BROWNFIELD CLEANUP PROGRAM

SITE MANAGEMENT PLAN

QUEEN CITY LANDING
NYSDEC SITE NUMBER: C915304
BUFFALO, NEW YORK

November 2018 0424-017-001

Prepared for:

APARTMENTS AT
QUEEN CITY LANDING

Queen City Landing
3275 North Benzing Road
Orchard Park, New York 14127

Prepared By:

BENCHMARK
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Revisions to Final Approved Site Management Plan:

Revision #	Submitted Date	Summary of Revision	DEC Approval Date

SITE MANAGEMENT PLAN
QUEEN CITY LANDING
BCP SITE NO. C915304

Certification Statement

I Thomas H. Forbes certify that I am currently a NYS registered professional engineer as in defined in 6 NYCRR Part 375 and that this November 2018 Site Management Plan was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

______________________________P.E.

11-21-18 Date

THOMAS H. FORBES
No. 70950-1

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List of Acronyms

AS	Air Sparging
ASP	Analytical Services Protocol
BCA	Brownfield Cleanup Agreement
BCP	Brownfield Cleanup Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CAMP	Community Air Monitoring Plan
C/D	Construction and Demolition
CFR	Code of Federal Regulation
CLP	Contract Laboratory Program
COC	Certificate of Completion
CO2	Carbon Dioxide
CP	Commissioner Policy
DER	Division of Environmental Remediation
EC	Engineering Control
ECL	Environmental Conservation Law
ELAP	Environmental Laboratory Approval Program
ERP	Environmental Restoration Program
EWP	Excavation Work Plan
FOP	Field Operating Procedure
GHG	Green House Gas
GWE&T	Groundwater Extraction and Treatment
HASP	Health and Safety Plan
IC	Institutional Control
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Codes, Rules, and Regulations
O&M	Operations and Maintenance
OM&M	Operation, Maintenance and Monitoring
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PID	Photoionization Detector
PRP	Potentially Responsible Party
PRR	Periodic Review Report
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RAWP	Remedial Action Work Plan

List of Acronyms

RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RP	Remedial Party
RSO	Remedial System Optimization
SAC	State Assistance Contract
SCG	Standards, Criteria, and Guidelines
SCO	Soil Cleanup Objective
SMP	Soil Management Plan
SOP	Standard Operating Procedures
SOW	Statement of Work
SPDES	State Pollutant Discharge Elimination System
SSD	Sub-slab Depressurization
SVE	Soil Vapor Extraction
SVI	Soil Vapor Intrusion
SVMS	Soil Vapor Mitigation System
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VCA	Voluntary Cleanup Agreement
VCP	Voluntary Cleanup Program

EXECUTIVE SUMMARY

The following provides a brief summary of the controls implemented for the Site, as well as the inspections, monitoring, maintenance and reporting activities required by this Site Management Plan:

Site Identification:	BCP Site No. C915304 Queen City Landing 975 and 1005 Fuhrmann Boulevard

Institutional Controls:	1. The property may be used for restricted residential, commercial, and industrial use;
	2. A periodic certification of institutional and engineering controls in accordance with Part 375-1.8 will be required.
	3. Requires compliance with the NYSDEC approved Site Management Plan;
	4. ECs (cover system) must be inspected at a frequency and in a manner defined in the SMP.
	5. Restricts the use of groundwater as a source of potable water or process water without necessary water quality treatment as determined by NYSDOH or Erie County DOH.
Engineering Controls:	1. Cover system
Inspections:	Frequency
1. Cover inspection	Annually
Monitoring	Frequency
1. Groundwater Monitoring Wells MW-1, -4, -6, and -7	Annually
Maintenance:	
1. Cover System	As needed
Reporting:	
1. Periodic Review Report	Annually

Further descriptions of the above requirements are provided in detail in the latter sections of this Site Management Plan

1.0 INTRODUCTION

1.1 General

This Site Management Plan (SMP) is a required element of the remedial program for the Queen City Landing (QCL) Site located in Buffalo, New York (hereinafter referred to as the "Site"), see Figure 1. The Site is currently in the New York State (NYS) Brownfield Cleanup Program (BCP) Site No. C915304 which is administered by New York State Department of Environmental Conservation (NYSDEC).

Queen City Landing, LLC entered into a Brownfield Cleanup Agreement (BCA) on June 29, 2016 with the NYSDEC to remediate the site. A figure showing the site location and boundaries of this Site is provided in Figure 2. The boundaries of the site are more fully described in the metes and bounds site description that is part of the Environmental Easement provided in Appendix A.

After completion of the remedial work, some contamination was left at this Site, which is hereafter referred to as "remaining contamination." Institutional and Engineering Controls (ICs and ECs) have been incorporated into the site remedy to control exposure to remaining contamination to ensure protection of public health and the environment. An Environmental Easement granted to the NYSDEC, and recorded with the Erie County Clerk, requires compliance with this SMP and all ECs and ICs placed on the site.

This SMP was prepared to manage remaining contamination at the site until the Environmental Easement is extinguished in accordance with ECL Article 71, Title 36. This plan has been approved by the NYSDEC, and compliance with this plan is required by the grantor of the Environmental Easement and the grantor's successors and assigns. This SMP may only be revised with the approval of the NYSDEC.

It is important to note that:

- This SMP details the site-specific implementation procedures that are required by the Environmental Easement. Failure to properly implement the SMP is a violation of the Environmental Easement, which is grounds for revocation of the Certificate of Completion (COC);
- Failure to comply with this SMP is also a violation of Environmental Conservation Law, 6NYCRR Part 375 and the BCA (Index #C915304-06-16; Site #C915304) for the site, and thereby subject to applicable penalties.

All reports associated with the site can be viewed by contacting the NYSDEC or its successor agency managing environmental issues in New York State. A list of contacts for persons involved with the site is provided in Appendix B of this SMP.

This SMP was prepared by Benchmark Environmental Engineering and Science, PLLC, on behalf of Queen City Landing, LLC, in accordance with the requirements of the NYSDEC's DER-10 ("Technical Guidance for Site Investigation and Remediation"), dated May 2010 (Ref. 1), and the guidelines provided by the NYSDEC. This SMP addresses the means for implementing the ICs and/or ECs that are required by the Environmental Easement for the site.

1.2 Revisions

Revisions to this plan will be proposed in writing to the NYSDEC's project manager. Revisions will be necessary upon, but not limited to, the following occurring: a change in media monitoring requirements, upgrades to or shut-down of a remedial system, post-remedial removal of contaminated sediment or soil, or other significant change to the site conditions. In accordance with the Environmental Easement for the site, the NYSDEC will provide a notice of any approved changes to the SMP and append these notices to the SMP that is retained in its files.

1.3 Notifications

Notifications will be submitted by the property owner to the NYSDEC, as needed, in accordance with NYSDEC's DER – 10 for the following reasons:

- 60-day advance notice of any proposed changes in site use that are required under the terms of the BCA, 6NYCRR Part 375 (Ref. 2) and/or Environmental Conservation Law.
- 7-day advance notice of any field activity associated with the remedial program.
- 15-day advance notice of any proposed ground-intrusive activity pursuant to the Excavation Work Plan.

- Notice within 48-hours of any damage or defect to the foundation, structures, or EC that reduces or has the potential to reduce the effectiveness of an EC, and likewise, any action to be taken to mitigate the damage or defect.
- Verbal notice by noon of the following day of any emergency, such as a fire; flood; or earthquake that reduces or has the potential to reduce the effectiveness of ECs in place at the site, with written confirmation within 7 days that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.
- Follow-up status reports on actions taken to respond to any emergency event requiring ongoing responsive action submitted to the NYSDEC within 45 days describing and documenting actions taken to restore the effectiveness of the ECs.

Any change in the ownership of the site or the responsibility for implementing this SMP will include the following notifications:

- At least 60 days prior to the change, the NYSDEC will be notified in writing of the proposed change. This will include a certification that the prospective purchaser/Remedial Party has been provided with a copy of the Brownfield Cleanup Agreement (BCA), and all approved work plans and reports, including this SMP.
- Within 15 days after the transfer of all or part of the site, the new owner's name, contact representative, and contact information will be confirmed in writing to the NYSDEC.

Table 1 below includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of site-related contact information is provided in Appendix B.

Table 1: Notifications*

Name	Contact Information
NYSDEC Project Manager Jaspal Walia, P.E.	716-851-7220 jaspal.walia@dec.ny.gov
NYSDEC Regional HW Engineer Chad Staniszewski, P.E.	716-851-7220 chad.staniszewski@dec.ny.gov
NYSDEC Site Control Kelly Lewandowski, P.E.	518-402-9543 kelly.lewandowski@dec.ny.gov
NYSDOH Bureau of Environmental Exposure Investigation	518-402-7860 beei@health.ny.gov

* Note: Notifications are subject to change and will be updated as necessary.

2.0 SUMMARY OF PREVIOUS INVESTIGATION & REMEDIAL ACTIONS

2.1 Site Location and Description

The Site is located in Buffalo, Erie County, New York and is identified as the eastern portion of Section 132.06 Block 1 and Lot 1.1 (975 Fuhrmann Boulevard, 7.24 acres) and Section 132.06 Block 1 and Lot 1.2 (1005 Fuhrmann Boulevard, 0.48 acres) on the Erie County Tax Map (see Figure 3). The Site is an approximately ±7.72-acres and is bounded by commercial property used for boat storage to the north, Lake Erie/Small boat Harbor to the south, Fuhrmann Boulevard to the east, and vacant land/Lake Erie to the west (see Figure 2 – Site Layout Map). The boundaries of the Site are more fully described in Appendix A – Environmental Easement. The owner(s) of the site parcel(s) at the time of issuance of this SMP is/are:

Queen City Landing, LLC, 3275 N. Benzing Road, Orchard Park, New York 14127

2.2 Physical Setting

2.2.1 Land Use

The Site is the former Freezer Queen facility and operated as a warehouse and manufacturer of frozen foods for approximately 75 years, when food operations ceased in 2004. The Site is undergoing redevelopment for a mixed residential and commercial use. The former structures have been demolished and the Site has been covered/grades raised to prepare for redevelopment activities. The Site was re-zoned in 2008 from M3 - Heavy Industrial to CM – General Commercial and this revised zoning is grandfathered from the terms of the City of Buffalo Green Code. There are no Site occupants at the time of the submittal of this SMP, but after redevelopment the anticipated occupants will be residential along with associated amenities (restaurant, and other commercial entities).

The properties adjoining the Site and in the surrounding area are primarily commercial and recreational properties. The properties immediately south of the Site include commercial and recreational properties; the properties immediately north of the Site include commercial property and Lake Erie; the properties immediately east of the Site include

Fuhrmann Boulevard and recreational properties; and the property to the west of the Site include vacant commercial and Lake Erie.

2.2.2 Geology

The subsurface conditions generally consist of fill material overlying native soil (silty clay). Two types of fill materials were generally encountered at the Site: urban fill and construction fill.

The heterogeneous urban fill is present at the Site at depths ranging from 8 to 17 feet below grade (fbg). The urban fill generally consists of various amounts of soil (silt, sand, clay and gravel), brick, concrete, wood, ceramics, and metal.

The construction fill was generally found below the urban fill in portions of the Site and was placed into Lake Erie to create the land that is the Site. This construction fill consists of fine to coarse sand and the depth varies in different areas of the Site. The construction fill was found in alternating intervals with urban fill and clay layers throughout the Site but was typically the last layer encountered before the native soil. In general, the construction fill was encountered at greater depths on the western-most portion of the Site and shallower depths on the eastern portion.

Native soil (silty clay) was only encountered in the eastern portion of the Site, beneath the construction fill at depths of approximately 9 feet to 13 fbg.

A geologic cross section is shown in Figure 4. Site specific subsurface logs are provided in Appendix C.

2.2.3 Hydrogeology

Groundwater is present at approximately 5 to 7 feet below grade (fbg). The presence of Lake Erie on three (3) sides of the Site has an effect on the groundwater flow. In general, groundwater flow is from the east to west with components of flow to the north (in the northern portion of the Site) and to the south (in the southern portions of the Site). Groundwater at the Site is not used for public drinking water supply.

A groundwater contour map is shown in Figure 5. Groundwater elevation data is provided in Table 2. Groundwater monitoring well construction logs are provided in Appendix C.

2.3 Investigation and Remedial History

The following narrative provides a remedial history timeline and a brief summary of the available project records to document key investigative and remedial milestones for the Site. Full titles for each of the reports referenced below are provided in Section 8.0 - References.

February 2008 – Phase II Environmental Site Assessment

WSP Environmental Strategies completed an investigation (Ref. 3) to assess concerns identified during a 2007 site visit. Five (5) of the nine (9) subsurface borings completed as part of the investigation were completed on the BCP Site. The following samples were submitted for analysis.

- Three soil/fill samples were submitted for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), and Target Analyte List (TAL) metals. Two samples were submitted for polychlorinated biphenyls (PCBs).
- Three groundwater samples were submitted for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), and Target Analyte List (TAL) metals.

The results of the soil/fill samples collected from the BCP Site were as follows.

- Acetone and methylene chloride were detected in the three samples submitted for analysis. The detected concentrations were below the NYSDEC Part 375 Restricted Residential Use Soil Cleanup Objectives (RRSCOs).
- SVOCs were detected in the three samples submitted for analysis. SVOCs exceeding their respective RRSCOs were detected at one sample location (B-11, 0 to 2 ft).
- Metal analytes were detected in the three samples submitted for analysis. Lead was the only analyte detected above its respective RRSCO at one location (B-12, 6 to 8 ft).
- No PCBs were detected above method detection limits.

The results of the groundwater samples collected from the BCP Site were as follows.

- No VOCs were detected above method detection limits.

- Two SVOCs were detected in one groundwater sample (MW-12) at concentrations above their respective groundwater quality standards.
- Metal analytes were detected in the three samples submitted for analysis. Arsenic, iron, magnesium, manganese and sodium were detected in the samples above their respective groundwater quality standards.

<u>September 2015 – Phase I Environmental Site Assessment</u>

AMD Environmental Consultants, Inc. (AMD) performed a Phase I (Ref. 4) on the BCP Site and identified the following recognized environmental conditions (RECs).

- Exterior and interior transformers were located throughout the facility.
- An abandoned water treatment facility was located on-site with a water treatment tank and associated underground apparatus still in-place.
- The area behind the existing building was used to house a metal warehouse building that was demolished.
- Construction debris from a previous demolition may contain possible asbestos containing materials.
- The area north of the building has two fill ports that could indicate the presence of underground tanks.
- There are miscellaneous drums, paint and unlabeled liquid waste throughout the building.
- Universal wastes (bulbs, ballasts, mercury devices) are located throughout the site.
- The site was filled with construction hard fill (concrete, bricks and slag).
- Numerous fuel tanks were on the property and previously removed.
- The basement area was flooded.

<u>November 2015 – Phase II Environmental Site Assessment</u>

AMD performed a Phase II ESA (Ref. 5) to assess the RECs identified during their Phase I. The work included assessment of subsurface soil/fill, water in the building basement, construction and demolition materials and the former water treatment area. The findings of the Phase II are as follows.

Six soil samples were collected from test pits completed at the Site.

- NYSDEC Spill No. 1509303 was opened for the Site after petroleum contamination was observed around the UST.

- Test pit samples collected contained at least one SVOC at concentrations that exceeded Restricted Residential Use SCOs.
- Four of the six samples contained concentrations of certain SVOCs at levels exceeding Commercial Use SCOs. One sample contained benzo(a)pyrene at a concentration exceeding Industrial Use SCOs.
- One soil sample collected from the test pits was also analyzed for RCRA metals. Barium and cadmium were detected at concentrations exceeding Commercial Use SCOs. Arsenic and lead were detected at concentrations exceeding Industrial Use SCOs.

Ten additional soil samples were collected from borings at the Site.

- One sample contained SVOCs at concentrations exceeding Residential Use and Restricted Residential Use SCOs.
- Selenium was detected at concentrations exceeding Unrestricted Use SCOs.

<u>March 2016 – Supplemental Phase II Environmental Site Assessment</u>

C&S Engineers, Inc. conducted a supplemental Phase II to further characterize soil/fill and groundwater conditions at the Site. Eight soil borings were completed to collect soil/fill samples and install eight groundwater monitoring wells. A total of 24 soil/fill samples and eight groundwater samples were collected. The findings of the C&S investigation were as follows.

- No VOCs or PCBs were detected in the soil samples.
- Ten soil samples collected from the urban and construction fill contained SVOCs that exceeded Restricted Residential Use and Commercial Use SCOs. The SVOCs detected at elevated concentrations included the PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.
- Four soil samples collected from the urban and construction fill exceeded Industrial Use SCO (ISCOs) for benzo(a)pyrene.
- Two urban fill samples contained pesticides above Unrestricted SCOs (USCOs) but below the RRSCOs.

- Metals such as arsenic, lead, mercury and zinc were detected in the urban and construction fill above USCOs but below the RRSCOs.
- One soil sample in the construction fill at 10 to 12 feet below grade exceeded the Commercial SCO (CSCO) for copper.
- One soil sample in the urban fill exceeded Industrial Use SCO for arsenic.
- Two groundwater samples exceed the groundwater quality standards for lead (guidance value 35 ug/L). Concentrations range from 25.7 to 41.9 ug/L, well below the generally applicable maximum acceptable objective of 1 ppm.
- Four groundwater samples exceeded the TOGS value for manganese (300 ug/L). Concentrations range from 318 to 870 ug/L.
- One groundwater sample slightly exceeded for benzene (1 ug/L) at 1.95 ug/L. No other VOCs exceeded the criteria.
- One groundwater sample exceeded the guidance value for naphthalene (10 ug/L) at 29.5 ug/L. No other SVOCs exceeded the criteria.

March 2016 – Remedial Investigation

C&S conducted a Remedial Investigation in accordance with a NYSDEC-approved Remedial Investigation/Interim Remedial Measures/Alternative Analysis Work Plan (RI/IRM/AA WP, Ref. 6). The RI included the performance of a geophysical survey and the sampling of surface soil/fill, subsurface fill material and native soil, groundwater, and outdoor air. The urban fill at the Site was found to contain concentrations of certain SVOCs and metals above the RRSCOs while the concentrations in the underlying construction fill and native soils were generally below the SCOs. Impacts to groundwater were minimal and the outdoor air samples did not identify a concern. The findings of the RI were documented in a RI Report (Ref. 7).

An area containing underground storage tanks and petroleum contamination were also identified and address as part of an Interim Remedial Measure as discussed below.

August 2017 – November 2017 – Interim Remedial Measure

An Interim Remedial Measure (IRM) was completed at the Site from August 2017 through November 2017 which was documented in an IRM Report (Ref. 8) submitted to NYSDEC in January 2018.

Petroleum excavation activities began on September 22, 2017 after waste characterization samples were collected and landfill disposal approval was received. Petroleum-impacted soil/fill excavation, transportation, and landfill disposal activities continued until October 24, 2017. The petroleum-impacted soil/fill was taken to the Tonawanda Landfill in Tonawanda, New York. Approximately 4,956 tons (3,098 cubic yards based on a conversion of 1.6 tons per cubic yard) of petroleum impacted soil/fill was excavated and taken to the landfill.

A total of three (3) underground storage tanks (USTs) were encountered during the IRM activities. The tanks were estimated to be 5,000-gallons in size. The USTs were filled with concrete/flowable fill which was emptied into the excavation, broken up with the excavator, and the contents disposed along with the petroleum-impacted soil/fill. No free product was observed and the water present was too minimal to be pumped out. The USTs were placed on polyethylene sheeting, cleaned, and taken off-site to be recycled.

The dimensions of the final excavation area were approximately 140 feet (north-south) by 130 feet (east-west) and varied in depth from 5 feet below ground surface (fbgs) on the southern side to approximately 9 fbgs on the northern side (see Figure 6).

Once the limits of the petroleum-impacted soil/fill excavation were reached, and the analytical results indicated that the petroleum-impacts had been removed, the excavation was backfilled. The excavation backfill consisted of crushed concrete from the former building and clay soil imported from the Quaker Crossing stockpile located on Amelia Drive in Orchard Park, New York. The concrete from the former building was processed and screened on-site in accordance with the NYSDEC-approved Crushed Concrete Management Plan (CCMP, Ref. 9). Concrete greater than ⅛-inch in size was used as backfill per the NYSDEC-approved (CCMP) Addendum (Ref. 10) and material less than ⅛-inch was taken off-site for landfill disposal. Approximately 4,420 tons of concrete material (2,210 cubic yards based on a conversion of 2 tons per cubic yards) were disposed off-site at Tonawanda Landfill. A NYSDEC Request to Import was submitted for the Quaker Crossing soil along with the required analytical testing which was approved for import to the Site by NYSDEC via email on October 3, 2017.

Based on visual evidence, olfactory evidence, headspace sample PID measurements, and the confirmatory sample analytical results, the IRM activities have properly addressed the removal of the USTs and petroleum-impacted soil/fill that was present in the northwestern portion of the Site.

May 2018 – Alternative Analysis

The findings of the RI and IRM were used to develop an Alternative Analysis Report (AAR, Ref. 11) by Benchmark. Based on the alternatives analysis completed, the recommended remedial approach for the Site is a Restricted Residential Use (Track 4) Cleanup. This alternative will be fully protective of public health and the environment; is significantly less disruptive to the community; is consistent with future land use; and represents a cost-effective approach while fully satisfying the RAOs for the Site. This alterative involved.

