), preferably constructed of stainless steel.

   Surface soil samples are typically collected from 0 to 6 inches below ground surface (bgs). Subsurface soils are typically sampled from varying depths greater than 6-inches bgs based on field observations and as directed by the Project Work Plan.

2. Transfer samples for chemical (VOC, SVOC, Metals etc.) and physical (i.e., Atterberg Limits, Grain Size, Permeability etc.) analytical testing by direct grab (i.e., directly from the bucket of the excavation equipment, split-spoon sampler, hand auger etc.) using the dedicated (or decontaminated non-dedicated) sampling tools into appropriate laboratory-supplied containers and seal. The chemical or physical laboratory selected to perform the analysis should determine minimum sample volume for analysis.

3. Prepare collected samples in accordance with TurnKey's FOP: Sample Labeling, Storage and Shipment Procedures. Do not allow the chemical soil samples to freeze during storage and shipping. It should be noted, ice is not required for physical soil samples and all physical soil samples should be kept at the collected soil moisture by securing with a tight sealing lid. Do not allow physical soil samples to gain or lose moisture from the collected soil moisture prior to analysis.

4. Record all sampling details (i.e., depth and location) in the Project Field Book; appropriate TurnKey log sheets depending on method of intrusion (i.e., drilling, test pitting, hand augering etc.); and on the Soil/Sediment Sample Collection Summary Log (sample attached).

PARAMETER-SPECIFIC PROCEDURES

1. Volatile Organic Compound (VOCs): Transfer sufficient soil volume to fill the laboratory-supplied container (typically 4 ounces) by packing the soil sample with the sampling tool to the top of the container leaving no headspace. At no time should a gloved hand (i.e., latex, nitrile etc.) be used to pack the sample into the sample container as the sample may be compromised via cross-contamination.

2. All Other Parameters: All other parameters include, but are not limited to, Semi-VOCs (SVOCs), polychlorinated biphenyls (PCBs), herbicides, pesticides, total metals etc. Transfer sufficient soil volume to fill the laboratory-supplied container by packing the soil sample with the sampling

tool to the top of the container. Unless otherwise indicated by the laboratory or the Project Work Plan, the sample jar for all other parameters does not have to be packed completely leaving no headspace as with the VOC containers.

ATTACHMENTS

Tailgate Safety Meeting Form (sample)
Soil/Sediment Sample Collection Summary Log (sample)
Real Time Air Monitoring Log (sample)

REFERENCES

<u>TurnKey FOPs:</u>

006	*Calibration and Maintenance of Combustible Gas/Oxygen Meter*
010	*Calibration and Maintenance of Portable Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
040	*Non-disposable and Non-dedicated Sampling Equipment Decontamination*
046	*Sample Labeling, Storage and Shipment Procedures*
073	*Real-Time Air Monitoring During Intrusive Activities*

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:
Project Number: Client:
Work Activities:

HOSPITAL INFORMATION:

Name:
Address: *City:* *State:* *Zip:*
Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)
Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

ATTENDEES

Name Printed	Signatures

Meeting conducted by:

SOIL/SEDIMENT
SAMPLE COLLECTION SUMMARY LOG

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to variance, location changes, depth changes, important matrix observations or description, gravel thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water over or through decontaminated sampling equipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples collected the same day. HSL Metals can be substituted by only the Metals analyzed for that day (except Hexavalent Chromium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionzied water lot # or distilled water can be substit info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matrix per day. Analyze for all those parameters analyzed for the samples collected the same day.*

Field Blank *- Pour clean deionized water (used as final decon rinse water) into sample containers while at the sampling site. Collect field blanks at a frequency of 1 per lot of deionized water. Note water lot number and dates in use for decon in 'Comments' section.*

Investigation Derived Waste (IDW) Characterization samples *- One composited sample from all drums of decon fluids and soil. Please note number of drums and labels on collection log.*

Notes:

1. See QAPP for sampling frequency and actual number of QC samples.
2. CWM - clear, wide-mouth glass jar with Teflon-lined cap.
3. HDPE - high density polyethylene bottle.
4. MS/MSD/MSB - Matrix Spike, Matrix Spike Duplicate, Matrix Spike Blank.
5. BD - Blind Duplicate - indicate location of duplicate.

REAL TIME AI

Date:
Project Name:
Project Number:
Project Location:
Client:
Purpose of Air Monitoring:

WEATHER CONDITIONS:

Time of Day:	A.M.
Ambient Air Temp.:	
Wind Direction:	
Wind Speed:	
Precipitation:	

Date	Personnel	Time	Air Monitoring Meter Measurement (Units)							Locatio
			PID (ppm)	LEL (%)	H2S (ppm)	O2 (%)	CO (ppm)	Particulates (mg/m^3)	Other	

NOTE: SEE EQUIPMENT CALIBRATION LOG FOR DESCRIPTION OF EQUIPMENT TYPE.

Prepared By:

TurnKey Environmental Restoration, LLC

Field Operating Procedures

Real-Time Air Monitoring During Intrusive Activities

FOP 073.2

REAL-TIME AIR MONITORING DURING INTRUSIVE ACTIVITIES PROCEDURE

PURPOSE

This guideline presents requirements for real-time community air monitoring and required responses during all project required intrusive activities, such as drilling, test pitting, earthwork construction etc. This procedure is consistent with the requirements for community air monitoring for all intrusive projects, including projects conducted at remediation sites, as established by the New York State Department of Health (NYSDOH) and the New York State Department of Environmental Conservation (NYSDEC). Accordingly, it follows procedures and practices outlined under NYSDEC's DER-10 (May 2010) Appendix 1A (NYSDOH's Generic Community Air Monitoring Plan) and Appendix 1B (Fugitive Dust and Particulate Monitoring).