- Removal of: the PAH-impacted soil/fill present at Boundary-SS2 (less than 5 cubic yards); a soil/fill stockpile present in the vicinity of F6 (estimated at 240-280 tons); and petroleum-impacted soil/fill present in the vicinity of D7 (estimated 300 cubic yards). The impacted soil/fill will be disposed off-site at a commercial sanitary landfill. Samples will be collected from these removal activities to confirm the remedial actions have meet the remedial objectives.
- Backfilling of the excavation with material that will meet the requirements of 6NYCRR Part 375-6.7(d) or otherwise NYSDEC-approved material (e.g., crushed concrete greater than ⅛-inch from processing of the former on-site building).
- Site grades will need to be raised across the majority of the Site. The Site grades will be raised using existing on-site processed concrete (greater than ⅛-inch in size) and imported soil/fill material meeting the requirements of 6NYCRR Part 357-6.7(d).
- Placement of a DER-10 compliant cover system consisting of a 2-foot vegetated soil/fill cover across most of the Site and a concrete walking path and retaining wall (to stabilize fill remaining at depth and protect future site structures from erosion and/or sidewall collapse) along the southern portion. A demarcation layer (e.g., orange plastic netting) will be installed beneath the cover system that will be installed to meet the existing Site grades along the northern and eastern boundaries of the Site. The existing soil/fill in the northern and eastern areas will be excavated along the perimeter of the Site to create space for 2 feet of a compliant soil/fill cover. The

excavated material will be disposed off-site at a commercial sanitary landfill or used as on-site backfill underneath the 2-foot soil/fill cover system with NYSDEC approval.

- Implementation of a Site Management Plan (SMP). For any BCP Site not remediated to meet NYSDEC Part 375 USCOs, preparation of an SMP that describes site-specific Institutional Controls and/or Engineering Controls (IC/EC) is a required component of the final remedy. The SMP will include the following components: IC/EC Plan; Operations and Maintenance (O&M) Plan; Excavation Work Plan; Site Monitoring Plan; and Environmental Easement.

2018 – Post Decision Document Remedial Action & Cover System Installation

NYSDEC issued a Decision Document (Ref. 12) dated June 19, 2018 which approved the Restricted-Residential Use (Track 4) Cleanup remedial approach for the Site proposed in the AAR. A Remedial Action Work Plan (RAWP; Ref. 13) was submitted to NYSDEC on July 20th to implement remedial action and cover system installation and was approved on July 26, 2018.

As outlined in the AAR and RAWP, the remedial actions involved removal, landfill disposal and confirmatory sampling to address the following areas (see Figure 6).

- PAH-impacted soil/fill present at RI sampling location Boundary-SS2.
- Soil/fill stockpile present in the vicinity of F6.
- Petroleum-impacted soil/fill present in the vicinity of D7.

Upon the completion of these remedial actions, approximately 960 tons of impacted soil/fill were taken to the Tonawanda Landfill for disposal. Upon reaching the limits of the excavations completed in the vicinity of D7 and Boundary-SS2 and removal of the soil/fill stockpile in the vicinity of F6, confirmation samples were collected. As outlined in the RAWP, the cleanup criteria for the remedial actions are as follows:

- 6NYCRR Part 375 Restricted Residential Soil Cleanup Objectives (RRSCOs) for soil/fill present in the upper 2 feet of the Site;
- Arsenic - 24 mg/kg;
- Lead - 1,000 mg/kg;
- Chromium – 1,500 mg/kg; and
- Manganese – 10,000 mg/kg.

The results of the post-excavation confirmatory samples achieved the cleanup criteria established for the Site.

Another component of the Site remedy is the use of a cover system, as sampling results indicated that PAHs and metals are present in surface/near-surface soil/fill on-site above Part 375 RRSCOs. Therefore, placement of a cover system is a feasible engineering control to protect human health and the environment. The cover system is comprised of:

- **Non-Vegetated Areas:** These areas consist of a concrete retaining wall and walking path in the southern portion of the Site.
- **Vegetated Areas:** A minimum of 24 inches of imported backfill, tested and determined to meet RRSCOs will be placed (Quaker Crossing Plaza stockpile). The uppermost approximate 6-inches is comprised of topsoil capable of sustaining plant growth.
- **2-inch Crushed Stone Area:** These areas consist of a construction roadway, proposed building footprint and proposed parking areas. One (1) foot of 2-inch crushed stone was placed on top of 1 foot of soil imported from the Quaker Crossing Plaza stockpile.
- **Demarcation Layer:** A demarcation layer (e.g., orange plastic mesh) was placed beneath the cover system installed.

Figure 9 shows a layout of the cover system areas that were installed. The cover system thickness was verified by pre- and post-cover construction elevation survey. Figure 10 identifies the cover system thickness which verify that a minimum of 2 feet of cover was installed in the non-hardscape areas.

2.4 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the Site as listed in the Decision Document dated June 19, 2018 are as follows:

2.4.1 Soil:

RAOs for Public Health Protection

- Prevent ingestion/direct contact with contaminated soil/fill.

RAOs for Environmental Protection

- Prevent migration of contaminants that would result in groundwater or surface water contamination.

2.4.2 Groundwater:

RAOs for Public Health Protection

- Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.

RAOs for Environmental Protection

- Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.

2.5 Remaining Contamination

2.5.1 Soil

The previous investigations completed at the Site have identified a substantial amount of the urban fill and construction fill material at the Site. Typical of urban fill, SVOCs (specifically polycyclic aromatic hydrocarbons (PAHs)) and metals (chromium, lead, arsenic manganese, copper and mercury) have been identified in the urban fill at concentrations exceeding the RRSCOs. Due to the heterogeneous nature of the urban fill at the Site, the contaminant class (PAHs and metals) and the concentrations detected vary across the Site as well as with depth.

Table 3 presents a summary of the surface soil/fill sample results that exceed the USCO and RRSCOs from the RI. Table 4 and 5 present a summary of the subsurface soil/fill results that exceed the USCO and RRSCO from the RI. Figure 7 identifies the locations of soil/fill present at the Site containing contamination above its respective USCOs.

To meet the grades along the northern, eastern, southeastern and southern boundaries of the BCP Site, existing soil/fill was excavated and reused on-site below the demarcation/cover system to allow a minimum of a 2-foot cover system to be installed in those areas and meet the grades of the surrounding property or sea wall (along the southern boundary). Existing soil/fill generated from the Site grading activities was reused on-site so long as it was not grossly impacted and/or exhibited elevated photoionization detector (PID) readings, as there were areas of the Site that required filling to achieve the deign grades prior to installation of the cover system.

To achieve the cover system design grades and proposed redevelopment, a substantial amount of NYSDEC-approved fill material (crushed concrete greater than ⅛-inch from the processing of the former building in accordance with the CCMP and CCMP Addendum, soil from Quaker Crossing Plaza stockpile, and existing Site soil/fill) was used to raise the grades at the Site, prior to installing the cover system. These fill materials raised the grades of the Site on average 3 to 4 feet from the former grade at the time of the RI in the central portion of the Site. Prior to installation of the cover system, a demarcation layer was placed. The demarcation layer was placed a minimum of 2 feet below the soil cover system areas.

2.5.2 Groundwater

Two (2) groundwater sampling events were completed at the Site in March 2016 and February 2017 as part of the RI.

Low-level contamination was detected during the sampling events and consisted primarily of VOCs, SVOCs and metals. Table 6 is a summary of the groundwater sampling results and Figure 8 shows the locations with contaminants exceeding their respective GWQSs. The results are discussed below by class, but the detected concentrations are not considered to be a concern at the Site.

<u>VOCs</u>

VOCs were detected in four (4) and six (6) of the nine (9) groundwater monitoring wells sampled during the first (March 30, 2016) and second (February 7, 2017) sampling events, respectively. Analytes detected at concentrations exceeding GWQS included the following:

- Benzene in MW-1 during both events at concentrations of 1.95 ug/l and 4.2 ug/l in the 2016 and 2017 event, respectively.

- Methyl tert buytl ether (MTBE) in MW-7 during both events at concentrations of 20.7 ug/l and 39 ug/l in the 2016 and 2017 event, respectively.
- Naphthalene in MW-7 during the first event in 2016 at a concentration of 29.5 ug/l.
- Dichlorodifluoromethane and acetone were detected in MW-9 during the second event in 2017 at concentrations of 10 ug/l and 52 ug/l, respectively.

<u>SVOCs</u>

SVOCs were detected in two (2) and nine (9) of the nine (9) groundwater monitoring wells during the first and second sampling events in 2016 and 2017, respectively. Naphthalene was the only SVOC detected above its respective GWQS (10 ug/l) at a concentration of 23 ug/l at MW-7 during the 2016 event.

SVOCs detected above their respective GWQS during the 2017 sampling event are as follows:

- Benzo(a)anthracene was detected in eight (8) of the nine (9) wells sampled at concentrations above its respective GWQS (0.002 ug/l) at concentrations ranging from 0.03 ug/l (MW-5, -6, and -7) and 0.12 ug/l (MW-4).
- Benzo(a)pyrene was detected in three (3) of the nine (9) wells sampled at concentrations above its respective GWQS (non-detect) at concentrations of 0.08 ug/l (MW-1), 0.05 ug/l (MW-2) and 0.01 ug/l (MW-4).
- Benzo(b)fluoranthene was detected in seven (7) of the nine (9) wells sampled at concentrations above its respective GWQS (0.002 ug/l) at concentrations ranging from 0.03 ug/l (MW-5, and -8) and 0.13 ug/l (MW-4).
- Benzo(k)fluoranthene was detected in two (2) of the nine (9) wells sampled at concentrations above its respective GWQS (0.002 ug/l) at concentrations of 0.04 ug/l (MW-1) and 0.05 ug/l (MW-4).
- Chrysene was detected in four (4) of the nine (9) wells sampled at concentrations above its respective GWQS (0.002 ug/l) at concentrations ranging from 0.06 ug/l (MW-2) and 0.13 ug/l (MW-4).

- Indeno(1,2,3-cd)pyrene was detected in three (3) of the nine (9) wells samples at concentrations above its respective GWQS (0.002 ug/l) at concentrations ranging from 0.04 ug/l (MW-2) and 0.08 ug/l (MW-4).

Metals

Metal analytes were detected in each of the nine (9) groundwater wells sampled during both events. During the first sampling event (2016), analytes detected at concentrations exceeding the criteria included lead in two (2) sample locations (MW-2 and MW-4) and manganese in four (4) sample locations (MW-1, -2, -4, and -5). During the second event (2017), analytes detected at concentrations exceeding their respective GWQS included the following:

- Iron was detected in eight (8) of the nine (9) sample locations above its respective GWQS (300 ug/l). The location where lead did not exceed its GWQS was MW-6. Lead was not analyzed for during the 2016 sampling event.
- Magnesium was detected in three (3) of the nine (9) sample locations above its respective GWQS (35,000 ug/l). These locations were MW-1 (48,300 ug/l), MW-5 (35,600 ug/l), and MW-8 (97,800 ug/l). Magnesium was not analyzed for during the 2016 sampling event.
- Sodium in eight (8) of the nine (9) sample locations above its respective GWQS (20,000 ug/l). The location lead did not exceed its GWQS was MW-6. Sodium was not analyzed for during the 2016 sampling event.

No PCBs, pesticides or herbicides were detected above method detection limits.

3.0 INSTITUTIONAL & ENGINEERING CONTROL PLAN

3.1 General

Since remaining contamination exists at the Site, Institutional Controls (ICs) and Engineering Controls (ECs) are required to protect human health and the environment. This IC/EC Plan describes the procedures for the implementation and management of all IC/ECs at the site. The IC/EC Plan is one component of the SMP and is subject to revision by the NYSDEC.

This plan provides:

- A description of all IC/ECs on the site;
- The basic implementation and intended role of each IC/EC;
- A description of the key components of the ICs set forth in the Environmental Easement;
- A description of the controls to be evaluated during each required inspection and periodic review;
- A description of plans and procedures to be followed for implementation of IC/ECs, such as the implementation of the Excavation Work Plan (EWP) (as provided in Appendix D) for the proper handling of remaining contamination that may be disturbed during maintenance or redevelopment work on the site; and
- Any other provisions necessary to identify or establish methods for implementing the IC/ECs required by the site remedy, as determined by the NYSDEC.

3.2 Institutional Controls

A series of ICs is required by the Decision Document to: (1) implement, maintain and monitor Engineering Control systems; (2) prevent future exposure to remaining contamination; and, (3) limit the use and development of the site to restricted residential, commercial, and industrial uses only. Adherence to these ICs on the Site is required by the Environmental Easement and will be implemented under this SMP. ICs identified in the Environmental Easement may not be discontinued without an amendment to or extinguishment of the Environmental Easement. The IC boundaries are shown on Figure 2 and 3. These ICs are:

- The property may be used for restricted residential; commercial, industrial use;
- All ECs must be operated and maintained as specified in this SMP;
- All ECs must be inspected at a frequency and in a manner defined in the SMP.
- The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the Erie County Department of Health to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department.
- Data and information pertinent to site management must be reported at the frequency and in a manner as defined in this SMP;
- All future activities that will disturb remaining contaminated material must be conducted in accordance with this SMP;
- Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical component of the remedy shall be performed as defined in this SMP;
- Access to the site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by the Environmental Easement; and
- Vegetable gardens and farming on the site are prohibited;

3.3 Engineering Controls

3.3.1 Cover (or Cap)

Exposure to remaining contamination at the Site is prevented by a cover system placed over the Site. This cover system is comprised of a minimum of 24-inches of clean soil and a minimum of 6-inches of hardscape (e.g., asphalt pavement, concrete-covered walkway, and concrete retaining wall). Figure 9 presents the location of the cover system and applicable demarcation layers. The Excavation Work Plan (EWP) provided in Appendix D outlines the procedures required to be implemented in the event the cover system is breached, penetrated, or temporarily removed, and any underlying remaining contamination is disturbed. Procedures for the inspection of this cover are provided in the Monitoring and Sampling Plan included in Section 4.0 of this SMP. Any work conducted pursuant to the EWP must also be conducted in accordance with the procedures defined in a Health and Safety Plan (HASP) and associated Community Air Monitoring Plan (CAMP) prepared for the Site and provided in Appendix E.

Figure 9 shows the location of the ECs for the site.

3.3.2 Criteria for Completion of Remediation/Termination of Remedial Systems

Generally, remedial processes are considered completed when monitoring indicates that the remedy has achieved the remedial action objectives identified by the decision document. The framework for determining when remedial processes are complete is provided in Section 6.4 of NYSDEC DER-10.

3.3.2.1 Cover (or Cap)

The composite cover system is a permanent control and the quality and integrity of this system will be inspected at defined, regular intervals in accordance with this SMP in perpetuity.

4.0 MONITORING AND SAMPLING PLAN

4.1 General

This Monitoring and Sampling Plan describes the measures for evaluating the overall performance and effectiveness of the remedy. This Monitoring and Sampling Plan may only be revised with the approval of the NYSDEC. Details regarding the sampling procedures, data quality usability objectives, analytical methods, etc. for all samples collected as part of site management for the site are included in the Quality Assurance Project Plan provided in Appendix I.

This Monitoring and Sampling Plan describes the methods to be used for:

- Sampling and analysis of all appropriate media (e.g., groundwater);
- Assessing compliance with applicable NYSDEC standards, criteria and guidance (SCGs), particularly groundwater standards; and
- Evaluating site information periodically to confirm that the remedy continues to be effective in protecting public health and the environment;

To adequately address these issues, this Monitoring and Sampling Plan provides information on:

- Sampling locations, protocol and frequency;
- Information on all designed monitoring systems;
- Analytical sampling program requirements;
- Inspection and maintenance requirements for monitoring wells;
- Monitoring well decommissioning procedures; and
- Annual inspection and periodic certification.

Reporting requirements are provided in Section 7.0 of this SMP.

4.2 Site-Wide Inspection

Site-wide inspections will be performed at a minimum of once per year. Modification to the frequency or duration of the inspections will require approval from the NYSDEC. Site-wide inspections will also be performed after all severe weather conditions that may affect ECs or monitoring devices. During these inspections, an inspection form will be completed as provided in Appendix F – Site Management Forms. The form will compile sufficient information to assess the following:

- Compliance with all ICs, including site usage;
- An evaluation of the condition and continued effectiveness of ECs;
- General site conditions at the time of the inspection;
- The site management activities being conducted including, where appropriate, confirmation sampling and a health and safety inspection; and
- Confirm that site records are up to date.

Inspections of all remedial components installed at the site will be conducted. A comprehensive site-wide inspection will be conducted and documented according to the SMP schedule, regardless of the frequency of the Periodic Review Report. The inspections will determine and document the following:

- Whether ECs continue to perform as designed;
- If these controls continue to be protective of human health and the environment;
- Compliance with requirements of this SMP and the Environmental Easement;
- Achievement of remedial performance criteria; and
- If site records are complete and up to date; and

Reporting requirements are outlined in Section 7.0 of this plan.

Inspections will also be performed in the event of an emergency. If an emergency, such as a natural disaster or an unforeseen failure of any of the ECs occurs that reduces or has the potential to reduce the effectiveness of ECs in place at the site, verbal notice to the NYSDEC must be given by noon of the following day. In addition, an inspection of the site will be conducted within 5 days of the event to verify the effectiveness of the IC/ECs implemented at the site by a qualified environmental professional, as determined by the NYSDEC. Written confirmation must be provided to the NYSDEC within 7 days of the event that includes a summary of actions taken, or to be taken, and the potential impact to the environment and the public.

4.3 Post-Remediation Media Monitoring and Sampling

Groundwater samples shall be collected from the Site. The sampling locations, required analytical parameters, and schedule are provided in Table 9 – Post Remediation Sampling Requirements and Schedule. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

Detailed sample collection and analytical procedures and protocols are provided in Appendix H – Field Activities Plan and Appendix I – Quality Assurance Project Plan.

4.4.3 Groundwater Sampling

Groundwater monitoring will be performed annually to assess the performance of the remedy. Modification to the frequency or sampling requirements will require approval from the NYSDEC.

Four (4) existing monitoring wells has been selected to monitor the groundwater conditions at the Site: MW-1, MW-4, MW-6 and MW-7. These four (4) wells have been selected based on their location near petroleum removal activities completed at the Site (MW-1 and MW-4), upgradient location (MW-6), and downgradient location (MW-7).

The monitoring wells locations are shown on Figure 5 and the monitoring wells elevation and depths and included on Table 2. Monitoring well construction logs are included in Appendix C of this document.

If biofouling or silt accumulation occurs in the on-site and/or off-site monitoring wells, the wells will be physically agitated/surged and redeveloped. Additionally, monitoring wells will be properly decommissioned and replaced, if an event renders the wells unusable.

Repairs and/or replacement of wells in the monitoring well network will be performed based on assessments of structural integrity and overall performance.

The NYSDEC will be notified prior to any repair or decommissioning of any monitoring well for the purpose of replacement, and the repair or decommissioning and replacement process will be documented in the subsequent Periodic Review Report. Well decommissioning without replacement will be done only with the prior approval of the NYSDEC. Well abandonment will be performed in accordance with NYSDEC's guidance entitled "CP-43: Groundwater Monitoring Well Decommissioning Procedures." Monitoring wells that are decommissioned because they have been rendered unusable will be replaced in kind in the nearest available location, unless otherwise approved by the NYSDEC.

The sampling frequency may only be modified with the approval of the NYSDEC. This SMP will be modified to reflect changes in sampling plans approved by the NYSDEC.

Deliverables for the groundwater monitoring program are specified in Section 7.0 – Reporting Requirements.

4.3.1 Vapor Intrusion Evaluation/Sampling

Currently there are no structures on the Site. An evaluation for vapor intrusion sampling will be completed, in consultation with the NYSDEC and NYSDOH, for any new structure(s) built on the Site. This evaluation will take into consideration, location, occupancy, construction (i.e., slab-on-grade, vapor barrier installation, open-air parking structure, etc.) and will be used to determine if vapor intrusion sampling is necessary.

If the evaluation determines that vapor intrusion sampling is required, the sampling will be completed in accordance with the NYSDOHs *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* dated October 2006 (and subsequent updates).

5.0 OPERATION & MAINTENANCE PLAN

5.1 General

The site remedy does not rely on any mechanical systems, such as groundwater treatment systems, sub-slab depressurization systems or air sparge/soil vapor extraction systems to protect public health and the environment. Therefore, the operation and maintenance of such components is not included in this SMP.

6.0 PERIODIC ASSESSMENTS/EVALUATIONS

6.1 Climate Change Vulnerability Assessment

Increases in both the severity and frequency of storms/weather events, an increase in sea level elevations along with accompanying flooding impacts, shifting precipitation patterns and wide temperature fluctuation, resulting from global climactic change and instability, have the potential to significantly impact the performance, effectiveness and protectiveness of a given site and associated remedial systems. Vulnerability assessments provide information so that the site and associated remedial systems are prepared for the impacts of the increasing frequency and intensity of severe storms/weather events and associated flooding.

The Site is considered to have low vulnerability related to climatic conditions. It will not employ any remedial systems reliant upon electrical power; will be serviced by a municipal storm drainage system; and will not incorporate any petroleum or chemical bulk storage in the redevelopment. A retaining wall was installed along the southern portion of the Site and the grades were raised prior to installation of the cover system, to prevent flooding from storm surges along the southern boundary with Lake Erie. Consequently, acute cap erosion resultant in potential exposure to remaining impacted soil/fill is unlikely.

6.2 Green Remediation Evaluation

NYSDEC's DER-31 Green Remediation requires that green remediation concepts and techniques be considered during all stages of the remedial program including site management, with the goal of improving the sustainability of the cleanup and summarizing the net environmental benefit of any implemented green technology. This section of the SMP provides a summary of any green remediation evaluations to be completed for the site during site management, and as reported in the Periodic Review Report (PRR).

The only engineering control established for the Site is the cover system. No other remedial components are expected or anticipated. The maintenance of cover system is not anticipated to generate additional waste, use energy, produce emissions, require substantial water for to promote vegetative cover growth, and/or affect any ecosystem. (Site is located in a developed area along the City of Buffalo's outer harbor).

However, NYSDEC has approved a Beneficial Use Determination, whereas the concrete greater than 1/8-inch generated from the demolition and crushing of the Site building, was reused as backfill raise the grades at the Site in preparation for redevelopment.

6.2.1 Timing of Green Remediation Evaluations

For major remedial system components, green remediation evaluations and corresponding modifications will be undertaken as part of a formal Remedial System Optimization (RSO), or at any time that the Project Manager feels appropriate, e.g. during significant maintenance events or in conjunction with storm recovery activities. As the only engineering control implemented at the Site is the cover system, we do not anticipate additional green remediation evaluations.

6.3 Remedial System Optimization

A Remedial Site Optimization (RSO) study will not be required as there are no active remedial systems. The only engineering control at the Site is the cover system.

7.0 REPORTING REQUIREMENTS

7.1 Site Management Reports

All site management inspection, maintenance, and monitoring events will be recorded on the appropriate site management forms provided in Appendix F. These forms are subject to NYSDEC revision.

All applicable inspection forms and other records, including media sampling data and system maintenance reports, generated for the site during the reporting period will be provided in electronic format to the NYSDEC in accordance with the requirements of Table 7 and summarized in the Periodic Review Report.

Table 7: Schedule of Interim Monitoring/Inspection Reports

Task/Report	Reporting Frequency*
Cover System Inspection Report	Annually
Groundwater Monitoring	Annually – subject to evaluation after year 1
Periodic Review Report	Annually, or as otherwise determined by the Department

* The frequency of events will be conducted as specified until otherwise approved by the NYSDEC.

All interim monitoring/inspections reports will include, at a minimum:

- Date of event or reporting period;
- Name, company, and position of person(s) conducting monitoring/inspection activities;
- Description of the activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet);
- Type of samples collected (e.g., sub-slab vapor, indoor air, outdoor air, etc.);

- Copies of all field forms completed (e.g., well sampling logs, chain-of-custody documentation, etc.);
- Sampling results in comparison to appropriate standards/criteria;
- A figure illustrating sample type and sampling locations;
- Copies of all laboratory data sheets and the required laboratory data deliverables required for all points sampled (to be submitted electronically in the NYSDEC-identified format);
- Any observations, conclusions, or recommendations; and
- A determination as to whether contaminant conditions have changed since the last reporting event.

Routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting maintenance activities;
- Description of maintenance activities performed;
- Any modifications to the system;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents noted (included either on the checklist/form or on an attached sheet); and,
- Other documentation such as copies of invoices for maintenance work, receipts for replacement equipment, etc., (attached to the checklist/form).

Non-routine maintenance event reporting forms will include, at a minimum:

- Date of event;
- Name, company, and position of person(s) conducting non-routine maintenance/repair activities;
- Description of non-routine activities performed;
- Where appropriate, color photographs or sketches showing the approximate location of any problems or incidents (included either on the form or on an attached sheet); and

- Other documentation such as copies of invoices for repair work, receipts for replacement equipment, etc. (attached to the checklist/form).

Data will be reported in digital format as determined by the NYSDEC. Currently, data is to be supplied electronically and submitted to the NYSDEC EQuIS™ database in accordance with the requirements found at this link **http://www.dec.ny.gov/chemical/62440.html**.

7.2 Periodic Review Report

A Periodic Review Report (PRR) will be submitted to the Department beginning sixteen (16) months after the Certificate of Completion is issued. After submittal of the initial Periodic Review Report, the next PRR shall be submitted annually to the Department or at another frequency as may be required by the Department. In the event that the Site is subdivided into separate parcels with different ownership, a single Periodic Review Report will be prepared that addresses the site described in Appendix A -Environmental Easement. The report will be prepared in accordance with NYSDEC's DER-10 and submitted within 30 days of the end of each certification period. Media sampling results will also be incorporated into the Periodic Review Report. The report will include:

- Identification, assessment, and certification of all ECs/ICs required by the remedy for the site.
- Results of the required annual site inspections and severe condition inspections, if applicable.
- All applicable site management forms and other records generated for the site during the reporting period in the NYSDEC-approved electronic format, if not previously submitted.
- A summary of any discharge monitoring data and/or information generated during the reporting period, with comments and conclusions.
- Data summary tables and graphical representations of contaminants of concern by media (groundwater, soil vapor, etc.), which include a listing of all compounds analyzed, along with the applicable standards, with all exceedances highlighted. These will include a presentation of past data as part of an evaluation of contaminant concentration trends.

- Results of all analyses, copies of all laboratory data sheets, and the required laboratory data deliverables for all samples collected during the reporting period will be submitted in digital format as determined by the NYSDEC. Currently, data is supplied electronically and submitted to the NYSDEC EQuIS™ database in accordance with the requirements found at this link: **http://www.dec.ny.gov/chemical/62440.html**
- A site evaluation, which includes the following:
  - The compliance of the remedy with the requirements of the site-specific RAWP, ROD or Decision Document;
  - The operation and the effectiveness of all treatment units, etc., including identification of any needed repairs or modifications;
  - Any new conclusions or observations regarding site contamination based on inspections or data generated by the Monitoring and Sampling Plan for the media being monitored;
  - Recommendations regarding any necessary changes to the remedy and/or Monitoring and Sampling Plan; and
  - Trends in contaminant levels in the affected media will be evaluated to determine if the remedy continues to be effective in achieving remedial goals as specified by the Decision Document.
  - The overall performance and effectiveness of the remedy.

7.2.1 Certification of Institutional and Engineering Controls

Following the last inspection of the reporting period, a qualified environmental professional or Professional Engineer licensed to practice in New York State will prepare, and include in the Periodic Review Report, the following certification as per the requirements of NYSDEC DER-10:

"*For each institutional or engineering control identified for the site, I certify that all of the following statements are true:*

- The inspection of the Site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under my direction;
- The institutional control and/or engineering control employed at this Site is unchanged from the date the control was put in place, or last approved by the Department;

- Nothing has occurred that would impair the ability of the control to protect the public health and environment;
- Nothing has occurred that would constitute a violation or failure to comply with any site management plan for this control;
- Access to the site will continue to be provided to the Department to evaluate the remedy, including access to evaluate the continued maintenance of this control;
- If a financial assurance mechanism is required under the oversight document for the Site, the mechanism remains valid and sufficient for the intended purpose under the document;
- Use of the Site is compliant with the environmental easement;
- The engineering control systems are performing as designed and are effective;
- To the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program; and
- The information presented in this report is accurate and complete.

I certify that all information and statements in this certification form are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law. I, [name], of [business address], am certifying as [Owner/Remedial Party or Owner's/Remedial Party's Designated Site Representative] (and if the site consists of multiple properties): *[I have been authorized and designated by all site owners/remedial parties to sign this certification] for the site."*

In addition, every five years the following certification will be added:

- *The assumptions made in the qualitative exposure assessment remain valid.*

The signed certification will be included in the Periodic Review Report.

The Periodic Review Report will be submitted, in electronic format, to the NYSDEC Central Office, Regional Office in which the site is located, and the NYSDOH Bureau of Environmental Exposure Investigation. The Periodic Review Report may need to be submitted in hard-copy format, as requested by the NYSDEC project manager.

7.3 Corrective Measures Work Plan

If any component of the remedy is found to have failed, or if the periodic certification cannot be provided due to the failure of an institutional or engineering control, a Corrective Measures Work Plan will be submitted to the NYSDEC for approval. This plan will explain the failure and provide the details and schedule for performing work necessary to correct the failure. Unless an emergency condition exists, no work will be performed pursuant to the Corrective Measures Work Plan until it has been approved by the NYSDEC.

7.4 Remedial Site Optimization Report

In the event that an RSO is to be performed, the RSO report will document the research/ investigation and data gathering that was conducted, evaluate the results and facts obtained, present a revised conceptual site model and present recommendations. RSO recommendations are to be implemented upon approval from the NYSDEC. Additional work plans, design documents, HASPs etc., may still be required to implement the recommendations, based upon the actions that need to be taken. A final engineering report and update to the SMP may also be required.

The RSO report will be submitted, in electronic format, to the NYSDEC Central Office, Regional Office in which the site is located, Site Control, and the NYSDOH Bureau of Environmental Exposure Investigation.

8.0 REFERENCES

1. New York State Department of Environmental Conservation. *DER-10; Technical Guidance for Site Investigation and Remediation*. May 2010.
2. 6NYCRR Part 375, Environmental Remediation Programs. December 14, 2006.
3. WSP Environmental Strategies LLC. *Phase II Environmental Site Assessment, Former Freezer Queen, Inc. Property, Buffalo, New York*. February 28, 2008.
4. AMD Environmental Consultants, Inc. *Phase I Environmental Site Assessment, 975 Fuhrmann Blvd., Buffalo, NY 14203*. September 2015.
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6. C&S Engineers, Inc. *Remedial Investigation, Alternatives Analysis Report, and Remedial Work Plan Report, Queen City Landing, 1005 Fuhrmann Blvd (SBL: 132.06-1-1.2) and a Portion of 975 Fuhrmann Blvd (SBL: 132.06-1-1.1), City of Buffalo, Erie County, New York, Site No. C915304*. April 2017.
7. Benchmark Environmental Engineering and Science, PLLC. *Remedial Investigation Report, Queen City Landing Site, 975 & 1005 Fuhrmann Boulevard, Buffalo, New York, BCP site No. C915304*. May 2018.
8. Benchmark Environmental Engineering and Science, PLLC. *Interim Remedial Measure Report, Petroleum Contamination Cleanup, Queen City Landing Site BCP Site No. C915304, 975 and 1005 Fuhrmann Boulevard, Buffalo, New York*. January 25, 2018.
9. C&S Engineers, Inc. *Crushed Concrete Management Plan, Queen City Landing, Eastern Parcel, BCP Site No. C915304*. March 1, 2017.
10. Benchmark Environmental Engineering and Science, PLLC. *Queen City Landing (BCP Site: C915304), Crushed Concrete Management Plan Addendum*. August 3, 2017.
11. Benchmark Environmental Engineering and Science, PLLC. *Alternative Analysis Report, Queen City Landing Site, 975 & 1005 Fuhrmann Boulevard, Buffalo, New York, BCP site No. C915304*. May 2018.
12. New York State Department of Environmental Conservation. *Decision Document, Queen City Landing, Brownfield Cleanup Program, Buffalo, Erie County, Site No. C915304*. June 2018.
13. Benchmark Environmental Engineering and Science, PLLC. *Queen City Landing (BCP Site: C915304), Remedial Action Work Plan*. July 20, 2018.

TABLES

TABLE 2

SUMMARY OF GROUNDWATER ELEVATIONS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING
BUFFALO, NEW YORK

Location	Well Depth (fbgs)	Water Depth (fbgs)	Riser Height (ft)	Well Elevation (fmsl)	Water Elevation (fmsl)	Depth to Water from Top of Riser (ft)
MW1	11.7	4.6	5	580.50	575.90	9.6
MW2	15.2	6.0	5	580.95	574.95	11.0
MW3	13.6	1.8	5	578.33	576.53	6.8
MW4	15.3	6.4	5	580.80	574.40	11.4
MW5	11.9	4.7	5	580.53	575.83	9.7
MW6	15.3	1.2	5	577.75	576.55	6.2
MW7	15.1	3.0	5	576.52	573.52	8.0
MW8	15.1	4.1	5	576.83	572.73	9.1
MW9	15.1	0.5	5	576.83	575.87	5.5

Notes:

1. Fmsl = feet above mean sea level.
2. fbgs = feet below ground surface.
3. Depth to groundwater per February 2017 data collected by C&S Engineers.

TABLE 3

SUMMARY OF REMEDIAL INVESTIGATION SURFACE SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	A7-SS	Q	DUP-A-010617	Q	A8-SS	Q	A9-SS	Q	C1-SS	Q	D1-SS	Q	F1-SS	Q	F2-SS	Q	F3-SS	Q	F4-SS	Q	F5-SS	Q	F6-SS	Q	Boundary-SS1	Q	Boundary-SS2	Q	OFF-SITE SS-2 (0-2") NORTH	Q	OFF-SITE SS-2 NORTH (2-12")	Q	OFF-SITE SS-2 (0-2") SOUTH	Q	OFF-SITE SS-2 SOUTH (2-12")	Q	Boundary-SS3	Q	Boundary-SS4	Q
					1/6/2017		1/6/2017		1/20/2017		1/26/2017		1/20/2017		1/25/2017		1/6/2017		1/6/2017		1/25/2017		1/25/2017		1/26/2017		11/7/2016		1/6/2017		1/26/2017		12/12/2017		12/12/2017		12/12/2017		12/12/2017		1/26/2017		1/26/2017	
Volatile Organic Compounds (VOCs) - mg/Kg [4]																																												
Acetone	**0.05**	**100**	**500**	**1000**	ND	R	ND	R	ND	R	ND	R	ND	R	**0.614**	J	ND	R	ND	R	ND		ND		~~**0.199**~~	R	ND	R	ND	R	ND	R	NT		NT		NT		NT		ND	R	ND	R
Carbon disulfide	**--**	**--**	**--**	**--**	ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND		ND		~~0.0152~~	R	ND	R	ND	R	ND	R	NT		NT		NT		NT		ND	R	ND	R
Methylene chloride	**0.05**	**100**	**500**	**1000**	ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R	NT		NT		NT		NT		ND	R	~~0.0139~~	R
Naphthalene	**12**	**100**	**500**	**1000**	~~0.0812~~	R	~~0.0107~~	R	~~0.00782~~	R	ND	R	ND	R	0.662		ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R	NT		NT		NT		NT		ND	R	~~0.00774~~	R
Trichlorofluoromethane (Freon-11)	**--**	**--**	**--**	**--**	~~0.0787~~	R	~~0.0186~~	R	ND	R	ND	R	ND	R	0.395	J	ND	R	ND	R	0.0207	J	0.00739	J	~~0.0302~~	R	ND	R	ND	R	~~0.0458~~	R	NT		NT		NT		NT		ND	R	~~0.0744~~	R
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [4]																																												
Acenaphthene	**20**	**100**	**500**	**1000**	ND		ND		ND		ND		ND		0.675		ND		ND		ND		ND		ND		ND		ND		ND		0.079	J	0.067	J	0.072	J	0.059	J	ND		0.805	
Acenaphthylene	**100**	**100**	**500**	**1000**	ND		ND		ND		ND		0.324	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		0.085	J	0.044	J	0.099	J	0.31		ND		ND	
Anthracene	**100**	**100**	**500**	**1000**	4.6	J	5.19	J	0.179	J	ND		0.975		1.55 J		ND		ND		ND		ND		0.369		ND		0.53		7.3	J	0.21		0.42		0.27		0.34		ND		1.83	
Benzo(a)anthracene	**1**	**1**	**5.6**	**11**	**31**		**29.8**		0.693		0.283	J	**2.48**		**2.69**		0.569		ND		ND		**2.06**		**1.11**		**3.48**		**2.09**		**33.3**		**1.2**		0.68		**1.2**		0.8		0.575		**3.58**	
Benzo(a)pyrene	**1**	**1**	**1**	**1.1**	**35.5**		**33.6**		0.648		0.227	J	**2.31**		**1.84**		0.562		ND		ND		**2.58**		0.915		**5.01**		**2.05**		**37.2**		**1.5**		0.055		**1.7**		1		0.576		**2.48**	
Benzo(b)fluoranthene	**1**	**1**	**5.6**	**11**	**38.1**		**37.4**		0.67		0.253	J	**2.32**		**1.74**		0.556		ND		ND		**3.13**		0.947		**6.26**		**2.34**		**52.3**		**2.7**		0.8		**2.8**		**1.6**		0.599		**2.57**	
Benzo(ghi)perylene	**100**	**100**	**500**	**1000**	29.4		28.2		0.428		0.166	J	1.35		1.1		0.405		ND		0.203	J	3.05		0.618		4.65		1.49		36.8		1.4		0.31		1.3		0.88		0.444		1.55	
Benzo(k)fluoranthene	**0.8**	**3.9**	**56**	**110**	**31.4**		**26.9**		0.559		0.182	J	**1.69**		**1.35**		0.434		ND		ND		**1.96**		0.602		**4.55**		**1.43**		**32.3**		**0.86**		0.27		**0.83**		0.49		0.394		**1.85**	
Bis(2-ethylhexyl) phthalate	**--**	**--**	**--**	**--**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		6.75		ND		NT		NT		NT		NT		ND		ND	
Butyl benzyl phthalate	**--**	**--**	**--**	**--**	ND		ND		ND		ND		ND		11.9		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Carbazole	**--**	**--**	**--**	**--**	ND		ND		ND		ND		0.648		0.771		ND		ND		ND		ND		ND		ND		0.381		12.3		NT		NT		NT		NT		ND		0.895	
Chrysene	**1**	**3.9**	**56**	**110**	**42.7**		**40.2**		0.815		0.281	J	**2.92**		**2.09**		0.616		ND		ND		**2.57**		0.984		**5.59**		**2.36**		**51**		**1.9**		0.61		**1.7**		0.91		0.64		**2.96**	
Dibenzo(a,h)anthracene	**0.33**	**0.33**	**0.56**	**1.1**	**10.9**		**10.3**		ND		ND		**0.518**	J	**0.363**	J	0.183	J	ND		ND		ND		0.164	J	**1.66**		**0.623**		**8.72**	J	0.3		0.1	J	0.3		0.2		ND		**0.451**	J
Dibenzofuran	**7**	**59**	**350**	**1000**	ND		ND		ND		ND		0.335	J	0.538	J	ND		ND		ND		ND		ND		ND		ND		ND		0.05	J	0.11	J	0.048	J	0.053	J	ND		0.649	J
Fluoranthene	**100**	**100**	**500**	**1000**	84.4		81.2		1.46		0.705		7.37		6.08		1.09		ND		0.288	J	4.38		2.35		9.49		4.88		**117**		3.6		1.5		3.4		1.9		1.24		8.02	
Fluorene	**30**	**100**	**500**	**1000**	ND		ND		ND		ND		0.559	J	0.779		ND		ND		ND		ND		ND		ND		0.183	J	ND		0.091	J	0.18	J	0.079	J	0.094	J	ND		0.958	
Indeno(1,2,3-cd)pyrene	**0.5**	**0.5**	**5.6**	**11**	**19.8**		**19.2**		0.332	J	0.177	J	**1.08**		**1.31**		0.28	J	ND		ND		**2.88**		**0.755**		**3.01**		**1.12**		**41**		**1.4**		0.37		**1.5**		0.89		0.455		**1.78**	
Naphthalene	**12**	**100**	**500**	**1000**	ND		ND		ND		ND		ND		0.662		ND		ND		ND		ND		ND		ND		ND		ND		0.029	J	ND		0.044	J	0.06	J	ND		0.464	J
Phenanthrene	**100**	**100**	**500**	**1000**	32.1		33.9		0.87		0.544		7.42		5.77		0.52		ND		0.191	J	1.39	J	1.42		3.9		2.63		61.5		1.6		1.5	J	1.5		0.88		0.673		6.81	
Pyrene	**100**	**100**	**500**	**1000**	62.8		60.6		1.1		0.483		5.63		3.79		0.861		ND		0.212	J	3.29		1.64		8.39		3.54		81.4		2.7		1		2.6		1.4		1.02		5.23	
Total Metals - mg/Kg																																												
Arsenic	**13**	**16**	**16**	**16**	8.37		8.66		11.9		3.1		7.39		6.76		3.63		1.25		1.48		3.87		5.65		6.18		6.07		4.17		5.89		8.02		9.04		6.64		3.37		8.39	
Barium	**350**	**400**	**400**	**10000**	96.6		84.2		85		11.8		58.1		81.1	J	72.5		132		146	J	88.5	J	110		88.1		55.7		42.9		45.9		41.8		56.1		47		44.6		82.5	
Beryllium	**7.2**	**72**	**590**	**2700**	0.846		0.796		0.633		0.141	J	0.949		0.711		0.637		3.42		3.95		2.38		2.68		0.514		0.393		0.426		0.43		0.383		0.454		0.425		0.379		1.04	
Cadmium	**2.5**	**4.3**	**9.3**	**60**	**3.63**	J	1.08	J	0.793		0.502	M	0.221	J	1.12		1.27		2		1.29		0.891		1.11		**2.58**		0.886		0.766		0.382	J	0.393	J	0.422	J	0.393	J	0.916		1.6	
Hex Chromium	**1**	**110**	**400**	**800**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Chromium	**30**	**180**	**1500**	**6800**	24.7		27.9		17		4.66	D	4.31		14.3		**40.1**		9.86		7.17		8.29		10.4		**712**		12.1		17.9		12		11		13.3		10.7		13.5		10.9	
Copper	**50**	**270**	**270**	**10000**	48.3		36		25.5		4.48		23.4		22.2	J	36.1		21.2		12.4	J	10.7	J	13		**101**		19.5		20.3		19.4		18.1	J	20.7		16.5		19.6		30.8	
Cyanide	**27**	**27**	**27**	**10000**	ND		0.664		ND		ND		ND		0.435		ND		2.79		2.61		1.67		4.28		0.418		ND		1.79		ND		ND		ND		ND		ND		0.942	
Lead	**63**	**400**	**1000**	**3900**	**111**		**114**		**72.7**		28.6	M	39.3		59.7		**76.2**		23.5		11.1		23.6		37		**96.2**		**81.2**		44.9		26.9		26		29.6		27.6		**73.4**		**89.1**	
Manganese	**1600**	**2000**	**10000**	**10000**	562		508		447		624		344		442		1380		**2460**		**2360**		1150		1370		**11600**		289		472		318		326	J	357		396		411		558	
Mercury	**0.18**	**0.81**	**2.8**	**5.7**	**0.34**		**0.258**		0.113		0.0159		0.128		~~0.127~~	R	**0.64**		ND		ND		~~0.0882~~	R	ND		0.137		0.0994		0.0193		0.09	J	0.09	J	0.08	J	0.08	J	**0.229**		0.0303	
Nickel	**30**	**310**	**310**	**10000**	15		15.5		15.6		3.64	M	5.9		10.6		12		5.39		3.1		3.91		6.58		18.7		11.3		9.64		12.7		12.2	J-	13.8		12.4		8.9		10.1	
Selenium	**3.9**	**180**	**1500**	**6800**	2.42		3.46		1.09		2.49		2.17		**4.02**		2.09		2.77		2.94		1.51		4.17		0.714		1.53		**4.34**		0.335	J	0.317	J	0.406	J	0.457	J	1.52		**4.4**	
Silver	**2**	**180**	**1500**	**6800**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		**2.53**		ND		ND		ND		ND		ND		0.131	J	ND		**ND**	
Zinc	**109**	**10000**	**10000**	**10000**	**375**		**315**		**123**		68.2	DM	87.6		~~150~~	R	**153**		94.8		~~52.4~~	R	~~67~~	R	109		**214**		**165**		99.4		80.4		65.1	J	76.4		64.7		100		**148**	
Polychlorinated biphenyls (PCBs) - mg/Kg [4]																																												
Aroclor 1254	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.0307	J	ND		ND		ND		NT		NT		NT		NT		ND		ND	
Total PCBs	**0.1**	**1**	**1**	**25**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.0307	J	ND		ND		ND		NT		NT		NT		NT		ND		ND	
Pesticides and Herbicides - mg/Kg [4]																																												
4,4'-DDE	**0.0033**	**8.9**	**62**	**120**	ND		ND		ND		0.00202	NJ	ND		**0.00522**	JN	ND		ND		ND		ND		ND		ND		**0.0144**	NJ	ND		NT		NT		NT		NT		ND		ND	
4,4'-DDT	**0.0033**	**7.9**	**47**	**94**	ND		ND		ND		ND		**0.0278**	J	**0.00474**	JN	ND		0.00222	NJ	**0.00417**	J	ND		ND		**0.00761**	NJ+	**0.0074**		ND		NT		NT		NT		NT		**0.00703**	J+	**0.0318**	J+
4,4-DDD	**0.0033**	**13**	**92**	**180**	ND		ND		ND		ND		**ND**		ND		ND		0.00198	J	ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Aldrin	**0.005**	**0.097**	**0.68**	**1.4**	ND		ND		ND		ND		ND		**0.0111**	JN	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
alpha-BHC	**0.02**	**0.48**	**3.4**	**6.8**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
beta-BHC	**0.036**	**0.36**	**3**	**14**	ND		ND		ND		ND		ND		ND		ND		ND		ND		0.00481	NJ	ND		0.0239	J+	ND		ND		NT		NT		NT		NT		ND		ND	
cis-Chlordane	**0.094**	**4.2**	**24**	**47**	**0.207**		**0.173**		0.00367	J	0.00193	J	ND		ND		ND		ND		ND		ND		ND		0.0683	J+	ND		ND		NT		NT		NT		NT		ND		0.0251	NJ
delta-BHC	**0.04**	**100**	**500**	**1000**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Dieldrin	**0.005**	**0.2**	**1.4**	**2.8**	ND		ND		ND		ND		ND		0.00254	J	ND		ND		ND		ND		ND		**0.0157**	J+	ND		ND		NT		NT		NT		NT		0.0046	NJ	**0.00688**	NJ
Endosulfan I	**2.4**	**24**	**200**	**920**	ND		ND		ND		ND		ND		0.00897	NJ	ND		ND		ND		ND		ND		0.00525	J+	ND		ND		NT		NT		NT		NT		ND		ND	
Endosulfan II	**2.4**	**24**	**200**	**920**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Endosulfan sulfate	**2.4**	**24**	**200**	**920**	ND		ND		ND		ND		ND		0.00848	J	ND		0.00358	NJ	ND		0.00728	J	ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Endrin	**0.014**	**11**	**89**	**410**	ND		ND		ND		ND		ND		0.00531	NJ	ND		0.00178	J	ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Endrin aldehyde	**--**	**--**	**--**	**--**	0.0406	J	ND		ND		ND		ND		0.00218	J	ND		ND		ND		ND		ND		ND		ND		0.0262	J	NT		NT		NT		NT		0.0019	J+	ND	
Endrine ketone	**--**	**--**	**--**	**--**	ND		ND		ND		ND		ND		0.00831	J	ND		0.00233	J	ND		ND		ND		0.0158	J+	ND		ND		NT		NT		NT		NT		0.0123	J+	0.0144	J+
gamma-BHC (Lindane)	**0.1**	**1.3**	**9.2**	**23**	ND		ND		ND		ND		ND		ND		ND		0.00418	J	ND		0.00749		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Heptachlor	**0.042**	**2.1**	**15**	**29**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Heptachlor epoxide	**--**	**--**	**--**	**--**	0.0261	NJ	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
Methoxychlor	**--**	**--**	**--**	**--**	ND		ND		ND		0.00509	NJ	ND		0.0624	J	ND		ND		0.00427	J	0.0195	NJ	ND		ND		ND		ND		NT		NT		NT		NT		ND		ND	
trans-Chlordane	**--**	**--**	**--**	**--**	ND		N		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		NT		NT		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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:

ND = Parameter not detected above laboratory detection limit.
NT = Parameter was not analyzed for.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
NJ = The detection is tenative in identification and estimated in value.
R = The sample results are rejected due to deficiencies in meeting Quality Control limits. Tha analyte may or may not be present.

🟩 **Bold** = Result exceeds Unrestricted Use SCOs.
🟨 **Bold** = Result exceeds Restricted Residential Use SCOs.
🟦 **Bold** = Result exceeds Commercial Use SCOs.
🟥 **Bold** = Result exceeds Industrial use SCO's.

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TABLE 4

SUMMARY OF REMEDIAL INVESTIGATION SUBSURFACE SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	MW1-4-8ft	Q	MW1-10-12ft	Q	MW1-15-16ft	Q	MW2-2-4ft	Q	MW2-5-8ft	Q	MW2-15-18ft	Q	MW3-5-7ft	Q	MW3-12-14ft	Q	MW3-14-16ft	Q	MW4-2-5ft	Q	MW4-8.5-10ft	Q	MW4-15ft	Q	MW5-4-6ft	Q	MW5-9-12ft	Q
					Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Native		Urban Fill		Urban Fill		Native		Urban Fill		Construction Fill	
Volatile Organic Compounds (VOCs) - mg/Kg 4																																
1,2-Dichlorobenzene	1.1	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
1,2,4-Trimethylbenzene	3.6	52	190	380	ND		ND		ND		0.00237		ND		ND		0.00104	J	ND		ND		ND		ND		ND		ND		ND	
1,3,5-Trimethylbenzene	8.4	52	190	380	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2-Butanone (MEK)	0.12	100	500	1000	ND		ND		ND		ND		0.00658	J	ND		ND		ND		ND		ND		ND		ND		ND		ND	
Acetone	0.05	100	500	1000	ND		0.0154		0.00941		0.0169		0.0206		0.00611	J	0.0061	J	ND		0.00734	J	0.00974	J	ND		0.0236		ND		0.00674	J
Benzene	0.06	4.8	44	89	ND		ND		0.00358		ND		ND		ND		0.00262		ND		ND		ND		ND		ND		ND		ND	
Carbon disulfide	--	--	--	--	ND		ND		0.00462		0.00193	J	0.00108	J	ND		0.00133	J	ND		ND		0.00119	J	ND		ND		ND		ND	
Chlorobenzene	1.1	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
cis-1,2-Dichloroethylene	0.25	100	500	1000	ND		ND		ND		ND		ND		0.0032		ND		ND		ND		ND		ND		ND		ND		ND	
Cyclohexane	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Ethylbenzene	1	41	390	780	ND		ND		ND		ND		ND		ND		0.00102	J	ND		ND		ND		ND		ND		ND		ND	
Isopropylbenzene (Cumene)	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Total Xylenes	0.26	100	500	1000	ND		ND		ND		0.00179	J	ND		ND		0.00209		ND		ND		ND		ND		ND		ND		ND	
Methyl acetate	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Methylcyclohexane	--	--	--	--	ND		ND		ND		ND		ND		ND		0.002		ND		ND		ND		ND		ND		ND		ND	
Methylene chloride	0.05	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Naphthalene	12	100	500	1000	0.00489		0.0062		0.0426		0.0076		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.00504	
n-Butylbenzene	12	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
n-Propylbenzene	3.9	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
p-Cymene (p-isopropyltoluene)	--	--	--	--	ND		0.00154	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
sec-Butylbenzene	11	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Styrene	--	--	--	--	ND		ND		ND		ND		ND		ND		0.0105		ND		ND		ND		ND		ND		ND		ND	
tert Butyl Methyl Ether	0.93	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Toluene	0.7	100	500	1000	ND		ND		ND		ND		ND		ND		0.00189		ND		ND		ND		ND		ND		ND		ND	
Trichloroethene	0.47	21	200	400	ND		ND		ND		ND		ND		0.000992	J	ND		ND		ND		ND		ND		ND		ND		ND	
Vinyl chloride	0.02	0.9	13	27	ND		ND		ND		ND		ND		0.00137	J	ND		ND		ND		ND		ND		ND		ND		ND	
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [4]																																
1,1-Biphenyl	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2-Methylnaphthalene	--	--		--	ND		ND		0.196	J	ND		ND		ND		0.259	J	ND		ND		ND		ND		ND		ND		ND	
Acenaphthene	20	100	500	1000	ND		0.312	J	0.21	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.198	J
Acenaphthylene	100	100	500	1000	ND		0.278	J	ND		ND		0.29	J	ND		ND		ND		ND		ND		ND		ND		ND		ND	
Anthracene	100	100	500	1000	0.397		1.24		0.429		ND		0.606		ND		ND		ND		ND		ND		0.469		0.24	J	ND		0.902	
Benzo(a)anthracene	1	1	5.6	11	0.815		**2.6**		**1.11**		0.973	J	**1.52**		ND		0.576		ND		0.35	J	0.25	J	**1.15**		0.354		ND		**1.38**	
Benzo(a)pyrene	1	1	1	1.1	0.609		**2.19**		0.969		0.848	J	**1.39**		ND		0.454		ND		0.282	J	0.249	J	**1.01**		0.246	J	ND		**1.09**	
Benzo(b)fluoranthene	1	1	5.6	11	0.558		**2.68**		**1.21**		0.891	J	**1.5**		ND		0.494		ND		0.233	J	0.28	J	**1.24**		0.193	J	ND		**1.06**	
Benzo(ghi)perylene	100	100	500	1000	0.329		1.44		0.627		ND		0.887		ND		0.287	J	ND		ND		0.211	J	0.725		ND		ND		0.614	
Benzo(k)fluoranthene	0.8	3.9	56	110	0.389		**1.45**		0.574		ND		**0.903**		ND		0.34		ND		ND		0.196	J	0.552		0.191	J	ND		0.765	
Carbazole	--	--	--	--	ND		0.475		0.245	J	ND		0.279	J	ND		ND		ND		ND		ND		0.213	J	ND		ND		0.233	J
Chrysene	1	3.9	56	110	0.891		**2.64**		**1.14**		1	J	**1.52**		ND		0.527		ND		0.336	J	0.273	J	**1.08**		0.307	J	ND		**1.81**	
Dibenzo(a,h)anthracene	0.33	0.33	0.56	1.1	ND		**0.545**		0.241	J	ND		0.285	J	ND		ND		ND		ND		ND		0.249	J	ND		ND		0.235	J
Dibenzofuran	7	59	350	1000	ND		0.435		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.214	J
Fluoranthene	100	100	500	1000	1.39		5.19		2.1		2.03		3.57		ND		1.19		ND		0.481		0.506		2.09		0.661		0.313	J	3.19	
Fluorene	30	100	500	1000	ND		0.68		0.267	J	ND		0.268		ND		ND		ND		ND		ND		0.209	J	ND		ND		0.381	
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	11	0.478		**2.13**		**0.989**		**1.11**	J	**1.38**	J	ND		0.494		ND		0.197	J	0.285	J	**1.09**		0.212	J	ND		**0.899**	
Naphthalene	12	100	500	1000	ND		0.0062		0.521		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Phenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3-Methylphenol/4-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Phenanthrene	100	100	500	1000	1.81		4.84		1.63		1.96		2.56		ND		0.464		ND		0.545		0.302	J	1.85		0.66		0.21	J	2.76	
Pyrene	100	100	500	1000	1.75	JP	4.2		1.74		1.74		2.92		ND		0.978		ND		0.605		0.399		1.74		0.551		0.248	J	2.31	
Total Metals - mg/Kg																																
Arsenic	13	16	16	16	3.16		9.42		4.12		3.09		4.72		3.93		**13.9**		3.51		ND		5.71		9.23		8.52		7.62		ND	
Barium	350	400	400	10000	64.9		164		45.6		48.9		86.4		22.6		89.8		92		103		82.3		104		67.4		79.6		42.6	
Beryllium	7.2	72	590	2700	0.327		0.463		0.225	J	0.858		0.365		0.243	J	0.899		0.576		0.635		0.329		0.157	J	0.372		0.619		0.194	J
Cadmium	2.5	4.3	9.3	60	0.659		1.67		0.662		0.383		0.781		0.439		0.868		0.831		0.848		0.788		1.09		0.942		0.761		0.412	
Hex Chromium	1	110	400	800	NT		NT		NT		NT		NT		NT		NT		NT		NT		NT		NT		NT		NT		NT	
Chromium	30	180	1500	6800	12.2		14		8.28		7.3		11.8		12.6		6.53		17.5		19.4		25.7		12.9		11.1		17.2		4.97	
Copper	50	270	270	10000	20.5		**278**		30.2		14.6		26.6		10.3		30.7		15.3		16.7		33.5		34.1		26.5		29.7		21.4	
Cyanide	27	27	27	10000	0.479		0.394	J	0.269	J	0.408	JM	0.304	J	0.319	J	0.259	J	ND		ND		0.277	J	0.288	J	ND		ND		0.347	J
Lead	63	400	1000	3900	**168**		**345**		**66**		32.2		**201**		21.7		**85.4**		15.9		21.4		**196**		**162**		**129**		21.3		**210**	
Manganese	1600	2000	10000	10000	313		255		256		373		188		338		191		200		178		503		273		410		588		339	
Mercury	0.18	0.81	2.8	5.7	**1.55**		**0.36**		**0.277**		ND		**0.377**		**0.292**		**0.264**		0.0409		0.0431		0.0191		**0.246**		0.0719		0.0505		0.0103	
Nickel	30	310	310	10000	9.14		18.2		8.47		7.13		10.3		11.6		4.82		24.8		28.3		10.7		15.6		18		29.5		8.75	
Selenium	3.9	180	1500	6800	ND		ND		ND		ND		1.73		1.37		1.22		2.78		2.98		2.35		3.41		2.43		2.41		1.24	
Silver	2	180	1500	6800	0.879		0.748		0.425	J	ND		0.354	J	ND		ND		0.705		0.798		1.1		1.68		1.02		0.987		0.666	
Zinc	109	10000	10000	10000	**151**		**708**		**113**		49		**144**		61.5		**115**		99.4		104		**145**		**193**		108		82.2		94.7	
Polychlorinated biphenyls (PCBs) - mg/Kg [4]																																
Aroclor 1254	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Aroclor 1260	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		0.184		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Total PCBs	0.1	1	1	25	ND		ND		ND		**0.184**		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Pesticides and Herbicides - mg/Kg [4]																																
4,4'-DDE	0.0033	8.9	62	120	ND		ND		ND		**0.0788**	J	0.00185	NJ	ND		ND		ND		ND		ND		ND		ND		ND		ND	R
4,4'-DDT	0.0033	7.9	47	94	0.00223	NJ	ND		ND		**0.0947**	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
4,4-DDD	0.0033	13	92	180	ND		ND		ND		**0.175**	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Aldrin	0.005	0.097	0.68	1.4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
alpha-BHC	0.02	0.48	3.4	6.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
beta-BHC	0.036	0.36	3	14	ND		ND		ND		0.00437	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
cis-Chlordane	0.094	4.2	24	47	0.0155		ND		ND		ND		ND		ND		0.00468	NJ	ND		ND		ND		0.00815		ND		0.00223	J	ND	R
delta-BHC	0.04	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Dieldrin	0.005	0.2	1.4	2.8	ND		ND		ND		ND		0.00228	NJ	ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Endosulfan I	2.4	24	200	920	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Endosulfan II	2.4	24	200	920	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Endosulfan sulfate	2.4	24	200	920	ND		ND		ND		0.0496	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Endrin	0.014	11	89	410	ND		ND		ND		**0.0369**	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Endrin aldehyde	--	--	--	--	0.00226	J	ND		ND		0.0235	J	ND		ND		0.00182	JP	ND		ND		ND		ND		ND		ND		ND	R
Endrine ketone	--	--	--	--	0.00244	J	0.00581	NJ+	ND		0.0114	P	0.00223	J	ND		ND		ND		ND		ND		ND		ND		ND		ND	R
gamma-BHC (Lindane)	0.1	1.3	9.2	23	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Heptachlor epoxide	--	--	--	--	ND		ND		ND		0.00508	P	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
Methoxychlor	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R
trans-Chlordane	--	--	--	--	ND		ND		ND		0.00379	NJ	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R

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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:

ND = Parameter not detected above laboratory detection limit.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
NJ = The detection is tenative in identification and estimated in value.
R = The sample results are rejected due to deficiencies in meeting Quality Control limits. Tha analyte may or may not be present.
Bold = Result exceeds Unrestricted Use SCOs.
Bold = Result exceeds Restricted Residential Use SCOs.
Bold = Result exceeds Commercial Use SCOs.
Bold = Result exceeds Industrial use SCO's.