This FOP requires real-time monitoring for constituents of concern (COC) (i.e., volatile organic compounds (VOCs), lower explosive limit (% LEL), particulates (i.e., dust) etc.) at the upwind and downwind perimeter as well as the exclusion zone of a project site during all intrusive activities. This FOP is not intended for use in establishing action levels for worker respiratory protection (see Project Health and Safety Plan (HASP) for worker protection action levels). Rather, its intent is to provide a measure of protection for the surrounding community from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The community, as referenced in this document, includes any off-site residences, public buildings/grounds and commercial or industrial establishments adjacent to the project site. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, this FOP helps to confirm that work activities did not spread contamination off-site through via air transport mechanisms. Community air monitoring shall be integrated with the construction worker personal exposure-monitoring program contained in the project and site-specific HASP.

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

MONITORING & MITIGATION PROCEDURE

Real-time air monitoring perimeter locations for monitoring stations will be established based on the location of the exclusion zone (i.e., immediate work area) and wind direction. Where wind direction is shifting or winds are calm, the downwind monitoring location will default to the perimeter location nearest the most sensitive receptor (i.e., residential property). All downwind receptors being equal, the downwind monitoring location will default to the perimeter location downwind of the prevailing winds at the site. Although additional site specific COCs may be monitored during real-time air monitoring activities, the most common COCs are discussed in this FOP, including organic vapors (i.e., VOCs), airborne particulates (i.e., fugitive dust) and combustible gases (i.e., methane) and oxygen.

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

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

ORGANIC VAPORS

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

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

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

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

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

- **Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures**

    - When work areas are within 20 feet of potentially exposed populations or occupied structures, the continuous monitoring locations for VOCs and particulates must reflect the nearest potentially exposed individuals and the location of ventilation system intakes for nearby structures. The use of engineering controls such as vapor/dust barriers, temporary negative-pressure enclosures, or special ventilation devices should be considered to prevent exposures related to the work activities and to control dust and odors. Consideration should be given to implementing the planned activities when potentially exposed populations are at a minimum, such as during weekends or evening hours in non-residential settings.

- If total VOC concentrations opposite the walls of occupied structures or next to intake vents exceed 1 ppm, monitoring should occur within the occupied structure (s). Background readings in the occupied spaces must be taken prior to commencement of the planned work. Any unusual background readings should be discussed with NYSDOH prior to commencement of the work.

- If total particulate concentrations opposite the walls of occupied structures or next to intake vents exceed 150 mcg/m3, work activities should be suspended until controls are implemented and are successful in reducing the total particulate concentration to 150 mcg/m3 or less at the monitoring point.

- Depending upon the nature of contamination and remedial activities, other parameters (e.g., explosivity, oxygen, hydrogen SUlfide, carbon monoxide) may also need to be monitored Response levels and actions should be pre-determined, as necessary, for each site.

Additionally, if following the cessation of work and efforts to abate the emission source are unsuccessful, and if sustained organic vapor levels exceed 25 ppm above background within the 20-foot zone for more than 30 minutes, then the **Major Vapor Emission Response Plan** (see below) will automatically be placed into effect.

Major Vapor Emission Response Plan

Upon activation of Major Vapor Emission Response Plan, the following activities will be undertaken:

1. All Emergency Response Contacts as listed below and in the Site-Specific Health and Safety Plan will be contacted.

2. The local police authorities will immediately be contacted by the Site Safety and Health Officer and advised of the situation.

3. The Site Safety and Health Officer will determine if site workers can safely undertake source abatement measures. Abatement measures may include covering the source area with clean fill or plastic sheeting, or consolidating contaminated materials to minimize surface area. The Site Safety and Health Officer will adjust worker personal protective equipment as necessary to protect workers from over-exposure to organic vapors.

The following personnel are to be notified by the Site Safety and Health Officer in the listed sequence if the Major Vapor Emission Response Plan is activated:

Contact	**Phone**
Police/Fire Department	911
New York State DOH	(518) 402-7860
New York State DEC Region 8	(585) 226-2466, switchboard

New York State DEC Region 9	(716) 851-7220
State Emergency Response Hotline	(800) 457-7362

In addition, the Site Safety and Health Officer will provide these authorities with a description of the apparent source of the contamination and abatement measures being taken by the contractor, if any.

AIRBORNE PARTICULATES

Fugitive dust suppression and airborne particulate monitoring shall be performed during any intrusive activities involving disturbance or handling of site soil/fill materials. Fugitive dust suppression techniques will include the following minimum measures:

- Spraying potable water on all excessively dry work areas and roads.
- All fill materials leaving the site will be hauled in properly covered containers or haul trailers.
- Additional dust suppression efforts may be required as discussed below.

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 (μg/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 μg/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 μg/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 μg/m^3 of the upwind level and in preventing visible dust migration.

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

Visual Assessment

In conjunction with the real-time monitoring program, TurnKey personnel and any subcontractors thereof will be responsible for visually assessing fugitive dust migration from the site. If airborne dust is observed leaving the site, the work will be stopped until supplemental dust suppression techniques are employed in those areas.

Supplemental Dust Suppression

Supplemental dust suppression techniques may include but are not necessarily limited to the following measures:

- Reducing the excavation size, number of excavations or volume of material handled.
- Restricting vehicle speeds.
- Applying water on buckets during excavation and dumping.
- Wetting equipment and excavation faces.
- Wetting haul roads.
- Restricting work during extreme wind conditions.
- Use of a street sweeper on paved haul roads, where feasible.

Work can resume using supplemental dust suppression techniques provided that the measures are successful in reducing the sustained downwind particulate concentration to below 150 ug/m^3 of the upwind level, and in preventing visible dust migration off-site.

COMBUSTIBLE GASES & OXYGEN

Ambient combustible gas and oxygen concentrations should be measured prior to commencing intrusive activities each workday and a minimum of every 30-minutes thereafter. Air monitoring activities should be performed using equipment appropriate to measure combustible gases in percent lower explosive limit (LEL) and percent oxygen and calibrated daily. All combustible gas and oxygen readings must be recorded in the Project Field Book and/or Real-Time Air Monitoring Logs (sample attached) and, if applicable, be made available for State (DEC and DOH) personnel to review.

Mitigation upon the detection of various action levels of organic vapors are presented below:

Combustible Gas:

- If the sustained ambient air concentration of combustible gas at the downwind perimeter of the site exceeds a reading of 10 to 25% LEL, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 10% LEL, work activities can resume with continued monitoring.

- If sustained combustible gas levels at the downwind perimeter of the site persist at levels in excess of 25% LEL, work activities must be halted, the source of explosion hazards identified, corrective actions taken to abate emissions and monitoring continued. Following combustible gas mitigation, work activities can resume provided that the sustained total organic vapor level 200 feet downwind of the exclusions 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 a sustained value of 10% LEL.

Oxygen:

- If the sustained ambient oxygen concentration at the downwind perimeter of the site measures a reading between 19.5% - 21% oxygen, work activities can continue with extreme caution, however attempts to determine the potential source of oxygen displacement must be conducted.

- If the sustained oxygen level readily decreases below 19.5% LEL, work activities should be discontinued and all personnel must leave the area immediately.

- If the sustained oxygen level at the downwind perimeter of the site persists at levels between 21-25%, work activities can resume with caution.

- If the sustained oxygen level at the downwind perimeter of the site persists at levels exceeding 25% (fire hazard potential), work activities should be discontinued and all personnel must leave the area immediately.

ATTACHMENTS

Real-Time Air Monitoring Log (sample)

REFERENCES

<u>TurnKey FOPs:</u>

006	*Calibration and Maintenance of Combustible Gas/Oxygen Meter*
010	*Calibration and Maintenance of Flame Ionization Detector*
011	*Calibration and Maintenance of Portable Photoionization Detector*
084	*Calibration and Maintenance of Portable Particulate Meter*

REAL TIME AI

Date:
Project Name:
Project Number:
Project Location:
Client:
Purpose of Air Monitoring:

WEATHER CONDITIONS:

Time of Day:	A.M.
Ambient Air Temp.:	
Wind Direction:	
Wind Speed:	
Precipitation:	

Date	Personnel	Time	Air Monitoring Meter Measurement (Units)							Locatio
			PID (ppm)	LEL (%)	H2S (ppm)	O2 (%)	CO (ppm)	Particulates (mg/m^3)	Other	

NOTE: SEE EQUIPMENT CALIBRATION LOG FOR DESCRIPTION OF EQUIPMENT TYPE.

Prepared By:

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

"Before Going Into the Field" Procedure

FOP 076.0

"BEFORE & AFTER" PROJECT PROCEDURES FOR FIELD PERSONNEL

PURPOSE

This procedure describes the required field and office activities to be preformed "before and after" project assignments by field personnel. Field activities may include, but are not limited to, drilling oversight, excavation contractor oversight, matrix sample collection (e.g., soil, sediment, groundwater, surface water, wipe, and/or air), third party oversight, and site reconnaissance to name a few. Office activities may include, but are not limited to, photocopying field book entries, completing all field forms, tabulating collected field and laboratory data, and preparation of report text.

The primary goal of this procedure is to eliminate delays and unnecessary budgetary "strain" due to a lack of preparedness and knowledge of the site by the field team members. This procedure also seeks to streamline the preparation and transfer of field information/data from field personnel to the Project Manager upon field work completion.

PROJECT ASSIGNMENT

During the initial meeting with the Project Manager, several questions should be raised by the field team member and answered by the Project Manager. A pad of paper and pen should be in hand to record all pertinent job information. At a minimum, the following questions should be answered:

1. *What is the job number?*
2. *Who is the client and the on-site representative (if applicable)?*
3. *What is the name of the project?*
4. *What are the job responsibilities and how should they be accomplished?*
5. *How much time do I have to complete the assigned tasks?*
6. *Are there any project required documents? What are they?*

Any deviation from the above questions should be approved by the Project Manager prior to contravention, not at the end of the day or following the project completion.

"BEFORE" CHECKLISTS

Checklists should be developed and used so that all of the required steps prior to going into the field are undertaken. A good checklist will include:

- Adequate review of the documents listed in this FOP
- Any documents, equipment, and supplies presented in this FOP
- Providing adequate notification to the laboratory (so that holding times are not exceeded) and to the owner of the site and the primary regulatory agency (usually in writing) that a round of sampling is to commence in order to facilitate sampling and allow for a sampling audit or split sampling.
- Specifying and documenting the equipment maintenance and calibration undertaken prior to going into the field relative to the sampling event.
- Checking and calibrating the equipment.
- Listing the documents, equipment, and supplies required to collect samples at the site as presented in this FOP.

Prior to going into the field, sampling personnel should reacquaint themselves with the sampling plan. The review is undertaken so that the required specific protocol such as sampling from the least to the most contaminated wells, knowing where quality control samples are to be taken, knowing the disposition of purge water, etc., is understood and followed.

The amount of equipment maintenance and calibration required prior to going into the field should be clearly specified in the presampling equipment maintenance and calibration checklists, which are based on the manufacturer's recommendations, sampling objectives, and prior experience. Maintenance and calibration performed before sampling must be documented to provide evidence that the equipment was adequately maintained and calibrated and to keep a permanent record of equipment servicing and performance.

A list of all the documents, equipment, and supplies required for the sampling event should be prepared and used. It can be frustrating and time consuming to forget equipment and supplies, so some up-front preparation is warranted. The following sections provide a list of the documentation, equipment, and supplies, which should assist in preparing a site-specific equipment and supply checklist. Once prepared, the checklist and project requirements should be reviewed with the Project Manager.

"BEFORE" DOCUMENTATION SUMMARY

Prior to going into the field, the field team should review and understand all of the project documents including, but not limited to:

- The Health and Safety Plan (HASP)
- The Site Analytical Plan (SAP), Sampling Plan, or similar document
- The Quality Assurance Project Plan (QAPP)
- The Work Plan
- Project specific Field Operating Procedures and field forms
- Site Maps
- Equipment operation manuals
- Chain-of-Custody forms
- Shipping labels and custody seals
- Any reference materials (i.e., conversion tables, volume calculation, etc.). The Pocket Ref, Third Edition by Thomas Glover is a great source for the field.