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TABLE 4

SUMMARY OF REMEDIAL INVESTIGATION SUBSURFACE SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	MW5-14-16ft	Q	MW6-4.5-7ft	Q	MW6-8-10ft	Q	MW6-14-16ft	Q	MW7-2-4ft	Q	MW7-12-14ft	Q	MW7-14-16ft	Q	MW8-0.5-2ft	Q	MW8-12-13ft	Q	MW8-14-15ft	Q	A7-10-11ft	Q	A7-15ft	Q	A9-7-8ft	Q	A9-15ft	Q
					Native		Urban Fill		Construction Fill		Native		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Construction Fill		Native		Urban Fill		Native	
Volatile Organic Compounds (VOCs) - mg/Kg 4																																
1,2-Dichlorobenzene	1.1	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
1,2,4-Trimethylbenzene	3.6	52	190	380	ND		ND		ND		ND		ND		ND		0.12	J	ND		ND		ND		ND	R	ND	R	ND	R	ND	R
1,3,5-Trimethylbenzene	8.4	52	190	380	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
2-Butanone (MEK)	0.12	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	0.0788	R
Acetone	0.05	100	500	1000	0.0346		0.0371		0.0177		0.0155		0.0194		0.0142		ND		ND		ND		0.00736	J	~~0.0243~~	R	~~0.101~~	R	~~0.0312~~	R	0.332	R
Benzene	0.06	4.8	44	89	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	~~0.0036~~	R	ND	R
Carbon disulfide	--	--	--	--	ND		ND		0.00123	J	ND		ND		0.00386		ND		ND		ND		0.00141	J	ND	R	ND	R	ND	R	0.0656	R
Chlorobenzene	1.1	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
cis-1,2-Dichloroethylene	0.25	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Cyclohexane	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Ethylbenzene	1	41	390	780	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Isopropylbenzene (Cumene)	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Total Xylenes	0.26	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	~~0.00405~~	R	ND	R
Methyl acetate	--	--	--	--	0.0217		ND		ND		ND		ND		ND		0.12		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Methylcyclohexane	--	--	--	--	ND		ND		ND		ND		ND		0.00184	J	ND		ND		ND		ND		ND	R	ND	R	~~0.00424~~	R	ND	R
Methylene chloride	0.05	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Naphthalene	12	100	500	1000	ND		ND		ND		ND		ND		0.173		**13.2**		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
n-Butylbenzene	12	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
n-Propylbenzene	3.9	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
p-Cymene (p-isopropyltoluene)	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
sec-Butylbenzene	11	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Styrene	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
tert Butyl Methyl Ether	0.93	100	500	1000	ND		ND		ND		ND		ND		0.00317		ND		ND		0.00152	J	0.0042		ND	R	ND	R	~~0.00673~~	R	0.00471	R
Toluene	0.7	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Trichloroethene	0.47	21	200	400	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Vinyl chloride	0.02	0.9	13	27	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R	ND	R	ND	R
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [4]																																
1,1-Biphenyl	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2-Methylnaphthalene	--	--		--	ND		ND		ND		ND		ND		1.65	J	ND		ND		ND		ND		ND		ND		ND		ND	
Acenaphthene	20	100	500	1000	ND		ND		ND		ND		ND		2.55		1.15	J	ND		ND		ND		ND		ND		ND		ND	
Acenaphthylene	100	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.197	J	ND		ND		ND	
Anthracene	100	100	500	1000	ND		ND		ND		ND		0.301	J	6.26		2.62		0.28	J	ND		0.234	J	0.39		ND		ND		ND	
Benzo(a)anthracene	1	1	5.6	11	ND		0.374		0.245	J	0.416		0.46		**7.14**		**3.14**		**1.38**		ND		0.324	J	0.945		ND		ND		ND	
Benzo(a)pyrene	1	1	1	1.1	ND		0.432		0.204	J	0.383		0.358		**6.11**		**2.89**		**1.1**		ND		0.262	J	0.696		ND		ND		ND	
Benzo(b)fluoranthene	1	1	5.6	11	ND		0.565		0.208	J	0.443		0.318	J	**5.55**		**2.81**		1.24		ND		0.238	J	0.684		ND		ND		ND	
Benzo(ghi)perylene	100	100	500	1000	ND		0.43		ND		0.271	J	0.21	J	3.44		1.78		0.606		ND		ND		0.366		ND		ND		ND	
Benzo(k)fluoranthene	0.8	3.9	56	110	ND		0.3	J	ND		0.282	J	0.286	J	**4.73**		**2.04**		0.9		ND		0.138	J	0.483		ND		ND		ND	
Carbazole	--	--	--	--	ND		ND		ND		ND		ND		2.84		1.19		ND		ND		ND		ND		ND		ND		ND	
Chrysene	1	3.9	56	110	ND		0.421		0.226	J	0.448		0.424		**6.83**		**3.2**		**1.24**		ND		0.336	J	0.753		ND		ND		ND	
Dibenzo(a,h)anthracene	0.33	0.33	0.56	1.1	ND		ND		ND		ND		ND		**1.02**	J	ND		0.199	J	ND		ND		ND		ND		ND		ND	
Dibenzofuran	7	59	350	1000	ND		ND		ND		ND		ND		3.4		1.31	J	ND		ND		ND		ND		ND		ND		ND	
Fluoranthene	100	100	500	1000	ND		0.806		0.548		1.05		1.03		18.4		8.16		2.26		ND		0.821		1.98		ND		ND		ND	
Fluorene	30	100	500	1000	ND		ND		0.194	J	ND		ND		4.2		1.82		ND		ND		ND		ND		ND		ND		ND	
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	11	ND		**0.53**		0.191	J	0.432		0.32	J	**4.01**		**2.09**		**0.705**		ND		ND		0.441		ND		ND		ND	
Naphthalene	12	100	500	1000	ND		ND		0.482		ND		ND		4.5		1.75		ND		ND		ND		ND		ND		ND		ND	
Phenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3-Methylphenol/4-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Phenanthrene	100	100	500	1000	ND		0.283	J	0.613		0.678		1.03		24.5		10.3		0.831		ND		0.788		0.896		ND		ND		ND	
Pyrene	100	100	500	1000	ND		0.683		0.435		0.843		0.835		14.9		6.74		2.11		ND		0.699		1.35		ND		ND		ND	
Total Metals - mg/Kg																																
Arsenic	13	16	16	16	ND		ND		ND		ND		ND		4.45		4.93		7.44		3.31		6.09		2.82		3.28		**16.2**		2.87	
Barium	350	400	400	10000	21.7		94.4		21		36.3		58.7		70.2		90	J	93.1		10.8		36.8		29.9		71.1		138		7.28	
Beryllium	7.2	72	590	2700	0.32		0.707		ND		0.244	J	0.347		0.501		0.74		0.315		ND		0.416		0.188	J	0.683		1.17		ND	
Cadmium	2.5	4.3	9.3	60	0.348		1.22		0.276	J	0.413		0.511		2.31		0.579		1.34		ND		0.28	J	0.58		0.253	J	ND		0.294	J
Hex Chromium	1	110	400	800	NT		NT		NT		NT		NT		NT		NT		NT		NT		NT		ND		NT		NT		ND	
Chromium	30	180	1500	6800	8.18		11.7		5.2		6.09		7.55		10.2		11.9		12.2		4.81		14.5		5.31		18.7		19.8		3.65	
Copper	50	270	270	10000	20.2		13.4		8.45		10.1		23.4		16.7		20.6	D	22		3.55		22		17.4		24.4		35.3		3.14	
Cyanide	27	27	27	10000	ND		0.513	J	ND		0.334	J	0.451	J	0.649		NT		0.281	J	ND		NT		ND		ND		7.95		ND	
Lead	63	400	1000	3900	8.84		50		32.8		56.7		**155**		**150**		**90.3**	J	**83.2**		6.05		15.2		**75**		12.4		**339**		3.37	
Manganese	1600	2000	10000	10000	60.7		871		225		232		258		407	J	428	D	277		183		228		344		169		1420		96.6	
Mercury	0.18	0.81	2.8	5.7	0.0114		0.0297		0.0185		0.0791		**0.828**		0.0185	DM	0.0504	M	0.171		0.0141		0.0315		0.0575		0.0689		0.12		0.00977	
Nickel	30	310	310	10000	16.6		14.8		4.04		5.07		5.29		9.77		13.1		10.1		8.34		17.8		7.34		**32**		14.6		6.45	
Selenium	3.9	180	1500	6800	0.922		3.53		1.08		1.48		1.68		1.72		1.95		ND		ND		0.484	J	2.03		1.93		ND		1.06	
Silver	2	180	1500	6800	ND		1.66		0.536	J	0.629		0.432	J	0.673		0.771		ND		ND		ND		ND		ND		ND		ND	
Zinc	109	10000	10000	10000	42		94.5		54		66.4		**291**		**229**		66.8		**240**		28.6		66.2		57.2		72.1		**175**		20.2	
Polychlorinated biphenyls (PCBs) - mg/Kg [4]																																
Aroclor 1254	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Aroclor 1260	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Total PCBs	0.1	1	1	25	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Pesticides and Herbicides - mg/Kg [4]																																
4,4'-DDE	0.0033	8.9	62	120	ND		ND		ND		ND		ND		ND		ND		**0.00819**	J+	ND		ND		ND		ND		ND		ND	
4,4'-DDT	0.0033	7.9	47	94	ND		ND		ND		ND		ND		ND		ND		**0.0726**	J+	ND		ND		ND		ND		ND		ND	
4,4-DDD	0.0033	13	92	180	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Aldrin	0.005	0.097	0.68	1.4	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
alpha-BHC	0.02	0.48	3.4	6.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
beta-BHC	0.036	0.36	3	14	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
cis-Chlordane	0.094	4.2	24	47	ND		ND		0.00174	J	ND		0.00537	J+	ND		ND		0.023	J+	ND		ND		0.00396		ND		ND		ND	
delta-BHC	0.04	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Dieldrin	0.005	0.2	1.4	2.8	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endosulfan I	2.4	24	200	920	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endosulfan II	2.4	24	200	920	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endosulfan sulfate	2.4	24	200	920	ND		ND		ND		ND		ND		ND		ND		ND		0.00527	NJ	0.00214	J	0.00394	NJ	ND		ND		ND	
Endrin	0.014	11	89	410	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Endrin aldehyde	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		0.00855	J+	ND		ND		ND		ND		ND		ND	
Endrine ketone	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		0.00317	NJ+	ND		ND		ND		ND		ND		ND	
gamma-BHC (Lindane)	0.1	1.3	9.2	23	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Heptachlor epoxide	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Methoxychlor	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		0.01	NJ	ND		0.00743	NJ	ND	
trans-Chlordane	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		0.00355	J+	ND		ND		ND		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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:
ND = Parameter not detected above laboratory detection limit.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
NJ = The detection is tenative in identification and estimated in value.
R = The sample results are rejected due to deficiencies in meeting Quality Control limits. Tha analyte may or may not be present.

🟩 **Bold**	= Result exceeds Unrestricted Use SCOs.
🟨 **Bold**	= Result exceeds Restricted Residential Use SCOs.
🟦 **Bold**	= Result exceeds Commercial Use SCOs.
🟥 **Bold**	= Result exceeds Industrial use SCO's.

TABLE 4

SUMMARY OF REMEDIAL INVESTIGATION SUBSURFACE SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	B2-2.5-4	Q	DUP-E-012617	Q	B3-3-4ft	Q	B4-2-4ft	Q	B5-6-8ft	Q	B6-5-6ft	Q	B8-15ft	Q	B9-10-11ft	Q	BM9-10.5	Q	Blind Duplicate	Q	C1-6-7ft	Q	C2-6.5-7.5ft	Q	C2-15ft	Q	C4-7-8ft	Q
					Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Native		Construction Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill	
Volatile Organic Compounds (VOCs) - mg/Kg 4																																
1,2-Dichlorobenzene	1.1	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
1,2,4-Trimethylbenzene	3.6	52	190	380	ND	R	ND	R	~~0.0236~~	R	ND		ND	R	~~0.00714~~	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
1,3,5-Trimethylbenzene	8.4	52	190	380	ND	R	ND	R	~~0.00703~~	R	ND		ND	R	~~0.00267~~	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
2-Butanone (MEK)	0.12	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		~~0.0196~~	R	~~0.0222~~	R	ND	R	ND	R
Acetone	0.05	100	500	1000	~~0.0608~~	R	ND	R	~~0.0762~~	R	**0.334**	J	~~0.0462~~	R	~~0.134~~	R	~~0.0603~~	R	ND	R	ND		ND		~~0.209~~	R	~~0.18~~	R	ND	R	~~0.0461~~	R
Benzene	0.06	4.8	44	89	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Carbon disulfide	--	--	--	--	~~0.00389~~	R	ND	R	~~0.00969~~	R	0.0858		~~0.00803~~	R	~~0.0343~~	R	ND	R	ND	R	ND		ND		~~0.0124~~	R	~~0.00801~~	R	ND	R	~~0.00243~~	R
Chlorobenzene	1.1	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
cis-1,2-Dichloroethylene	0.25	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Cyclohexane	--	--	--	--	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Ethylbenzene	1	41	390	780	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Isopropylbenzene (Cumene)	--	--	--	--	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Total Xylenes	0.26	100	500	1000	ND	R	ND	R	~~0.00432~~	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Methyl acetate	--	--	--	--	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Methylcyclohexane	--	--	--	--	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		~~0.00671~~	R	ND	R	ND	R	ND	R
Methylene chloride	0.05	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		~~0.00822~~	R	ND	R	ND	R	ND	R
Naphthalene	12	100	500	1000	ND	R	ND	R	0.085	R	ND		~~0.0194~~	R	~~0.0317~~	R	ND	R	~~0.0104~~	R	ND		ND		ND	R	~~0.0213~~	R	ND	R	ND	R
n-Butylbenzene	12	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
n-Propylbenzene	3.9	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
p-Cymene (p-isopropyltoluene)	--	--	--	--	ND	R	ND	R	~~0.00743~~	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
sec-Butylbenzene	11	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Styrene	--	--	--	--	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
tert Butyl Methyl Ether	0.93	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Toluene	0.7	100	500	1000	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Trichloroethene	0.47	21	200	400	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Vinyl chloride	0.02	0.9	13	27	ND	R	ND	R	ND	R	ND		ND	R	ND	R	ND	R	ND	R	ND		ND		ND	R	ND	R	ND	R	ND	R
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [4]																																
1,1-Biphenyl	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
2-Methylnaphthalene	--	--		--	ND		ND		0.249	J	ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Acenaphthene	20	100	500	1000	ND		ND		ND		0.278	J	0.335	J	ND		ND		ND		NT		NT		ND		ND		ND		ND	
Acenaphthylene	100	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Anthracene	100	100	500	1000	0.544		ND		ND		0.545		0.822		0.258	J	0.206	J	0.509		NT		NT		ND		0.318	J	ND		ND	
Benzo(a)anthracene	1	1	5.6	11	0.749		ND		0.376	J	0.901		**1.25**		0.477		0.203	J	0.547		NT		NT		0.184	J	0.541		0.23	J	ND	
Benzo(a)pyrene	1	1	1	1.1	0.571		ND		0.363	J	0.709		0.967		0.395		0.152	J	0.508		NT		NT		ND		0.408		0.194	J	ND	
Benzo(b)fluoranthene	1	1	5.6	11	0.566		ND		0.309	J	0.681		**1.04**		0.484		ND		0.471		NT		NT		0.218	J	0.391		0.251	J	ND	
Benzo(ghi)perylene	100	100	500	1000	0.328	J	ND		ND		0.439		0.616		0.315	J	ND		0.362		NT		NT		ND		0.217	J	ND		ND	
Benzo(k)fluoranthene	0.8	3.9	56	110	0.356	J	ND		0.242	J	0.401		0.565		0.242	J	ND		0.423		NT		NT		ND		0.257	J	ND		ND	
Carbazole	--	--	--	--	0.262	J	ND		ND		0.265	J	0.402		ND		ND		ND		NT		NT		ND		0.168	J	ND		ND	
Chrysene	1	3.9	56	110	0.705		ND		0.356	J	0.794		**1.12**		0.442		0.194	J	0.576		NT		NT		0.232	J	0.463		0.25	J	ND	
Dibenzo(a,h)anthracene	0.33	0.33	0.56	1.1	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Dibenzofuran	7	59	350	1000	ND		ND		ND		ND		0.235	J	ND		ND		ND		NT		NT		ND		ND		ND		ND	
Fluoranthene	100	100	500	1000	1.76		0.274	JN	0.484		2.44		3.01		1.22		0.489		1.3		NT		NT		0.41		1.44		0.475		ND	
Fluorene	30	100	500	1000	0.223	J	ND		ND		0.28	J	0.397		ND		ND		ND		NT		NT		ND		0.169	J	ND		ND	
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	11	0.253	J	ND		ND		0.459		0.434		0.35		ND		0.296	J	NT		NT		ND		0.233	J	ND		ND	
Naphthalene	12	100	500	1000	ND		ND		0.085		ND		0.227	J	ND		ND		ND		NT		NT		ND		ND		ND		ND	
Phenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
3-Methylphenol/4-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Phenanthrene	100	100	500	1000	2.03		ND		0.326	J	2.27		3.16		1.08		0.466		0.967		NT		NT		0.377		1.28		0.373		ND	
Pyrene	100	100	500	1000	1.33		0.228	J	0.442	J	1.92		2.3	J	0.795		0.35		1.02		NT		NT		0.328	J	1.06		0.393		ND	
Total Metals - mg/Kg																																
Arsenic	13	16	16	16	5.82		5.07		1.69		3.35		3.85	D	7.33		6.64		8.55		NT		NT		**16.6**		3.28		3.03		1.23	
Barium	350	400	400	10000	13.2		16.1		34.6		57.2	J	78.5	J	128		27.0		31.4		NT		NT		65.3		92.7		59.8		12.1	
Beryllium	7.2	72	590	2700	ND		0.181	J	0.231	J	0.351		0.361	D	0.286		0.192	J	0.349		NT		NT		0.509		0.459		0.393		ND	
Cadmium	2.5	4.3	9.3	60	0.349		0.367		0.436		0.781		1.0	J	0.811		0.187	J	0.303		NT		NT		1.57		0.924		0.708		0.295	J
Hex Chromium	1	110	400	800	NT		NT		ND		ND		NT		NT		NT		NT		NT		NT		ND		NT		NT		NT	
Chromium	30	180	1500	6800	3.65		3.97		6.38		12.6		23.1		12.0		5.68		7.76		NT		NT		14.6		13.5		11.7		4.86	
Copper	50	270	270	10000	2.49		3.63		7.19		13.6	J	20.9	D	25.1		9.88		22.1		NT		NT		**236**		14.9		11.9		6.28	
Cyanide	27	27	27	10000	ND		0.453	J	2.99		ND		1.47	J	1.91		ND		ND		NT		NT		ND		ND		1.27		ND	
Lead	63	400	1000	3900	~~21~~	R	~~1180~~	R	**69.7**		**69**		**102**	J	**102**		4.90		30.7		NT		NT		**423**		49.6		**95.7**		8.78	
Manganese	1600	2000	10000	10000	114		122		255		265		268	D	327		383		447		NT		NT		505		273		345		158	
Mercury	0.18	0.81	2.8	5.7	0.0196	J	0.0485	J	0.166		~~**0.295**~~	R	**0.288**	J	**0.422**		ND		0.0225		NT		NT		**0.49**		0.164		0.136		0.0181	
Nickel	30	310	310	10000	7.75		7.6		4.34		10.4		9.88	J	10.0		16.2		12.3		NT		NT		17.9		13.7		9.87		3.73	
Selenium	3.9	180	1500	6800	ND		ND		1.65		2.5		1.01	J	3.34		2.67		2.84		NT		NT		**7.7**		2.01		2.04		ND	
Silver	2	180	1500	6800	0.302	J	0.349	J	ND		ND		0.506	J	0.412	J	ND		ND		NT		NT		ND		ND		ND		ND	
Zinc	109	10000	10000	10000	32.6		35		83.9		~~84.0~~	R	**152**	J	**119**		50.0		45.6		NT		NT		**383**		91.7		72.0		61.5	
Polychlorinated biphenyls (PCBs) - mg/Kg [4]																																
Aroclor 1254	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Aroclor 1260	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Total PCBs	0.1	1	1	25	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Pesticides and Herbicides - mg/Kg [4]																																
4,4'-DDE	0.0033	8.9	62	120	ND		ND		ND		ND		0.00207	NJ	ND		ND		ND		NT		NT		ND		ND		ND		ND	
4,4'-DDT	0.0033	7.9	47	94	ND		ND		ND		ND		ND		**0.0041**		ND		ND		NT		NT		ND		ND		ND		ND	
4,4-DDD	0.0033	13	92	180	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Aldrin	0.005	0.097	0.68	1.4	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
alpha-BHC	0.02	0.48	3.4	6.8	ND		ND		ND		ND		ND		ND		0.00234	J	ND		NT		NT		ND		ND		ND		ND	
beta-BHC	0.036	0.36	3	14	ND		ND		ND		0.00827	J	ND		0.00337	NJ	ND		ND		NT		NT		ND		ND		ND		ND	
cis-Chlordane	0.094	4.2	24	47	ND		ND		ND		ND		0.00628	J	ND		ND		ND		NT		NT		ND		ND		ND		ND	
delta-BHC	0.04	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Dieldrin	0.005	0.2	1.4	2.8	ND		ND		ND		ND		ND		ND		ND		**0.00583**		NT		NT		ND		ND		ND		ND	
Endosulfan I	2.4	24	200	920	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Endosulfan II	2.4	24	200	920	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Endosulfan sulfate	2.4	24	200	920	ND		ND		0.00241	J	ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Endrin	0.014	11	89	410	ND		ND		ND		ND		ND		0.00185	J	ND		0.00211	NJ	NT		NT		ND		ND		ND		ND	
Endrin aldehyde	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		0.002	J	NT		NT		ND		ND		ND		ND	
Endrine ketone	--	--	--	--	ND		ND		ND		ND		0.00384	J	ND		ND		ND		NT		NT		ND		ND		ND		ND	
gamma-BHC (Lindane)	0.1	1.3	9.2	23	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		ND		ND		ND	
Heptachlor epoxide	--	--	--	--	ND		ND		ND		ND		0.00318	J	ND		ND		ND		NT		NT		ND		ND		ND		ND	
Methoxychlor	--	--	--	--	0.00568		0.00453	J	ND		0.0115	JN	ND		0.0282	NJ	ND		ND		NT		NT		ND		0.01		ND		ND	
trans-Chlordane	--	--	--	--	ND		ND		ND		ND		ND		ND		ND		ND		NT		NT		ND		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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:
ND = Parameter not detected above laboratory detection limit.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
NJ = The detection is tenative in identification and estimated in value.
R = The sample results are rejected due to deficiencies in meeting Quality Control limits. Tha analyte may or may not be present.
Bold = Result exceeds Unrestricted Use SCOs.
Bold = Result exceeds Restricted Residential Use SCOs.
Bold = Result exceeds Commercial Use SCOs.
Bold = Result exceeds Industrial use SCO's.