If at any time, the field team does not understand the project required protocol, procedures, sample locations, etc.; the Project Manager should be consulted for clarification.

"BEFORE" EQUIPMENT SUMMARY

Prior to going into the field, the field team should review the following equipment checklist, noting that project specific equipment may not be included in this list:

- Water level indicator
- Pumps, sample tubing, flow controllers, power cord(s), batteries, compressors, generators, etc.
- Bailers (disposable, PVC, stainless steel, glass), rope
- Flow-through cell
- Field meters with adequate calibration solutions (pH/Eh meter, conductivity meter, dissolved oxygen meter, turbidity meter, batteries, etc.)
- Garden hose
- Explosive gas meter and/or photoionization detector (PID) with calibration supplies
- Complete set of hand tools including a sharp knife, screw drivers, pliers, hacksaw, flashlight, large pipe wrench, hammer, bolt cutters, and replacement locks
- Fish hook with weight and string
- Field filtering equipment and supplies
- Decontamination supplies, such as scrub brushes, Alconox®, distilled water, potable water, 5-gallon bucket, paper towels, aluminum foil
- 5-gallon bucket(s)
- Measuring cup
- Sample bottles/containers (with extras) and preservatives
- Stainless steel spoons, trowels, shovels
- Shipping containers (i.e., coolers)
- Clipboard
- Calculator
- Water resistant clock or watch with second hand
- First aid kit

"BEFORE" SUPPLIES SUMMARY

Prior to going into the field, the field team should review the following supplies checklist, noting that project specific supplies may not be included in this list:

- Laboratory grade non-phosphate detergent (Alconox®)
- Appropriate personal protective equipment appropriate to the contaminants of concern, such as nitrile gloves, Tyvek, boots, hardhat, safety glasses, hearing protection, etc.
- Bags of ice
- Plastic garbage bags
- Plastic sheeting
- Sufficient quantities of potable and laboratory grade deionized water for cleaning and equipment blanks
- Methanol
- Isopropyl alcohol
- Clean rags and paper towels
- Electrical tape, duct tape, and wide transparent tape
- Hand soap
- Regular, ballpoint, and indelible pens
- Hollow braid polyethylene rope

After providing adequate notification (lab, state and/or federal agencies), performing the presampling maintenance and calibration, obtaining the site and well keys, and packing the supplies and equipment, the field activities are ready to be performed.

"AFTER" – PROJECT FILE REVIEW & CREATION

It is the responsibility of each field crew member to review his/her own field notes and time sheet for accuracy and completeness. All errors to the field notes should be corrected, dated, and initialed for Project Manager review. Once reviewed by the field team member, the Project Field Book, all field forms, photographs, chain-of-custodies etc. must be photocopied, scanned (if required), downloaded, etc. and then given to the Project Manager in an organized file folder in a timely manner. Avoiding delay during this step is critical, especially when there are severe time constraints for the project.

REFERENCES

1. Wilson, Neal. *Soil Water and Ground Water Sampling*, 1995

TurnKey
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FIELD OPERATING PROCEDURES

Geoprobe Drilling Procedures

FOP 078.0

GEOPROBE DRILLING PROCEDURES

PURPOSE

This guideline presents a method for direct-push drilling a borehole through unconsolidated materials, including soils or overburden.

PROCEDURE

The following procedure will be used to drill a borehole for sampling and/or well installation, using direct-push methods and equipment.

1. Follow TurnKey's Field Operating Procedure (FOP) for Drill Site Selection Procedure prior to implementing any drilling activity.
2. Perform drill rig safety checks with the driller by completing the Drilling Safety Checklist form (sample attached).
3. Conduct tailgate health and safety meeting with project team and drillers by completing the Tailgate Safety Meeting Form (sample attached).
4. Calibrate air-monitoring equipment in accordance with the appropriate TurnKey's FOPs or manufacturers recommendations.
5. Ensure all drilling equipment (i.e., rods, 4-foot sampler, dedicated PVC sleeves) appear clean and free of soil prior to initiating any subsurface intrusion. Decontamination of drilling equipment should be in accordance with TurnKey's Drilling and Excavation Equipment Decontamination Procedures FOP.
6. Mobilize the Geoprobe™ rig to the site and position over the borehole.
7. Level and stabilize the rig and recheck the rig location against the planned drilling location.

8. Fully advance the sampler into the subsurface using an ATV-mounted direct-push Geoprobe™ drill rig and 1.5-inch diameter sampler, typically 4-feet in length and fitted with a dedicated PVC sleeve, for each four-foot core of soil.

9. Retrieve the 4-foot sample core from the driller, place on a piece of polyethylene tarp, and cut open using a sharp utility knife.

10. Visually characterize each 4-foot soil core using the Unified Soil Classification System (USCS) in accordance with TurnKey's Soil Description Procedures Using the USCS FOP.

11. Scan each 4-foot core for total volatile organic vapors with a calibrated Photovac 2020 PID equipped with a 10.6 eV lamp, and report any visual and/or olfactory observations. Record PID scan measurements in the Project Field Book and appropriate field forms.

12. If required, collect a representative soil sample for headspace determinations. In general, soil samples representative of each 4-foot core interval are collected, placed in a sealable plastic bag, and kept at or near room temperature (approximately 65-70° F) for a minimum of 15 minutes prior to measurement. Record PID headspace determination measurements in the Project Field Book and appropriate field forms.

13. Check sampler and rods periodically during drilling to ensure the boring is plumb. Adjust rig position as necessary to maintain plumb.

14. Continue drilling until reaching the assigned total depth, or until sampler refusal occurs. Sampler refusal is when the drilling penetration drops below 0.1 feet per 2 minutes, with the full weight of the rig on the sampler.

15. Plug and abandon boreholes not used for temporary well installation in accordance with TurnKey's Field Operating Procedure for Abandonment of Borehole. Boreholes to be used as temporary wells should be completed in accordance with TurnKey's Temporary Well (Piezometer) Construction Procedures FOP.