TABLE 4

SUMMARY OF REMEDIAL INVESTIGATION SUBSURFACE SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	C5-11ft	Q	BMC5-11ft	Q	C7-10-12ft	Q	C8-7-8ft	Q	C8-15-16ft	Q	D1-3-4ft	Q	DUPC-012517	Q	BMD1-3.5FT	Q	D2-3ft	Q	D2-15ft	Q	DUPD-012517	Q	D3-4ft	Q	D4-10-12ft	Q	DUPB-010617	Q
					Urban Fill		Urban Fill		Urban Fill		Construction Fill		Native		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Construction Fill		Construction Fill		Urban Fill		Urban Fill		Urban Fill	
Volatile Organic Compounds (VOCs) - mg/Kg 4																																
1,2-Dichlorobenzene	1.1	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
1,2,4-Trimethylbenzene	3.6	52	190	380	~~0.0037~~	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
1,3,5-Trimethylbenzene	8.4	52	190	380	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
2-Butanone (MEK)	0.12	100	500	1000	ND	R	ND		ND	R	ND	R	~~0.179~~	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Acetone	0.05	100	500	1000	~~0.0535~~	R	0.00312		~~0.0585~~	R	ND	R	~~0.537~~	R	0.0473	J	0.0471	J	0.0181	J	**0.084**	J	0.0393	J	0.046	J	0.0158	J	~~0.0329~~	R	~~0.0275~~	R
Benzene	0.06	4.8	44	89	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Carbon disulfide	--	--	--	--	~~0.0105~~	R	ND		~~0.00258~~	R	ND	R	~~0.0049~~	R	ND		0.00495		ND		0.00747		ND		ND		0.00754		ND	R	ND	R
Chlorobenzene	1.1	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
cis-1,2-Dichloroethylene	0.25	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Cyclohexane	--	--	--	--	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Ethylbenzene	1	41	390	780	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Isopropylbenzene (Cumene)	--	--	--	--	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Total Xylenes	0.26	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Methyl acetate	--	--	--	--	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Methylcyclohexane	--	--	--	--	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		~~0.0125~~	R	~~0.00962~~	R
Methylene chloride	0.05	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Naphthalene	12	100	500	1000	~~0.35~~	R	0.012		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
n-Butylbenzene	12	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
n-Propylbenzene	3.9	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
p-Cymene (p-isopropyltoluene)	--	--	--	--	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
sec-Butylbenzene	11	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Styrene	--	--	--	--	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
tert Butyl Methyl Ether	0.93	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Toluene	0.7	100	500	1000	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		0.00197	J	ND	R	ND	R
Trichloroethene	0.47	21	200	400	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Vinyl chloride	0.02	0.9	13	27	ND	R	ND		ND	R	ND	R	ND	R	ND		ND		ND		ND		ND		ND		ND		ND	R	ND	R
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [4]																																
1,1-Biphenyl	--	--	--	--	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
2-Methylnaphthalene	--	--		--	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Acenaphthene	20	100	500	1000	4.96		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Acenaphthylene	100	100	500	1000	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		0.169	J	ND	
Anthracene	100	100	500	1000	15.8		NT		ND		ND		ND		ND		ND		NT		0.37		ND		ND		0.409		0.538		ND	
Benzo(a)anthracene	1	1	5.6	11	**22.2**		NT		ND		0.227	J	ND		ND		0.178	J	NT		**1.14**		ND		ND		**1.17**		**1.4**		0.162	J
Benzo(a)pyrene	1	1	1	1.1	**18.4**		NT		ND		0.247	J	ND		ND		ND		NT		0.986		ND		ND		0.957		**1.01**		ND	
Benzo(b)fluoranthene	1	1	5.6	11	**15.8**		NT		ND		0.287	J	ND		ND		ND		NT		0.934		ND		ND		0.971		0.854		ND	
Benzo(ghi)perylene	100	100	500	1000	9.83		NT		ND		0.18	J	ND		ND		ND		NT		0.663		ND		ND		0.606		0.464		ND	
Benzo(k)fluoranthene	0.8	3.9	56	110	**13.4**		NT		ND		0.241	J	ND		ND		ND		NT		0.712		ND		ND		0.612		0.732		ND	
Carbazole	--	--	--	--	5.47		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Chrysene	1	3.9	56	110	**20.9**		NT		ND		0.336		ND		ND		0.167	J	NT		**1.04**		ND		ND		**1.01**		**1.2**		ND	
Dibenzo(a,h)anthracene	0.33	0.33	0.56	1.1	**4.1**		NT		ND		ND		ND		ND		ND		NT	J	0.228	J	ND		ND		0.201	J	0.269	J	ND	
Dibenzofuran	7	59	350	1000	4.34		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Fluoranthene	100	100	500	1000	53.5		NT		ND		0.756		ND		0.241	J	0.317		NT		2.19		ND		ND		2.14		2.63		0.29	J
Fluorene	30	100	500	1000	7.1		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	11	**7.86**		NT		ND		ND		ND		ND		ND		NT		**0.736**		ND		ND		**0.741**		0.361		ND	
Naphthalene	12	100	500	1000	2.42	J	NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Phenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
2-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
3-Methylphenol/4-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Phenanthrene	100	100	500	1000	49.6		NT		ND		0.463		ND		ND		0.199	J	NT		1.31		ND		ND		1.31		1.62		ND	
Pyrene	100	100	500	1000	41.9		NT		ND		0.683		ND		0.212	J	0.271	J	NT		1.73		ND		ND		1.65		2.12		0.254	J
Total Metals - mg/Kg																																
Arsenic	13	16	16	16	4.52		NT		1.09	D	1.50		9.76		2.14		1.90		NT		5.10		2.99		2.79		**14.9**		2.87		2.88	
Barium	350	400	400	10000	54.1		NT		19.8	J	11.4		70.3		32.4		23.7	J	NT		77.8	J	9.59	J	9.57	J	57.6	J	51.9		40.2	
Beryllium	7.2	72	590	2700	0.356		NT		0.162	J	0.153	J	0.637		0.223	J	0.195	J	NT		0.482		ND		ND		0.551		0.300		0.590	
Cadmium	2.5	4.3	9.3	60	0.234	J	NT		0.192	J	0.369		0.916		0.575		0.530		NT		1.52		0.405		0.405		1.32		0.422		0.305	
Hex Chromium	1	110	400	800	ND		NT		ND		NT		ND		NT		NT		NT		NT		NT		NT		NT		NT		NT	
Chromium	30	180	1500	6800	9.05		NT		5.86	D	5.63		19.4		7.81		6.53		NT		**30.1**		4.55		3.51		11.2		9.70		7.50	
Copper	50	270	270	10000	8.18		NT		7.06		7.24		30.5		7.99	J	7.21	J	NT		35.4	J	1.72	J	1.60	J	42.4	J	12.4		8.11	
Cyanide	27	27	27	10000	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Lead	63	400	1000	3900	**291**		NT		14.8	J	21.8		17.2		40.8		14.1		NT		**149**		4.04		3.98		**86.2**		**205**	J	**66.6**	J
Manganese	1600	2000	10000	10000	259		NT		221	J	200		244		262		296		NT		**4470**		149		146		381		286	J	433	J
Mercury	0.18	0.81	2.8	5.7	0.130		NT		0.0249		0.139		0.0279		~~0.0701~~	R	~~0.0177~~		NT		~~0.451~~	R	ND		ND		~~0.228~~	R	ND		0.0715	J
Nickel	30	310	310	10000	6.55		NT		4.95		4.53		**38.4**		6.46		5.39		NT		9.96		7.00		6.89		28.4		7.23		4.51	
Selenium	3.9	180	1500	6800	1.48		NT		0.969	J	ND		1.37		0.607		ND		NT		**4.54**		0.505	J	0.517	J	**4.03**		0.701		1.28	
Silver	2	180	1500	6800	ND		NT		ND		1.84		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Zinc	109	10000	10000	10000	96.2		NT		61.2		105		86.7		~~62.1~~	R	~~51.8~~	R	NT		~~108~~	R	~~21.7~~	R	~~20.8~~	R	~~123~~	R	72.6	J	40.4	J
Polychlorinated biphenyls (PCBs) - mg/Kg [4]																																
Aroclor 1254	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		0.0191	J	ND		ND	
Aroclor 1260	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Total PCBs	0.1	1	1	25	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		0.0191	J	ND		ND	
Pesticides and Herbicides - mg/Kg [4]																																
4,4'-DDE	0.0033	8.9	62	120	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
4,4'-DDT	0.0033	7.9	47	94	**0.00661**	J	NT		ND		ND		ND		ND		ND		NT		0.00326	J	ND		ND		0.00268	J	ND		ND	
4,4-DDD	0.0033	13	92	180	ND		NT		ND		ND		ND		ND		ND		NT		**0.00679**	J	ND		ND		ND		ND		ND	
Aldrin	0.005	0.097	0.68	1.4	**0.0159**		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
alpha-BHC	0.02	0.48	3.4	6.8	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
beta-BHC	0.036	0.36	3	14	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
cis-Chlordane	0.094	4.2	24	47	ND		NT		ND		0.0149		ND		ND		ND		NT		0.0039	JN	ND		ND		0.00757		ND		ND	
delta-BHC	0.04	100	500	1000	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Dieldrin	0.005	0.2	1.4	2.8	ND		NT		ND		ND		ND		ND		ND		NT		0.00197	J	ND		ND		ND		ND		ND	
Endosulfan I	2.4	24	200	920	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Endosulfan II	2.4	24	200	920	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Endosulfan sulfate	2.4	24	200	920	ND		NT		ND		ND		ND		ND		ND		NT		0.00515	JN	ND		ND		0.00489	JN	ND		ND	
Endrin	0.014	11	89	410	0.00503	J	NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Endrin aldehyde	--	--	--	--	ND		NT		0.00235	J	ND		ND		ND		ND		NT		ND		ND		ND		ND		ND		ND	
Endrine ketone	--	--	--	--	0.0241		NT		ND		0.0027	J	ND		ND		ND		NT		0.00655	J	ND		ND		0.00457	J	ND		ND	
gamma-BHC (Lindane)	0.1	1.3	9.2	23	ND		NT		ND		ND		0.00375	NJ	ND		ND		NT		ND		ND		ND		ND		ND		ND	
Heptachlor epoxide	--	--	--	--	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		0.00188	J	ND		ND	
Methoxychlor	--	--	--	--	ND		NT		ND		ND		ND		ND		ND		NT		0.015		ND		ND		0.0132		ND		ND	
trans-Chlordane	--	--	--	--	ND		NT		ND		ND		ND		ND		ND		NT		ND		ND		ND		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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:
ND = Parameter not detected above laboratory detection limit.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
NJ = The detection is tenative in identification and estimated in value.
R = The sample results are rejected due to deficiencies in meeting Quality Control limits. Tha analyte may or may not be present.

🟩 **Bold**	= Result exceeds Unrestricted Use SCOs.
🟨 **Bold**	= Result exceeds Restricted Residential Use SCOs.
🟦 **Bold**	= Result exceeds Commercial Use SCOs.
🟥 **Bold**	= Result exceeds Industrial use SCO's.

TABLE 4

SUMMARY OF REMEDIAL INVESTIGATION SUBSURFACE SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	D4-15ft	Q	D5-6-8ft	Q	D6-2-4ft	Q	D7-10-11ft	Q	TP-D7-SOUTH-1 (10-12)	Q	TP-D7-EAST-1 (10-12)	Q	TP-D7-NORTH-1 (10-12)	Q	TP-D7-WEST-2 (3-5)	Q	TP-D7-WEST-2 (5-7)	Q	TP-D7-WEST-2 (7-9)	Q	D7-15-16ft	Q	D8-5-6ft	Q	E2-7.5-8.5ft	Q	E3-5-6ft	Q	E3-15ft	Q	E5-3-4ft	Q	BME5-3.5ft	Q	E5-15-16ft	Q	BME5-15.5ft	Q	E6-7-8ft	Q
					Native		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Construction Fill		Urban Fill		Urban Fill		Native		Native		Urban Fill	
Volatile Organic Compounds (VOCs) - mg/Kg 4																																												
1,2-Dichlorobenzene	1.1	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
1,2,4-Trimethylbenzene	3.6	52	190	380	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	~~43.5~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
1,3,5-Trimethylbenzene	8.4	52	190	380	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	~~16.3~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
2-Butanone (MEK)	0.12	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		0.0144	J	ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Acetone	0.05	100	500	1000	~~0.0633~~	R	~~0.0668~~	R	~~0.0284~~	R	ND		**0.15**	J	NT		NT		ND		0.0071		NT		**0.0689**	J	~~0.0109~~	R	~~0.186~~	R	ND	R	~~0.045~~	R	ND	R	0.0229		~~0.0518~~	R	ND		0.0456	
Benzene	0.06	4.8	44	89	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Carbon disulfide	--	--	--	--	~~0.0035~~	R	~~0.00783~~	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		~~0.00226~~	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Chlorobenzene	1.1	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		0.00648	
cis-1,2-Dichloroethylene	0.25	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Cyclohexane	--	--	--	--	ND	R	ND	R	ND	R	ND		0.8	J	NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Ethylbenzene	1	41	390	780	ND	R	ND	R	ND	R	ND		0.3		NT		NT		0.057	J+	ND		NT		ND		ND	R	ND	R	~~3.31~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
Isopropylbenzene (Cumene)	--	--	--	--	ND	R	ND	R	ND	R	ND		0.12		NT		NT		0.18	J+	ND		NT		ND		ND	R	ND	R	~~2.87~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
Total Xylenes	0.26	100	500	1000	ND	R	ND	R	ND	R	ND		0.153	J	NT		NT		0.155	J+	ND		NT		ND		ND	R	ND	R	~~8.26~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
Methyl acetate	--	--	--	--	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Methylcyclohexane	--	--	--	--	ND	R	ND	R	ND	R	ND		2.4		NT		NT		0.12	J+	ND		NT		ND		ND	R	ND	R	~~5.83~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
Methylene chloride	0.05	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		~~0.00672~~	R	ND	R	ND	R	ND	R	~~0.00662~~	R	ND		ND	R	ND		ND	
Naphthalene	12	100	500	1000	ND	R	ND	R	ND	R	**28.3**		ND		NT		NT		ND		ND		NT		ND		ND	R	1.88	R	~~6.04~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
n-Butylbenzene	12	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	~~11.8~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
n-Propylbenzene	3.9	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	~~6.39~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
p-Cymene (p-isopropyltoluene)	--	--	--	--	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
sec-Butylbenzene	11	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	~~6.5~~	R	ND	R	ND	R	ND		ND	R	ND		ND	
Styrene	--	--	--	--	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
tert Butyl Methyl Ether	0.93	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Toluene	0.7	100	500	1000	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Trichloroethene	0.47	21	200	400	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Vinyl chloride	0.02	0.9	13	27	ND	R	ND	R	ND	R	ND		ND		NT		NT		ND		ND		NT		ND		ND	R	ND	R	ND	R	ND	R	ND	R	ND		ND	R	ND		ND	
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg 4																																												
1,1-Biphenyl	--	--	--	--	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		3.94		ND		ND		NT		ND		NT		ND	
2-Methylnaphthalene	--	--		--	ND		ND		ND		26.2		NT		NT		NT		NT		NT		NT		ND		ND		1.92	J	10.8		ND		ND		NT		ND		NT		ND	
Acenaphthene	20	100	500	1000	ND		ND		ND		**26**		ND		ND		0.056	J	0.58		NT		0.38		ND		ND		3.61		2.51	J	ND		2.12	J	NT		ND		NT		ND	
Acenaphthylene	100	100	500	1000	ND		ND		ND		ND		ND		ND		0.034	J	ND		NT		0.38		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Anthracene	100	100	500	1000	ND		ND		ND		47.5		ND		ND		0.16		0.36		NT		0.68		ND		0.372	J-	10.6		ND		ND		8.31		NT		ND		NT		ND	
Benzo(a)anthracene	1	1	5.6	11	ND		ND		ND		**49.4**		ND		ND		0.34		0.078	J	NT		**1.8**		0.186	J	0.939	J-	**13.6**		ND		0.259	J-	**16.5**		NT		ND		NT		ND	
Benzo(a)pyrene	1	1	1	1.1	ND		ND		ND		**41.6**		ND		ND		0.28		0.064	J	NT		**1.7**		ND		0.954	J-	**9.37**		ND		0.209	J-	**13.7**		NT		ND		NT		ND	
Benzo(b)fluoranthene	1	1	5.6	11	ND		ND		ND		**30.2**		ND		ND		0.36		0.093	J	NT		**2.1**		ND		0.987	J-	**7.18**		ND		0.228	J-	**10.9**		NT		ND		NT		ND	
Benzo(ghi)perylene	100	100	500	1000	ND		ND		ND		19.9		ND		ND		0.14	J	0.049	J	NT		0.92		ND		0.694	J-	4.55		ND		ND		6.28		NT		ND		NT		ND	
Benzo(k)fluoranthene	0.8	3.9	56	110	ND		ND		ND		**38.5**		ND		ND		0.12		ND		NT		**0.86**		ND		0.965	J-	**8.26**		ND		0.179	J-	**12.1**		NT		ND		NT		ND	
Carbazole	--	--	--	--	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		0.379	J-	ND		ND		ND		ND		NT		ND		NT		ND	
Chrysene	1	3.9	56	110	ND		ND		ND		**43.6**		ND		ND		0.32		0.083	J	NT		**2.2**		0.211	J	**1.35**	J-	**11.8**		ND		0.292	J-	**15.5**		NT		ND		NT		ND	
Dibenzo(a,h)anthracene	0.33	0.33	0.56	1.1	ND		ND		ND		**11**	J	ND		ND		0.044	J	ND		NT		0.24		ND		0.289	J-	**2.7**	J	ND		ND		**3.97**		NT		ND		NT		ND	
Dibenzofuran	7	59	350	1000	ND		ND		ND		**35.1**		ND		ND		0.035	J	0.67		NT		0.45		ND		ND		3.1	JP	2.02	J	ND		ND		NT		ND		NT		ND	
Fluoranthene	100	100	500	1000	ND		0.178	J	ND		**127**		0.032	J	ND		0.71		0.24		NT		5.3		0.486		3.07	J-	28.9		ND		0.454	J-	34.2		NT		ND		NT		ND	
Fluorene	30	100	500	1000	ND		ND		ND		**46.8**		ND		ND		0.076	J	1.8		NT		0.58		ND		0.205	J-	4.8		5.13		ND		3.6		NT		ND		NT		ND	
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	11	ND		ND		ND		**13.5**	J	ND		ND		0.16		0.045	J	NT		**1**		ND		0.441	J-	**3.54**	J	ND		ND		**5.35**		NT		ND		NT		ND	
Naphthalene	12	100	500	1000	ND		ND		ND		**107**		0.1	J	ND		0.029	J	0.29		NT		0.88		ND		ND		1.88		4.06		ND		ND		NT		ND		NT		ND	
Phenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		NT		0.066	J	ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
2-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		NT		0.04	J	ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
3-Methylphenol/4-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		ND		ND		ND		NT		0.1	J	ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Phenanthrene	100	100	500	1000	ND		ND		ND		**177**		0.049	J	ND		0.58		0.26		NT		5.8		0.443		2.3	J-	32		6.22		0.185	J-	26.2		NT		ND		NT		ND	
Pyrene	100	100	500	1000	ND		0.174	J	ND		95.4		0.025	J	ND		0.6		0.29		NT		4.4		0.434		2.6	J-	20.7		ND		0.426	J-	28.7		NT		ND		NT		ND	
Total Metals - mg/Kg																																												
Arsenic	13	16	16	16	4.64		6.21		7.17		4.59		NT		NT		NT		NT		NT		NT		3.02		**24.0**	J	9.59		1.54		3.57		4.90		NT		4.68		NT		1.81	
Barium	350	400	400	10000	33.9		24.8		52.6		57.4		NT		NT		NT		NT		NT		NT		97.7		72.0	J	147		11.0		44.6		122		NT		107		NT		14.7	
Beryllium	7.2	72	590	2700	0.247	J	0.166	J	0.460		0.196	J	NT		NT		NT		NT		NT		NT		0.749		0.518		0.435		0.159	J	0.338		0.734		NT		0.778		NT		ND	
Cadmium	2.5	4.3	9.3	60	0.643		1.23		0.531		0.322		NT		NT		NT		NT		NT		NT		0.602		**3.58**	J	2.32		0.404		0.609		0.784		NT		1.33		NT		0.275	J
Hex Chromium	1	110	400	800	NT		ND		NT		1.0		NT		NT		NT		NT		NT		NT		NT		NT		NT		ND		ND		NT		NT		ND		NT		NT	
Chromium	30	180	1500	6800	9.19		8.59		13.0		9.31		NT		NT		NT		NT		NT		NT		26.1		**30.1**	J	16.2		4.36		10.0		9.28		NT		18.2		NT		8.57	
Copper	50	270	270	10000	45.8	J	27.0		22.6		26.9		NT		NT		NT		NT		NT		NT		24.8		**210**	J	**87.3**		5.90		12.7		32.2		NT		33.7		NT		16.6	
Cyanide	27	27	27	10000	ND		ND		ND		0.544		NT		NT		NT		NT		NT		NT		ND		0.554		NT		ND		1.18		ND		NT		ND		NT		ND	
Lead	63	400	1000	3900	**72.2**		40.5		27.6		34.9		NT		NT		NT		NT		NT		NT		21.2		**518**	J	**291**		8.18		**95.6**		**296**		NT		27.8		NT		39.4	
Manganese	1600	2000	10000	10000	274		480		254		218		NT		NT		NT		NT		NT		NT		275		720	D	161		155		351		218		NT		216		NT		231	
Mercury	0.18	0.81	2.8	5.7	**0.232**	J	0.0551		0.122		**0.478**		NT		NT		NT		NT		NT		NT		0.0408		**1.06**	J	**0.826**		0.130		0.132		**0.225**		NT		0.0535		NT		**1.19**	
Nickel	30	310	310	10000	11.2		8.23		21.3		4.79		NT		NT		NT		NT		NT		NT		**34.0**		**58.0**	J	18.8		3.92		9.81		9.09		NT		28.0		NT		4.55	
Selenium	3.9	180	1500	6800	1.36	D	2.29		ND		ND		NT		NT		NT		NT		NT		NT		0.675		3.79		1.83		1.02		1.16		0.617		NT		1.62		NT		ND	
Silver	2	180	1500	6800	ND		0.380	J	ND		0.307	J	NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		0.503	J	NT		ND		NT		ND	
Zinc	109	10000	10000	10000	66.5		55.3		65.7		63.6		NT		NT		NT		NT		NT		NT		98.2		**293**	J	**226**		35.3		68.8		95.7		NT		95.0		NT		61.2	
Polychlorinated biphenyls (PCBs) - mg/Kg 4																																												
Aroclor 1254	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Aroclor 1260	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Total PCBs	0.1	1	1	25	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Pesticides and Herbicides - mg/Kg 4																																												
4,4'-DDE	0.0033	8.9	62	120	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
4,4'-DDT	0.0033	7.9	47	94	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
4,4-DDD	0.0033	13	92	180	ND		ND		ND		**0.00735**		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Aldrin	0.005	0.097	0.68	1.4	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
alpha-BHC	0.02	0.48	3.4	6.8	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		0.00203	J	ND		ND		NT		ND		NT		ND	
beta-BHC	0.036	0.36	3	14	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		0.00359	J	0.00239	NJ	ND		NT		ND		NT		ND	
cis-Chlordane	0.094	4.2	24	47	ND		ND		0.00390		ND		NT		NT		NT		NT		NT		NT		ND		0.0391	J	0.0264		ND		ND		0.0288	J	NT		ND		NT		ND	
delta-BHC	0.04	100	500	1000	ND		ND		ND		0.00594	NJ	NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Dieldrin	0.005	0.2	1.4	2.8	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		**0.00566**	NJ	NT		ND		NT		ND	
Endosulfan I	2.4	24	200	920	ND		ND		ND		0.00383	J	NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Endosulfan II	2.4	24	200	920	ND		ND		ND		0.00436	J	NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Endosulfan sulfate	2.4	24	200	920	ND		ND		0.00627	NJ	ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Endrin	0.014	11	89	410	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Endrin aldehyde	--	--	--	--	ND		ND		ND		0.0191	NJ	NT		NT		NT		NT		NT		NT		ND		ND		0.00424	NJ	ND		ND		0.00471	NJ	NT		ND		NT		ND	
Endrine ketone	--	--	--	--	0.00294	JP	ND		ND		0.00945	NJ	NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		0.00463	NJ	NT		ND		NT		ND	
gamma-BHC (Lindane)	0.1	1.3	9.2	23	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		ND	
Heptachlor epoxide	--	--	--	--	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		0.00287	NJ	ND		NT		ND		NT		ND	
Methoxychlor	--	--	--	--	ND		ND		0.00353	J	0.132	NJ	NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		0.00374	NJ	ND		NT		ND		NT		ND	
trans-Chlordane	--	--	--	--	ND		ND		ND		ND		NT		NT		NT		NT		NT		NT		ND		ND		ND		ND		ND		ND		NT		ND		NT		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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:
ND = Parameter not detected above laboratory detection limit.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
NJ = The detection is tenative in identification and estimated in value.
R = The sample results are rejected due to deficiencies in meeting Quality Control limits. Tha analyte may or may not be present.
🟩 **Bold** = Result exceeds Unrestricted Use SCOs.
🟨 **Bold** = Result exceeds Restricted Residential Use SCOs.
🟦 **Bold** = Result exceeds Commercial Use SCOs.
🟥 **Bold** = Result exceeds Industrial use SCO's.

TABLE 4

SUMMARY OF REMEDIAL INVESTIGATION SUBSURFACE SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	E8-7-8ft	Q	F1-14.5-16ft	Q	F2-6.5-8ft	Q	F2-15ft	Q	F3-3ft	Q	BMF3-3ft	Q	F3-6.5-8ft	Q	BMF3-7ft	Q	F3-15ft	Q	BMF3-15ft	Q	F4-3ft	Q	F4-COMP 3 FT	Q	F5-6.5-8ft	Q	F5-15ft	Q	F6-11-12ft	Q
					Urban Fill		Urban Fill		Urban Fill		Construction Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Construction Fill		Construction Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill		Urban Fill	
Volatile Organic Compounds (VOCs) - mg/Kg 4																																		
1,2-Dichlorobenzene	1.1	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		~~0.00225~~	R	ND	R	ND	R
1,2,4-Trimethylbenzene	3.6	52	190	380	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
1,3,5-Trimethylbenzene	8.4	52	190	380	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
2-Butanone (MEK)	0.12	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Acetone	0.05	100	500	1000	0.045		**0.142**	J	ND		0.0181	J	ND	R	ND		ND		ND		**0.0531**	J	ND		ND		NT		~~0.0598~~	R	~~0.0534~~	R	~~0.0645~~	R
Benzene	0.06	4.8	44	89	ND		0.0159		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Carbon disulfide	--	--	--	--	0.00241	J	0.0236		ND		ND		~~0.00715~~	R	ND		ND		ND		0.00255	J	ND		ND		NT		~~0.00331~~	R	ND	R	~~0.00338~~	R
Chlorobenzene	1.1	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
cis-1,2-Dichloroethylene	0.25	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Cyclohexane	--	--	--	--	ND		0.0157	J	ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Ethylbenzene	1	41	390	780	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Isopropylbenzene (Cumene)	--	--	--	--	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Total Xylenes	0.26	100	500	1000	0.00329	J	0.00383	J	ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Methyl acetate	--	--	--	--	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Methylcyclohexane	--	--	--	--	ND		0.00317	J	ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Methylene chloride	0.05	100	500	1000	0.00916	J	ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	~~0.00546~~	R
Naphthalene	12	100	500	1000	ND		ND		0.00731	J	ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
n-Butylbenzene	12	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
n-Propylbenzene	3.9	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
p-Cymene (p-isopropyltoluene)	--	--	--	--	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
sec-Butylbenzene	11	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Styrene	--	--	--	--	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
tert Butyl Methyl Ether	0.93	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Toluene	0.7	100	500	1000	ND		ND		ND		ND		ND	R	ND		ND		ND		0.00197	J	ND		ND		NT		ND	R	ND	R	ND	R
Trichloroethene	0.47	21	200	400	ND		ND		ND		0.00246	J	ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Vinyl chloride	0.02	0.9	13	27	ND		ND		ND		ND		ND	R	ND		ND		ND		ND		ND		ND		NT		ND	R	ND	R	ND	R
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [4]																																		
1,1-Biphenyl	--	--	--	--	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
2-Methylnaphthalene	--	--		--	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Acenaphthene	20	100	500	1000	ND		0.222	J	0.631	J	ND		0.196	J	NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Acenaphthylene	100	100	500	1000	ND		0.182	J	ND		ND		ND		NT		0.217	J	NT		ND		NT		ND		NT		ND		ND		ND	
Anthracene	100	100	500	1000	0.345	J	0.81	J	1.64		ND		0.563		NT		0.801		NT		ND		NT		ND		NT		ND		ND		0.365	
Benzo(a)anthracene	1	1	5.6	11	0.873		**2.28**	J	**3.35**		ND		**1.31**		NT		**2.46**		NT		ND		NT		0.542		NT		ND		ND		0.505	
Benzo(a)pyrene	1	1	1	1.1	0.884		**1.78**	J	**2.67**		ND		**1.13**		NT		**1.97**		NT		ND		NT		0.463		NT		ND		ND		0.507	
Benzo(b)fluoranthene	1	1	5.6	11	0.721		**1.86**	J	**2.77**		ND		**1.14**		NT		**2.07**		NT		ND		NT		0.504		NT		ND		ND		0.424	
Benzo(ghi)perylene	100	100	500	1000	0.514		1.09	J	1.66		ND		0.775		NT		1.25		NT		ND		NT		0.328	J	NT		ND		ND		0.268	J
Benzo(k)fluoranthene	0.8	3.9	56	110	**0.818**		**1.19**	J	**1.49**		ND		0.774		NT		**1.09**		NT		ND		NT		0.266	J	NT		ND		ND		0.422	
Carbazole	--	--	--	--	ND		0.358	J	0.89		ND		0.364	J	NT		0.249	J	NT		ND		NT		ND		NT		ND		ND		ND	
Chrysene	1	3.9	56	110	**1.02**		**2.08**	J	**3.11**		ND		**1.44**		NT		**2.21**		NT		ND		NT		0.463		NT		ND		ND		0.563	
Dibenzo(a,h)anthracene	0.33	0.33	0.56	1.1	0.233	J	**0.378**	J	**0.504**	J	ND		0.292	J	NT		**0.361**		NT		ND		NT		ND		NT		ND		ND		ND	
Dibenzofuran	7	59	350	1000	ND		ND		0.49	J	ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Fluoranthene	100	100	500	1000	2.12		5.15	J	8.57		ND		3.33		NT		5.57		NT		ND		NT		0.915		NT		ND		0.174	J	1.3	
Fluorene	30	100	500	1000	ND		0.345	J	0.794		ND		0.216		NT		0.208	J	NT		ND		NT		ND		NT		ND		ND		0.185	J
Indeno(1,2,3-cd)pyrene	0.5	0.5	5.6	11	0.329	J	**1.21**	J	**2.02**		ND		0.606		NT		**1.54**		NT		ND		NT		0.409		NT		ND		ND		0.197	J
Naphthalene	12	100	500	1000	ND		ND		0.00731	J	ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Phenol	0.33	100	500	1000	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
2-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
3-Methylphenol/4-Methylphenol	0.33	100	500	1000	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Phenanthrene	100	100	500	1000	1.55		3.28	J	8.34		ND		2.74		NT		2.72		NT		ND		NT		0.494		NT		0.191	J	ND		1.17	
Pyrene	100	100	500	1000	1.99		3.77	J	6.43		ND		2.61		NT		3.93		NT		ND		NT		0.725		NT		0.235	J	0.176	J	1.24	
Total Metals - mg/Kg																																		
Arsenic	13	16	16	16	**18.9**		11.1		8.36		4.08		8.58		NT		7.28		NT		3.85		NT		6.51		NT		5.15		3.33		2.57	
Barium	350	400	400	10000	287		163	J	81.8	J	9.65	J	132		NT		102	J	NT		7.93	J	NT		85.1	J	NT		70.3		21.7		36.3	
Beryllium	7.2	72	590	2700	0.583		0.345		0.308		ND		0.409		NT		0.359		NT		0.143	J	NT		0.453		NT		0.512		0.203	J	0.193	J
Cadmium	2.5	4.3	9.3	60	0.900		2.14		2.45		0.393		1.37		NT		1.40		NT		0.484		NT		2.03		NT		0.746		0.539		0.300	
Hex Chromium	1	110	400	800	ND		NT		ND		NT		~~ND~~	R	NT		NT		NT		NT		NT		NT		NT		ND		NT		NT	
Chromium	30	180	1500	6800	17.8		17.7		13.6		3.27		17.7		NT		17.1		NT		4.08		NT		**472**		10.3		9.56		5.88		5.80	
Copper	50	270	270	10000	**280**		~~233~~	J	**141**	J	2.26	J	**59.1**		NT		43.4	J	NT		2.15	J	NT		29.3	J	NT		10.2		8.03		23.6	
Cyanide	27	27	27	10000	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		0.510	
Lead	63	400	1000	3900	**480**		**275**		**178**		5.58		**417**		NT		**285**		NT		5.12		NT		**91.2**		NT		**100**		29.0		**114**	
Manganese	1600	2000	10000	10000	271		328	M	293		116		312		NT		213		NT		176		NT		**8910**		392		278		172		165	
Mercury	0.18	0.81	2.8	5.7	**0.239**		~~0.269~~	R	~~0.228~~	R	ND		**0.769**		NT		~~2.05~~	R	NT		ND		NT		~~0.401~~	R	NT		0.00646	J	0.0367		0.0479	
Nickel	30	310	310	10000	18.5		14.0		12.0		6.70		21.0		NT		12.9		NT		7.92		NT		16.8		NT		7.73		8.1		6.87	
Selenium	3.9	180	1500	6800	1.73		**4.39**		**4.84**		ND		1.99		NT		0.718		NT		0.752		NT		**7.3**		NT		2.77		1.89		ND	
Silver	2	180	1500	6800	0.748		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Zinc	109	10000	10000	10000	**422**		~~486~~	R	~~502~~	R	~~22.1~~	R	**242**		NT		~~306~~	R	NT		~~23.9~~	R	NT		~~111~~	R	NT		61.6		41.7		99.0	
Polychlorinated biphenyls (PCBs) - mg/Kg [4]																																		
Aroclor 1254	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		0.0228	J	NT		ND		ND		ND	
Aroclor 1260	See Total PCBs	See Total PCBs	See Total PCBs	See Total PCBs	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Total PCBs	0.1	1	1	25	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		0.0228	J	NT		ND		ND		ND	
Pesticides and Herbicides - mg/Kg [4]																																		
4,4'-DDE	0.0033	8.9	62	120	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
4,4'-DDT	0.0033	7.9	47	94	ND		ND		ND		ND		0.00258	NJ	NT		**0.00364**	JN	NT		ND		NT		ND		NT		ND		ND		ND	
4,4-DDD	0.0033	13	92	180	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Aldrin	0.005	0.097	0.68	1.4	ND		ND		ND		ND		0.00347	NJ	NT		ND		NT		ND		NT		**0.0061**	JN	NT		ND		ND		ND	
alpha-BHC	0.02	0.48	3.4	6.8	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
beta-BHC	0.036	0.36	3	14	ND		0.00937	J	ND		ND		ND		NT		ND		NT		0.00262	J	NT		ND		NT		ND		ND		ND	
cis-Chlordane	0.094	4.2	24	47	ND		ND		0.00278	JN	ND		0.0226		NT		0.0293		NT		ND		NT		ND		NT		ND		ND		0.00507	J
delta-BHC	0.04	100	500	1000	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Dieldrin	0.005	0.2	1.4	2.8	0.00436		ND		ND		ND		ND		NT		ND		NT		ND		NT		0.00336		NT		ND		ND		ND	
Endosulfan I	2.4	24	200	920	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Endosulfan II	2.4	24	200	920	ND		ND		0.00242	J	ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Endosulfan sulfate	2.4	24	200	920	ND		0.0199		ND		ND		ND		NT		0.00994		NT		ND		NT		ND		NT		ND		ND		ND	
Endrin	0.014	11	89	410	ND		ND		ND		ND		0.00312	NJ	NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Endrin aldehyde	--	--	--	--	ND		ND		0.004		ND		0.00559		NT		0.00407		NT		ND		NT		ND		NT		ND		ND		ND	
Endrine ketone	--	--	--	--	ND		ND		0.00714	J	ND		ND		NT		0.0114	J	NT		ND		NT		0.00457		NT		ND		ND		0.00238	J
gamma-BHC (Lindane)	0.1	1.3	9.2	23	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		ND		ND	
Heptachlor epoxide	--	--	--	--	ND		ND		0.00252	J	ND		ND		NT		0.00196	J	NT		ND		NT		ND		NT		ND		ND		ND	
Methoxychlor	--	--	--	--	ND		0.0638	JN	ND		ND		ND		NT		NT		NT		ND		NT		0.0223	JN	NT		ND		ND		ND	
trans-Chlordane	--	--	--	--	ND		ND		ND		ND		ND		NT		ND		NT		ND		NT		ND		NT		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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:

ND = Parameter not detected above laboratory detection limit.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
NJ = The detection is tenative in identification and estimated in value.
R = The sample results are rejected due to deficiencies in meeting Quality Control limits. Tha analyte may or may not be present.
Bold = Result exceeds Unrestricted Use SCOs.
Bold = Result exceeds Restricted Residential Use SCOs.
Bold = Result exceeds Commercial Use SCOs.
Bold = Result exceeds Industrial use SCO's.

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TABLE 5

SUMMARY OF REMEDIAL INVESTIGATION TEST PITS SOIL/FILL SAMPLE ANALYSIS RESULTS

SITE MANGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	Unrestricted Use SCOs [2]	Restricted Residential Use SCOs [3]	Commercial Use SCOs [3]	Industrial Use SCO's [3]	TP-1-5-6FT	Q	TP-2-6-7FT	Q	TP-3-6-7FT	Q	TP-4-6-7FT	Q	TP-6-5-6FT	Q	TP-7-6-7FT	Q
Volatile Organic Compounds (VOCs) - mg/Kg [4]																
Acetone	**0.05**	**100**	**500**	**1000**	~~0.069~~	R	~~0.0359~~	R	~~0.0222~~	R	ND	R	~~0.266~~	R	~~0.0157~~	R
Carbon disulfide	--	--	--	--	ND	R	ND	R	ND	R	~~0.00567~~	R	~~0.0148~~	R	ND	R
Naphthalene	**12**	**100**	**500**	**1000**	ND	R	ND	R	ND	R	ND	R	~~0.208~~	R	ND	R
2-Butanone (MEK)	**0.12**	**100**	**500**	**1000**	ND	R	ND	R	ND	R	ND	R	~~0.0622~~	R	ND	R
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg [4]																
2-Methylnaphthalene	--	--	--	--	ND		ND		ND		0.348	J	ND		ND	
2,4-Dinitrotoluene	--	--	--	--	ND		ND		ND		ND		0.203	J	ND	
Acenaphthene	**20**	**100**	**500**	**1000**	ND		ND		ND		ND		0.223	J	ND	
Anthracene	**100**	**100**	**500**	**1000**	ND		ND		0.291	J	0.285	J	0.851		ND	
Benzo(a)anthracene	**1**	**1**	**5.6**	**11**	ND		0.228	J	0.466		**1.03**		**2.13**		ND	
Benzo(a)pyrene	**1**	**1**	**1**	**1.1**	ND		0.261	J	0.361		0.794		**1.78**		ND	
Benzo(b)fluoranthene	**1**	**1**	**5.6**	**11**	ND		0.371		0.31	J	0.82		**1.51**		ND	
Benzo(ghi)perylene	**100**	**100**	**500**	**1000**	ND		0.696		0.228	J	0.511		1.08		ND	
Benzo(k)fluoranthene	**0.8**	**3.9**	**56**	**110**	ND		0.238	J	0.315	J	0.594		**1.46**		ND	
Carbazole	--	--	--	--	ND		ND		ND		ND		0.303	J	ND	
Chrysene	**1**	**3.9**	**56**	**110**	ND		0.221	J	0.469		**1.02**		**2.02**		ND	
Dibenzo(a,h)anthracene	**0.33**	**0.33**	**0.56**	**1.1**	ND		ND		ND		0.223	J	**0.44**		ND	
Dibenzofuran	**7**	**59**	**350**	**1000**	ND		ND		ND		ND		0.192	J	ND	
Fluoranthene	**100**	**100**	**500**	**1000**	0.222	J-	0.352	J	1.03		1.79		4.52		ND	
Fluorene	**30**	**100**	**500**	**1000**	ND		ND		ND		ND		0.338	J	ND	
Indeno(1,2,3-cd)pyrene	**0.5**	**0.5**	**5.6**	**11**	ND		0.33	J	ND		0.387		**0.756**		ND	
Naphthalene	**12**	**100**	**500**	**1000**	ND		ND		ND		0.289	J	0.208	J	ND	
Phenanthrene	**100**	**100**	**500**	**1000**	ND		0.222	J	0.926		1.42		2.96		ND	
Pyrene	**100**	**100**	**500**	**1000**	0.192	J-	0.33	J	0.33		1.41		3.52		ND	
Total Metals - mg/Kg																
Arsenic	**13**	**16**	**16**	**16**	3.9		9.66		4.58		9.33		10.7		2.24	
Barium	**350**	**400**	**400**	**10000**	73.4		57		85.6		93.8		103		73	
Beryllium	**7.2**	**72**	**590**	**2700**	0.422		0.476		0.496		0.38		0.472		0.202	J
Cadmium	**2.5**	**4.3**	**9.3**	**60**	0.659		0.717		0.865		**2.96**		2.25		0.333	
Hex Chromium	**1**	**110**	**400**	**800**	NT		NT		ND		NT		NT		NT	
Chromium	**30**	**180**	**1500**	**6800**	13.2		12.3		13.7		**65.1**		22		6.57	
Copper	**50**	**270**	**270**	**10000**	28.2		23.6		48		**110**		**76.7**		11.9	
Cyanide	**27**	**27**	**27**	**10000**	NT		NT		NT		NT		NT		NT	
Lead	**63**	**400**	**1000**	**3900**	**70**		37.4		**190**		**371**		**261**		61.5	
Manganese	**1600**	**2000**	**10000**	**10000**	240		346		320		192		296	M	203	
Mercury	**0.18**	**0.81**	**2.8**	**5.7**	0.141		**1.44**		ND		**0.404**		**0.829**	D	0.162	
Nickel	**30**	**310**	**310**	**10000**	19.6		20.4		14.6		16.1		20.3		5.61	
Selenium	**3.9**	**180**	**1500**	**6800**	1.4		1.24		1.14		1.52		2.16	J	1.53	
Silver	**2**	**180**	**1500**	**6800**	ND		ND		ND		ND		ND		ND	
Zinc	**109**	**10000**	**10000**	**10000**	**111**		81.9		**1200**		**221**		**280**		92.9	
Polychlorinated biphenyls (PCBs) - mg/Kg [4]																
Total PCBs	**0.1**	**1**	**1**	**25**	ND		ND		ND		ND		ND		ND	
Pesticides and Herbicides - mg/Kg [4]																
4,4'-DDE	**0.0033**	**8.9**	**62**	**120**	ND		ND		ND		ND		ND		ND	
4,4'-DDT	**0.0033**	**7.9**	**47**	**94**	ND		ND		ND		**0.0247**		**0.00744**	J	ND	
4,4-DDD	**0.0033**	**13**	**92**	**180**	ND		ND		ND		ND		**0.047**	J	ND	
Aldrin	**0.005**	**0.097**	**0.68**	**1.4**	ND		ND		ND		ND		ND		ND	
alpha-BHC	**0.02**	**0.48**	**3.4**	**6.8**	ND		ND		ND		ND		ND		ND	
beta-BHC	**0.036**	**0.36**	**3**	**14**	ND		ND		ND		ND		ND		ND	
cis-Chlordane	**0.094**	**4.2**	**24**	**47**	ND		ND		ND		ND		ND		ND	
delta-BHC	**0.04**	**100**	**500**	**1000**	ND		ND		ND		ND		ND		ND	
Dieldrin	**0.005**	**0.2**	**1.4**	**2.8**	ND		ND		ND		ND		ND		ND	
Endosulfan I	**2.4**	**24**	**200**	**920**	ND		ND		ND		ND		ND		ND	
Endosulfan II	**2.4**	**24**	**200**	**920**	ND		ND		ND		ND		ND		ND	
Endosulfan sulfate	**2.4**	**24**	**200**	**920**	ND		ND		ND		ND		0.0119	J	ND	
Endrin	**0.014**	**11**	**89**	**410**	ND		ND		ND		ND		ND		ND	
Endrin aldehyde	--	--	--	--	ND		ND		ND		ND		ND		ND	
Endrine ketone	--	--	--	--	ND		ND		ND		ND		0.00591	P	ND	
gamma-BHC (Lindane)	**0.1**	**1.3**	**9.2**	**23**	ND		ND		ND		ND		ND		0.00198	NJ
Heptachlor	**0.042**	**2.1**	**15**	**29**	ND		ND		ND		ND		ND		ND	
Heptachlor epoxide	--	--	--	--	ND		ND		ND		0.00329	J	ND		ND	
Methoxychlor	--	--	--	--	0.00683	NJ	0.00993	J	0.0045	J	0.0164		ND		ND	
trans-Chlordane	--	--	--	--	ND		ND		ND		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 NYSDEC Part 375 Table 375-6.8(a) Unrestricted Soil Cleanup Objectives.
3. Values per NYSDEC Part 375 Table 375-6.8(b) Restricted Soil Cleanup Objectives.
4. Sample results were reported by the laboratory in ug/kg and converted to mg/kg for comparisons to SCOs.