16. Decontaminate all non-dedicated drilling tools between boring locations using potable tap water and a phosphate-free detergent (i.e., Alconox™) in accordance with TurnKey's Drilling and Excavation Equipment Decontamination Procedures FOP.

OTHER PROCEDURAL ISSUES

- Borings will not be over drilled (rat holed) without the express permission of the TurnKey field supervisor. All depth measurements should be accurate to the nearest 0.1 foot, to the extent practicable.

- Potable water may be placed in the sampler stem if critically necessary for borehole control or to accomplish sampling objectives. This will be performed only with the express permission of the TurnKey field supervisor.

ATTACHMENTS

Drilling Safety Checklist (sample)
Tailgate Safety Meeting Form (sample)

REFERENCES

<u>TurnKey FOPs:</u>

001	*Abandonment of Borehole Procedures*
017	*Drill Site Selection Procedure*
018	*Drilling and Excavation Equipment Decontamination Procedures*
054	*Soil Description Procedures Using the USCS*
077	*Temporary Well (Piezometer) Construction Procedures*

DRILLING SAFETY CHECKLIST

Project:
Date:
Project No.:
Drilling Company:
Client:
Drill Rig Type:

ITEMS TO CHECK	OK	ACTION NEEDED
"Kill switches" installed by the manufacturer are in operable condition and all workers at the drill site are familiar with their location and how to activate them?		
"Kill switches" are accessible to workers on both sides of the rotating stem? NOTE: Optional based on location and number of switches provided by the manufacturer.		
Cables on drill rig are free of kinks, frayed wires, "bird cages" and worn or missing sections?		
Cables are terminated at the working end with a proper eye splice, either swaged Coupling or using cable clamps?		
Cable clamps are installed with the saddle on the live or load side? Clamps should not be alternated and should be of the correct size and number for the cable size to which it is installed. Clamps are complete with no missing parts?		
Hooks installed on hoist cables are the safety type with a functional latch to prevent accidental separation?		
Safety latches are functional and completely span the entire throat of the hook and have positive action to close the throat except when manually displaced for connecting or disconnecting a load?		
Drive shafts, belts, chain drives and universal joints shall be guarded to prevent accidental insertion of hands and fingers or tools.		
Outriggers shall be extended prior to and whenever the boom is raised off its cradle. Hydraulic outriggers must maintain pressure to continuously support and stabilize the drill rig even while unattended.		
Outriggers shall be properly supported on the ground surface to prevent settling into the soil.		
Controls are properly labeled and have freedom of movement? Controls should not be blocked or locked in an action position.		
Safeties on any device shall not be bypassed or neutralized.		
Controls shall be operated smoothly and cables and lifting devices shall not be jerked or operated erratically to overcome resistance.		
Slings, chokers and lifting devices are inspected before using and are in proper working order? Damaged units are removed from service and are properly tagged?		
Shackles and clevises are in proper working order and pins and screws are fully inserted before placing under a load?		
High-pressure hoses have a safety (chain, cable or strap) at each end of the hose section to prevent whipping in the event of a failure?		
Rotating parts of the drill string shall be free of sharp projections or hooks, which could entrap clothing or foreign objects?		

DRILLING SAFETY CHECKLIST

Project: Date:

ITEMS TO CHECK	OK	ACTION NEEDED
Wire ropes should not be allowed to bend around sharp edges without cushion material.		
The exclusion zone is centered over the borehole and the radius is equal or greater than the boom height?		
The work area around the borehole shall be kept clear of trip hazards and walking surfaces should be free of slippery material.		
Workers shall not proceed higher than the drilling deck without a fall restraining device and must attach the device in a manner to restrict fall to less than 6 feet.		
A fire extinguisher of appropriate size shall be immediately available to the drill crew. The drill crew shall have received annual training on proper use of the fire extinguisher.		
29 CFR 1910.333 © (3) Except where electrical distribution and transmission lines have been de-energized and visibly grounded, drill rigs will be operated proximate to, under, by, or near power lines only in accordance with the following: .333 © (3) (ii) 50 kV or less -minimum clearance is 10 ft. For 50 kV or over - 10ft. Plus ½ in. For each additional kV **TurnKey Policy: Maintain 20 feet clearance**		
29 CFR 1910.333 © (3) (iii) While the rig is in transit with the boom in the down position, clearance from energized power lines will be maintained as follows: Less than 50 kV - 4 feet 50 to 365 kV - 10 feet 365 to 720 kV - 16 feet		

Name: (printed)

Signed: Date:

TAILGATE SAFETY MEETING FORM

Project Name: Date: Time:

Project Number: Client:

Work Activities:

HOSPITAL INFORMATION:

Name:

Address: *City:* *State:* *Zip:*

Phone No.: *Ambulance Phone No.*

SAFETY TOPICS PRESENTED:

Chemical Hazards:

Physical Hazards: Slips, Trips, Falls

PERSONAL PROTECTIVE EQUIPMENT:

Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D
Activity:	*PPE Level:*	A	B	C	D

New Equipment:

Other Safety Topic (s): Environmental Hazards (aggressive fauna)
Eating, drinking, use of tobacco products is prohibited in the Exclusion Zone (EZ)

ATTENDEES

Name Printed	**Signatures**

Meeting conducted by:

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Calibration & Maintenance of Portable Particulate Meter

FOP 084.0

CALIBRATION AND MAINTENANCE OF PORTABLE PARTICULATE METER

PURPOSE

This guideline describes a method for calibration of a portable particulate meter, specifically the Thermo Electron Corporation MIE DataRAM 4 (Model DR-4000). The DataRAM 4 measures the concentration of airborne particulate matter (liquid or solid), as well as mean particle size, air temperature, and humidity, providing direct and continuous readout as well as electronic recording of the information. This parameter is of interest both as a general indicator of air quality, and because of its pertinence to community air monitoring typically required at most construction/remediation/investigation sites. The DataRAM covers a wide measurement range from 0.0001 mg/m^3 to 400 mg/m^3. With its large capacity internal data logging capabilities with data retrieval on screen or downloaded, the DataRAM can store up to 50,000 data points, including individual point averages, particle size, temperature, and humidity with time stamp as well as overall average and maximum concentration.

Because the DataRAM meter must be factory calibrated once a year, this guideline presents a method for start-up, operation, and maintenance, which is performed to verify instrument function. All field instruments will be calibrated, verified and recalibrated at frequencies required by their respective operating manuals or manufacturer's specifications, but not less than once each year. Field personnel should have access to all operating manuals for the instruments used for the field measurements. This procedure also documents critical maintenance activities for this meter. The user should reference the manufacturer's instruction manual prior to operating this unit.

ACCURACY & PRECISION

The calibrated accuracy of the DataRAM 4 particulate meter is within ± 2% of reading ± precision over the temperature range of -4° to 158° F (-10° to 50° C) and 10 to 95% relative humidity (non-condensing). The precision is ± 1% of reading or ± 0.001 mg/m^3, whichever is greater (1-second averaging) and ± 0.3% of reading or ± 0.0003 mg/m^3, whichever is greater (10-second averaging).

INSTRUMENT PANEL VIEW

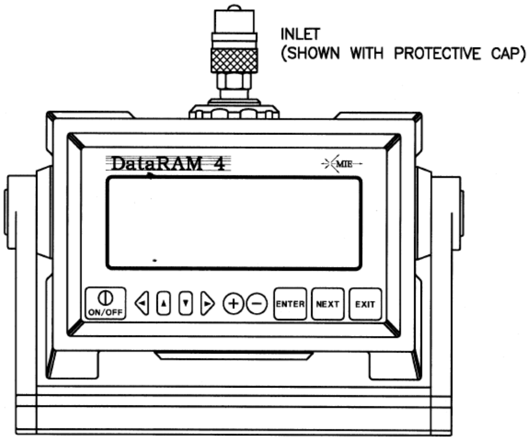


FIGURE 1. FRONT–PANEL VIEW OF DataRAM

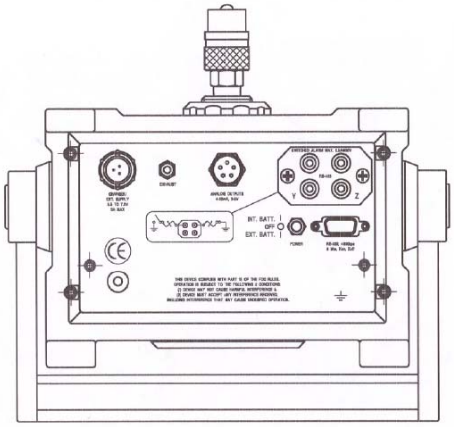


FIGURE 2. BACK–PANEL VIEW OF DataRAM

MAINTENANCE

General Guidelines

The DataRAM 4 is designed to be repaired at the factory. No user serviceable components are inside the metal enclosure of the DataRAM 4 with exception of the filter cartridge or the analytic filter holder. Access to the internal components of the unit by others than authorized MIE personnel voids warranty.

Unless a MALFUNCTION message is displayed, or other operational problems occur, the DataRAM 4 should be returned to the factory once every two years for routine check out, test, cleaning and calibration check.

Battery Charging and Cycling

If the DataRAM 4 is to be operated without its charger/power supply, i.e., deriving power from its internal battery, this battery should be fully charged before initiating a run. The

DataRAM 4 charger/power supply can be connected continuously to the instrument whether the DataRAM 4 is on or off. If the charger/power supply is not connected, the internal battery will discharge very slowly depending on storage temperature. Low storage temperature reduces battery capacity. High storage temperatures, however, reduce battery life which is of the order of 8 years at 20°C (68°F), and only 2 years at 40°C (104°F).

In general, the user should maintain the battery charge as high as possible in order to extend its charge/discharge cycling capacity (this characteristic differs from that of nickel-cadmium batteries).

Instrument Storage

If the DataRAM 4 is to be stored for an extended period of time (i.e., 3 months or more), place the 3-position switch on the back panel in its OFF position (mid-position), in order to minimize gradual battery discharge. This will have no effect on data retention or internal clock function. It is recommended, however, that the battery be recharged every 3 months in order to prolong battery life.

During storage always snap on quick-connect cap over the instrument inlet to protect the sensing optics from gradual dust contamination. Store DataRAM 4 in a dry environment.

Filter Replacement

To replace either of two types of filters used with DataRAM 4, place the instrument on its back rubber feet (front panel facing upward). On the bottom surface of the DataRAM, locate the large threaded plastic filter cover and holding the cross bar, rotate this cover counterclockwise. Remove cover and the filter holder within the open cavity.

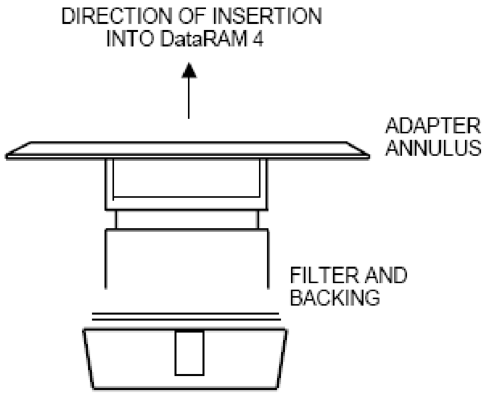
> *HEPA Filter Cartridge Replacement*
>
> The DataRAM 4 is shipped from the factory with the HEPA filter cartridge installed. This cartridge can be identified by its metallic cover. Remove this cartridge. Clean the internal black rubber gasket against which the cartridge is normally compressed. Install new HEPA-type cartridge (MIE part no. MSA-95302) by inserting its wider ridged end first. Reposition threaded plastic cover engaging threads carefully; rotate cover clockwise, hand tightening firmly. Properly dispose of used cartridge to prevent inadvertent re-use.

Analytic Filter Installation/Replacement

In order to install or replace the analytical filter holder, proceed as follows. Remove the HEPA cartridge normally in place. Remove (separate) the inlet cover (with the blue plug) of the Millipore plastic filter holder from the rest of that holder assembly containing the white membrane filter. Insert firmly the gray plastic adapter annulus into the open face of the filter holder assembly. Remove the red plastic plug from the exhaust nipple of the filter holder assembly. Ensure that all three components of the holder assembly are fully compressed to preclude any leafage. Insert the assembly into the filter cavity of the DataRAM 4 with the gray plastic adapter annulus bearing against the internal black gasket (adapter annulus inserted first). Reposition threaded plastic cover and hand-tighten carefully and firmly. Set aside HEPA cartridge for future use.

In order to remove and/or to replace the membrane filter within its holder, remove the gray plastic adapter annulus and separate (pry apart) the two transparent plastic rings that compress the membrane filter. Make sure to remove and replace only the membrane filter (using tweezers), leaving the white backing disc in the holder. A new membrane filter should then be placed over that backing and the sealing ring should then be inserted to trap and compress the filter and backing discs. For storage, the inlet cap with the blue plug should be inserted as well as the red plug on the back of the filter holder.

Analytical filter holder with adapter annulus inserted



Cleaning of Optical Sensing Chamber

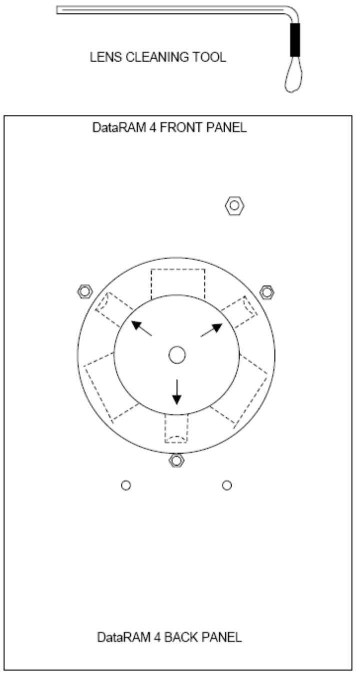
Although the DataRAM 4 incorporates filtered air shielding of the critical optical sensing surfaces, continued sampling of airborne particles at high concentrations may result in gradual build-up of contamination on those interior surfaces of the sensing chamber components. This may cause an excessively high optical background level. If this background level does becomes excessive, the DataRAM 4 will alert the user at the completion of the zeroing sequence by the display of a BACKGROUND HIGH message. If this message is presented, the DataRAM 4 can continue to be operated providing accurate measurements. However, it is then advisable to clean the front surfaces of the optical lenses within the sensing chamber at the first convenient opportunity, as described below. The tools required for this cleaning are: an intense concentrated light source (e.g., flash light) to view the inside of the sensing chamber, denatured alcohol, a soft lint-free cloth, and the special cleaning tool provided with the DataRAM 4 consisting of a cut-off cotton swab inserted in a plastic sleeve and held by a right-angle Allen wrench.

Proceed as follows to clean the lens surfaces within the sensing chamber:

- **Make sure to shut off power completely before proceeding with cleaning**
- Install the stainless steel cover on the inlet of the DataRAM 4 to protect this fitting.
- Place the DataRAM 4 upside down on a table, resting the instrument on the inlet cover and the rear protective bumper.
- Unscrew the gray plastic cover of the filter cavity on the bottom surface of the DataRAM 4.
- Remove the filter cartridge from its cavity.
- Carefully clean the black soft filter-sealing gasket within the filter cavity by wiping it with the lint-free soft cloth. Use alcohol if necessary.
- Shine the concentrated light source into the sensing chamber located about 3 cm (1¼ in.) beyond the soft-sealing gasket in the filter cavity.
- Locate the three smaller side cavities inside the sensing chamber, identified by the arrows on that figure (see page 6). These three cavities contain the lenses of the two sources and the common detector of the DataRAM 4. The frontal surfaces of these lenses are likely to require cleaning if the instrument indicates BACKGROUND HIGH.
- Wet the cotton swab of the lens-cleaning tool with alcohol (e.g., methanol, ethanol, or rubbing alcohol).

- Holding the cleaning tool by its long handle, insert this tool into the sensing chamber without touching the walls of this chamber.
- Direct the cotton swab tip towards the opening of one of the three smaller cavities as indicated by the arrows of the figure below, and insert the cotton tip into this cavity as far as it will go. Gently wipe that internal surface touched by the swab tip by a rotating motion. Carefully withdraw the swab tip from the cavity.
- Repeat previous cleaning step for the other two small cavities.
- Carefully remove the cleaning tool from the sensing chamber. Allow the alcohol to dry leaving the filter cavity open for about 15 minutes.
- Re-insert the filter cartridge into its cavity and close it with its gray plastic cover, hand-tightening it firmly. Remove the inlet cap and store on its pod on the back panel.
- Place the DataRAM 4 right side up and key ON. Proceed to check its optical background by running the ZERO/INITIALIZE check as. The message READY! should appear at the end of this check indicating that the lens contamination has been eliminated. Should the message BACKGROUND HIGH persist after completion of the above-described lens cleaning procedure, please contact the factory.

Lens cleaning tool and bottom view of open filter cavity showing location of sensor chamber lens cavities (arrows).



FACTORY CALIBRATION

For mass concentration measurements, each DataRAM 4 is factory calibrated against a set of reference monitors that, in turn, are periodically calibrated against a gravimetric standard traceable to the National Institute of Standards and Testing (NIST).

The primary factory reference method consists of generating a dust aerosol by means of a fluidized bed generator, and injecting continuously the dust into a mixing chamber from which samples are extracted concurrently by two reference filter collectors and by two master real-time monitors that are used for the routine calibration of every DataRAM 4.

The primary dust concentration reference value is obtained from the weight increase of the two filters due to the dust collected over a measured period of time, at a constant and known flow rate. The two master real-time monitors are then adjusted to agree with the reference mass concentration value (obtained from averaging the measurements of the two gravimetric filters) to within ±1%.

Three primary, NIST traceable, measurements are involved in the determination of the reference mass concentration: the weight increment from the dust collected on the filter, the sampling flow rate, and the sampling time. Additional conditions that must be met are: a) suspended dust concentration uniformity at all sampling inlets of the mixing chamber; b) identical sample transport configurations leading to reference and instrument under calibration; and c) essentially 100% collection efficiency of filters used for gravimetric reference for the particle size range of the test dust.

The test dust used for the MIE factory calibration of the DataRAM 4 is SAE Fine (ISO Fine) supplied by Powder Technology, Inc. It has the following physical characteristics (as dispersed into the mixing chamber):

- Mass median aerodynamic particle diameter: 2 to 3 µm
- Geometric standard deviation of lognormal size distribution: 2.5
- Bulk density: 2.60 to 2.65 g/cm3
- Refractive index: 1.54

In addition to the mass calibration described above, the DataRAM 4 is factory calibrated using a gas with known scattering coefficient in order to adjust the relative scattering irradiance at the two source wavelengths.

ATTACHMENTS

None

TurnKey
Environmental
Restoration, LLC

FIELD OPERATING PROCEDURES

Field Quality Control Procedures

FOP 085.0

FIELD QUALITY CONTROL PROCEDURES

PURPOSE

In addition to traditional environmental samples (e.g., soil, groundwater, wipe, vapor etc.) described in each project work plan, site-specific field quality assurance/quality control (QA/QC) samples are typically collected and analyzed to support the required third-party data usability assessment effort of a project. Site-specific QA/QC samples generally include matrix spikes, matrix spike duplicates, blind duplicates (where appropriate), and trip blanks which accompany aqueous volatile organic compound (VOC) samples only.

The number of QA/QC field samples (blind duplicate, matrix spike/matrix spike duplicate, trip blank, field blank, or equipment blank) will be designated prior to field mobilization, but final QC sample locations will be contingent upon field conditions. This procedure outlines and discusses each QA/QC sample that may be required during a project.

PROCEDURE

A brief summary of each QA/QC sample identified above is presented below. Where appropriate, the procedure to be used to collect these samples is also presented.

- **Trip Blanks** – A sufficient number of trip blanks for VOC analysis must be prepared by the laboratory and delivered to the sampling team prior to a sampling event, typically two or three 40-ml VOA vials with organic free reagent water. One sealed blank will be carried into the field per day along with the sample containers for each day that water matrix volatile organic samples are collected. Trip blanks will be transported and handled in the same manner as the actual samples. The results of the trip blank analysis will be reviewed to evaluate if the potential for sample contamination during transportation and handling exists. The trip blanks will be analyzed for the same VOCs (and method) as the project groundwater samples.

- **Blind Duplicate** – One blind duplicate must be collected and analyzed per 20 samples collected per matrix (i.e., soil, groundwater, soil vapor, etc.). The location of the sample collection point will not be disclosed to the analytical laboratory, therefore the field sample containers will be returned to the laboratory identified only as the "blind duplicate." The well or sample location will be recorded in the Project Field Book or handheld RuggedReader® Pocket PC and on the field data sheets, and the results will be compared to review analytical precision. Sample analysis will be identical to the original sample per the project work plan. The Blind Duplicate sample must be collected simultaneously from the same source under identical conditions as the original sample.

- **Matrix Spike/Matrix Spike Duplicate (MS/MSD)** – A sufficient volume of sample will be collected at one sampling location per sampling event for MS/MSD analysis per matrix (i.e., soil and groundwater only). The laboratory will report the results of the MS/MSD analysis, which will be reviewed for sampling and analysis precision and accuracy. Sample analysis will be identical to the original sample per the project work plan. The MS/MSD sample must be collected simultaneously from the same source under identical conditions as the original sample.

- **Equipment (Rinsate) Blank** – In general, dedicated sampling equipment is used to minimize field decontamination time and avoid the need for equipment blanks; however there may be instances where the use of non-dedicated equipment cannot be avoided. An equipment blank will be collected for each day of sampling activity when non-dedicated sampling equipment is used. These equipment blank samples will be used as a QC check of the decontamination procedures for sampling equipment. Sample analysis for the equipment blank will consist of the most comprehensive parameter list used for risk assessment in which the non-dedicated equipment was used for environmental sample collection. During most projects, every effort to use dedicated sampling equipment should be made in order to minimize field decontamination time and avoid the need for equipment blanks. Equipment Blank sampling procedure is as follows:
    - Non-dedicated equipment are to be decontaminated in accordance with TurnKey's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures prior to use in the field. If organic-free

deionized water (generally provided by the laboratory) is not available for decontamination, equipment will be allowed to thoroughly air dry.
  - Once properly rinsed or allowed to air dry, analyte-free water (provided by the laboratory) is poured appropriately over or through the decontaminated sample collection device, collected in a sample container, and returned to the laboratory as a sample.

- **Field Blank** – A field blank is a sample of the unused final decontamination rinse water that is collected at the sampling site and returned to the laboratory as a sample. Sample analysis for the field blank will consist of the most comprehensive parameter list used during the investigation.

- **Split Sample** – A split sample is a sample that has been portioned into two or more containers from a single sample container or sample mixing container. Samples for VOC analysis should never be mixed prior to splitting.

- **Blank Wipe Samples** – There are two types of blank wipe samples, an equipment blank and a field blank that may be required per the project work plan, both are described below:
  - Equipment Blank – Required only if reusable templates are used for wipe sample collection. The decontaminated template is wiped with a hexane saturated swab. The swab is placed in the appropriate sample container and returned to the laboratory as a sample.
  - Field Blank – Clean disposable gloves are wiped with a hexane saturated swab. The swab is placed in the appropriate sample container and returned to the laboratory as a sample.

REFERENCES

TurnKey FOPs:
040 Non-disposable and Non-dedicated Sampling Equipment Decontamination

APPENDIX G

ELECTRONIC COPY OF WORK PLAN