Definitions:
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🟩 **Bold**	= Result exceeds Unrestricted Use SCOs.
🟨 **Bold**	= Result exceeds Restricted Residential Use SCOs.
🟦 **Bold**	= Result exceeds Commercial Use SCOs.
🟥 **Bold**	= Result exceeds Industrial use SCO's.

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TABLE 6

SUMMARY OF REMEDIAL INVESTIGATION GROUNDWATER SAMPLE ANALYTICAL RESULTS

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

PARAMETER [1]	GWQS [2]	MW-1		MW-1		MW-2		MW-2		MW-3		MW-3		MW-4		BLIND DUP (MW-4)		MW-4		MW-5		MW-5		MW-6		MW-6		MW-7		MW-7		MW-8		MW-8		MW-9	
		2/7/2017		3/30/2016		2/7/2017		3/30/2016		2/7/2017		3/30/2016		2/7/2017		2/7/2017		3/31/2016		2/7/2017		3/30/2016		2/7/2017		3/30/2016		2/7/2017		3/30/2016		2/7/2017		3/30/2016		2/7/2017	
Volatile Organic Compounds (VOCs) - ug/l																																					
2-Butanone (MEK)	**50**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		6.6	
Acetone	**50**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		3 J	J	ND		1.7	J	ND		2.6	J	ND		**52**	
Benzene	**1**	**4.2**		**1.95**		ND		ND		0.36	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Cyclohexane	**--**	ND		ND		ND		ND		7.5	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Dichlorodifluoromethane (Freon-12)	**5**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		**10**	
Methyl acetate	**--**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Methyl tert butyl ether (MTBE)	**10**	0.95	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		**39**		**20.7**		0.93	J	3.97		0.88	J
Methylcyclohexane	**--**	ND		ND		ND		ND		0.69	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Naphthalene	**10**	ND		6.04		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		4.56	J	ND		**29.5**		ND		ND		ND	
Semi-Volatile Organic Compounds (SVOCs) - ug/l																																					
Acenaphthene	**20**	0.99		ND		0.11		ND		2.2		ND		0.35		0.25		ND		0.18		ND		0.3		ND		9.3		ND		0.37		ND		0.07	J
Acenaphthylene	**--**	0.07	J	ND		0.06	J	ND		0.07	J	ND		0.05	J	0.05	J	ND		ND		ND		ND		ND		0.22		ND		ND		ND		ND	
Anthracene	**50**	0.17	J	ND		0.05	J	ND		0.07	J	ND		0.2		0.16 J	J	ND		ND		ND		0.09	J	ND		1.1		ND		0.08	J	ND		0.04	J
Benzo(a)anthracene	**0.002**	**0.1**	J	ND		**0.06**	J	ND		**0.04**	J	ND		**0.12**	J	**0.07**	J	ND		**0.03**	J	ND		**0.03**	J	ND		**0.07**	J	ND		**0.03**	J	ND		ND	
Benzo(a)pyrene	**MDL**	**0.08**	J	ND		**0.05**	J	ND		ND		ND		**0.1**	J	**0.06**	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Benzo(b)fluoranthene	**0.002**	**0.12**	J	ND		**0.07**	J	ND		**0.04**	J	ND		**0.13**	J	**0.07**	J	ND		**0.03**	J	ND		ND		ND		**0.05**	J	ND		**0.03**		ND		ND	
Benzo(ghi)perylene	**--**	0.07	J	ND		ND		ND		ND		ND		0.08	J	0.04	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Benzo(k)fluoranthene	**0.002**	0.04	J	ND		ND		ND		ND		ND		0.05	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Chrysene	**0.002**	0.11	J	ND		0.06	J	ND		ND		ND		0.12	J	0.07	J	ND		ND		ND		ND		ND		0.07	J	ND		ND		ND		ND	
Fluoranthene	**50**	0.39		ND		0.16	J	ND		0.12	J	ND		0.48		0.29		ND		0.08	J	ND		0.17	J	ND		2.1		ND		0.13	J	ND		ND	
Fluorene	**50**	0.94		ND		0.1	J	ND		0.14	J	ND		0.3		0.18	J	ND		0.16	J	ND		0.1	J	ND		6.9		ND		0.31		ND		0.06	J
Indeno(1,2,3-cd)pyrene	**0.002**	0.07	J	ND		0.04	J	ND		ND		ND		0.08	J	0.04	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
2-Methylnapthalene	**--**	0.81		ND		0.12	J	ND		ND		ND		0.13	J	0.15	J	ND		ND		ND		ND		ND		0.13	J	ND		ND		ND		0.09	J
Naphthalene	**10**	5.8		ND		0.66		ND		0.06	J	ND		0.39		0.27		ND		0.05	J	ND		0.19	J	ND		1.9		ND		0.11	J	ND		ND	
Phenanthrene	**50**	1.4		ND		0.19	J	ND		0.15	J	ND		1		0.72		ND		0.14	J	ND		0.18	J	ND		7		ND		0.36		ND		0.11	J
Pyrene	**50**	0.29		ND		0.16	J	ND		0.14	J	ND		0.37		0.24		ND		0.06	J	ND		0.2		ND		1.3		ND		0.1	J	ND		ND	
Total Metals - ug/l																																					
Aluminum	**--**	278		NT		466		NT		686		NT		133		136		NT		194		NT		51.4		NT		782		NT		498		NT		547	
Antimony	**3**	ND		NT		ND		NT		ND		NT		ND		ND		NT		ND		NT		ND		NT		ND		NT		ND		NT		ND	
Arsenic	**25**	4.11		ND		3.31		ND		6.89		ND		2.46		1.89		ND		5.7		ND		1.53		ND		1.34		16.8	J-	9.61		ND		7.31	
Barium	**1000**	395.8		270	J-	78.48		111	J-	152.2		129		123.3		119.8		138		179.2		114	J-	53.12		55.2	J-	36.1		ND		79.49		54.4	J	70.04	
Cadmium	**5**	0.09	J	ND		ND		ND		0.09	J	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Calcium	**--**	149000		NT		144000		NT		145000		NT		132000		134000		NT		240000		NT		64300		NT		51200		NT		191000		NT		82000	
Hexavalent Chromium	**50**	NT		NT		ND		NT		NT		NT		NT		NT		NT		NT		NT		ND		NT		NT		NT		NT		NT		NT	
Chromium	**50**	1.66		ND		1		ND		1.52		ND		0.38	J	0.43	J	ND		0.59	J	ND		0.38	J	ND		1.48		ND		1.61		ND		1.49	
Cobalt	**--**	0.31	J	NT		0.58		NT		0.75		NT		0.43	J	0.41	J	NT		1.16		NT		ND		NT		0.71		NT		2.21		NT		0.7	
Copper	**200**	8.07		16.2	J-	3.15		ND		4.93		ND		12.95		11.66		ND		1.94		ND		0.51		ND		2.77		ND		2.46		ND		4.68	
Iron	**300**	**8800**		NT		**1440**		NT		**3670**		NT		**2340**		**2260**		NT		**6990**		NT		268		NT		**1370**		NT		**3060**		NT		**1360**	
Cyanide	**200**	3	J	NT		5		NT		4	J	NT		ND		ND		NT		ND		NT		5		NT		3	J	NT		2	J	ND		4	J
Lead	**25**	17.85		18.4	J-	21.87		**25.7**	J-	10.97		ND		11.6		11.66		**41.9**		3.9		ND		0.58	J	7.21	J-	9.47		20.4	J-	3.92		ND		3.35	
Magnesium	**35000**	**48300**		NT		28600		NT		32100		NT		25600		28500		NT		**35600**		NT		9150		NT		15400		NT		**97800**		NT		20100	
Manganese	**300**	253		**625**	J-	214.5		**318**	J-	244.1		296		**385.5**		**397.1**		**318**		**1107**		**870**	J-	127.2		131	J-	51.39		51	J-	**1382**		210		85.4	
Nickel	**100**	2.21		ND		1.68	J	ND		3.07		ND		1.41	J	1.01	J	ND		3.28		ND		1.1	J	ND		2.56		ND		4.84		ND		6.35	
Potassium	**--**	11600		NT		6730		NT		6770		NT		4270		4360		NT		11800		NT		6880		NT		9720		NT		7870		NT		22600	
Selenium	**10**	ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		4.08	J
Sodium	**20000**	**49800**		NT		13000		NT		**103000**		NT		**24600**		**25300**		NT		**350000**		NT		**254000**		NT		**74300**		NT		**41600**		NT		**128000**	
Vanadium	**--**	ND		NT		ND		NT		3.32	J	NT		ND		ND		NT		ND		NT		2.24	J	NT		2.9	J	NT		ND		NT		3.44	J
Zinc	**2000**	22.63		50.9	J-	14.92		40.5	J-	19.32		ND		8.85	J	8.53	J	55.1	J	10.81		ND		ND		ND		14.23		ND		10.25		ND		7.1	J
Polychlorinated biphenyls (PCBs) - ug/l																																					
Total PCBs		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND	
Pesticides and Herbicides - ug/l																																					
		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		ND		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 NYSDEC Division of Water Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations - Class GA (TOGS 1.1.1)

Definitions:

ND = Parameter not detected above laboratory detection limit.
NT = Parameter was not analyzed for.
"--" = No value available for the parameter; Parameter not analysed for.
J = Estimated value; result is less than the sample quantitation limit but greater than zero.
J+ = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased high.
J- = Analyte was positively identifed; the associated numerical value is an estimated quantity that may be biased low.
🟩 **Bold** = Result exceeds GWQS.

TABLE 8

IMPORT CRITERIA
RESTRICTED RESIDENTIAL USE SOIL CLEANUP OBJECTIVES
SITE MANAGEMENT PLAN
QUEEN CITY LANDING
BUFFALO, NEW YORK

PARAMETER	Restricted Residential Use SCOs [1]
Volatile Organic Compounds (VOCs) - mg/Kg	
1,1,1-Trichloroethane	**0.68**
1,1-Dichloroethane	**0.27**
1,1-Dichloroethene	**0.33**
1,2-Dichlorobenzene	**1.1**
1,2-Dichloroethane	**0.02**
cis-1,2-Dichloroethene	**0.25**
trans-1,2-Dichloroethene	**0.19**
1,3-Dichlorobenzene	**2.4**
1,4-Dichlorobenzene	**1.8**
1,4-Dioxane	**0.1**
Acetone	**0.05**
Benzene	**0.06**
Butylbenzene	**12**
Carbon tetrachloride	**0.76**
Chlorobenzene	**1.1**
Chloroform	**0.37**
Ethylbenzene	**1**
Hexachlorobenzene	**1.2**
Methyl ethyl ketone	**0.12**
Methyl tert butyl ether	**0.93**
Methylene chloride	**0.05**
n-Propylbenzene	**3.9**
sec-Butylbenzene	**11**
tert-Butylbenzene	**5.9**
Tetrachloroethene	**1.3**
Toluene	**0.7**
Trichloroethene	**0.47**
1,2,4-Trimethylbenzene	**3.6**
1,3,4-Trimethylbenzene	**8.4**
Vinyl chloride	**0.02**
Xylene	**1.6**

TABLE 8

IMPORT CRITERIA
RESTRICTED RESIDENTIAL USE SOIL CLEANUP OBJECTIVES
SITE MANAGEMENT PLAN
QUEEN CITY LANDING
BUFFALO, NEW YORK

PARAMETER	Restricted Residential Use SCOs [1]
Semi-Volatile Organic Compounds (SVOCs) - mg/Kg	
Acenaphthene	**98**
Acenaphthylene	**100**
Anthracene	**100**
Benzo(a)anthracene	**1**
Benzo(a)pyrene	**1**
Benzo(b)fluoranthene	**1**
Benzo(g,h,i)perylene	**100**
Benzo(k)fluoranthene	**1.7**
Chrysene	**1**
Dibenzo(a,h)anthracene	**0.33**
Fluoranthene	**100**
Fluorene	**100**
Indeno(1,2,3-cd)pyrene	**0.5**
m-Cresol	**0.33**
Naphthalene	**12**
o-Cresol	**0.33**
p-Cresol	**0.33**
Pentachlorophenol	**0.8**
Phenanthrene	**100**
Phenol	**0.33**
Pyrene	**100**
Metals - mg/Kg	
Arsenic	**16**
Barium	**400**
Beryllium	**47**
Cadmium	**4.3**
Chromium, trivalent	**180**
Chromium, hexavalent	**19**
Copper	**270**
Cyanide	**27**
Lead	**400**
Manganese	**2000**
Mercury	**0.73**
Nickel	**130**
Selenium	**4**
Silver	**8.3**
Zinc	**2480**

TABLE 8

IMPORT CRITERIA
RESTRICTED RESIDENTIAL USE SOIL CLEANUP OBJECTIVES
SITE MANAGEMENT PLAN
QUEEN CITY LANDING
BUFFALO, NEW YORK

PARAMETER	Restricted Residential Use SCOs [1]
Pesticides/Herbicides and PCBs - mg/Kg	
Silvex (2,4,5-TP)	**3.8**
4,4'-DDE	**8.9**
4,4'-DDT	**7.9**
4,4'-DDD	**13**
Aldrin	**0.097**
alpha-BHC	**0.02**
beta-BHC	**0.09**
alpha-Chlordane	**2.9**
delta-BHC	**0.25**
Dibenzofuran	**59**
Dieldrin	**0.1**
Endosulfan I	**24**
Endosulfan II	**24**
Endosulfan sulfate	**24**
Endrin	**0.06**
Heptachlor	**0.38**
Lindane	**0.1**
Polychlorinated biphenyls (PCBs)	**1**

Notes:

1. Values per NYSDEC DER-10 Appendix 5 Subdivision 5.4 (e).

Table 9 – Post Remediation Sampling Requirements and Schedule

Sampling Location	**Analytical Parameters**			**Schedule**
	TCL VOCs	Part 375 List Metals	Part 375 List SVOCs	
MW-1	X	X	X	Annually – Note 1
MW-4	X	X	X	Annually – Note 1
MW-6	X	X	X	Annually – Note 1
MW-7	X	X	X	Annually – Note 1

Note 1 – Annual groundwater sampling will be subject to evaluation and recommendations after year 1.

TCL = Target Compound List

VOCs = volatile organic compounds

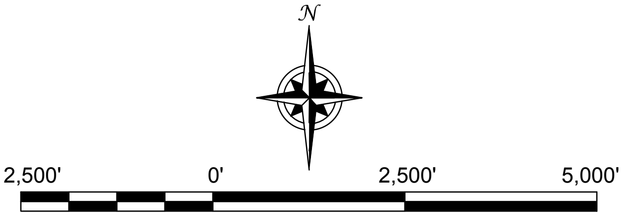
Part 375 List = compounds and analytes to be analyzed for are those found on Table 375-6.8(b) of 6NYCRR Part 375.

SVOCs = semi-volatile organic compounds

FIGURES

F:\CAD\Benchmark\Queen City Landing\SMP\Figure 1; Site Location and Vicinity Map2018.dwg, DWG To PDF.pc3

FIGURE 1



SCALE: 1 INCH = 2,500 FEET
SCALE IN FEET
(approximate)

LEGEND:

🟥 BCP SITE BOUNDARY

*BASEMAP ADAPTED FROM BING MAPS

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PROJECT NO.: 0424-017-001

DATE: OCTOBER 2018

DRAFTED BY: RFL

SITE LOCATION AND VICINITY MAP

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
BCP SITE NO. 915304
BUFFALO, NEW YORK
PREPARED FOR
QUEEN CITY LANDING, LLC

F:\CAD\Benchmark\Queen City Landing\SMP\Figure 2; Site Layout Map2018.dwg, DWG To PDF.pc3

LEGEND:

🟥 BCP SITE BOUNDARY

NOTES:
1. AERIAL IMAGE FROM GOOGLE EARTH PRO 2017.

N

150' 0' 150' 300'

SCALE: 1 INCH = 150 FEET
SCALE IN FEET
(approximate)

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SITE LAYOUT MAP

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK

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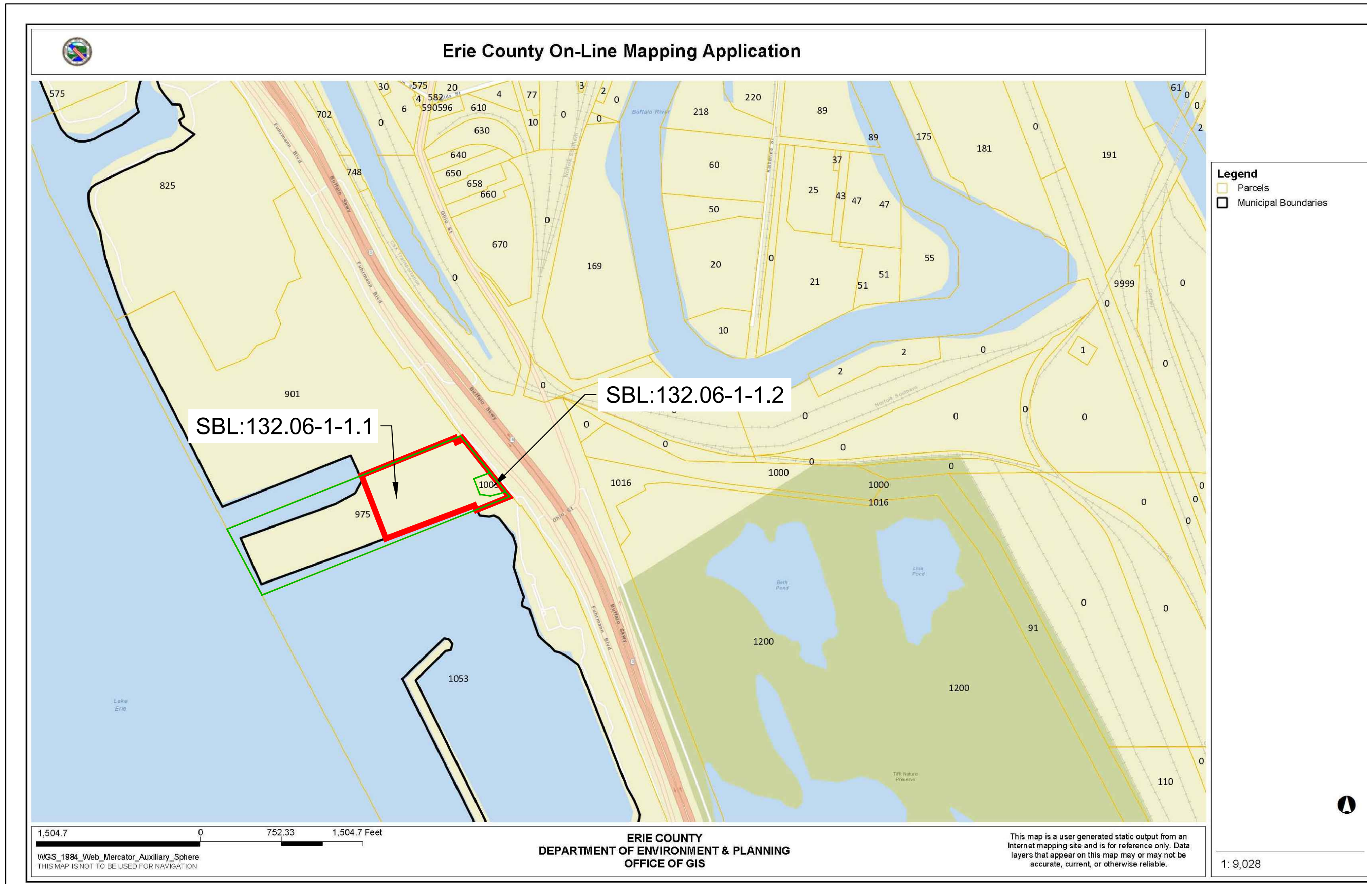
FIGURE 2

F:\CAD\Benchmark\Queen City Landing\SMP\Figure 3; Tax Map2018.dwg, DWG To PDF.pc3



Erie County On-Line Mapping Application

ERIE COUNTY
DEPARTMENT OF ENVIRONMENT & PLANNING
OFFICE OF GIS

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

LEGEND:

🟥 BCP SITE BOUNDARY

🟩 PARCEL BOUNDARY

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TAX MAP

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK

PREPARED FOR
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FIGURE 3

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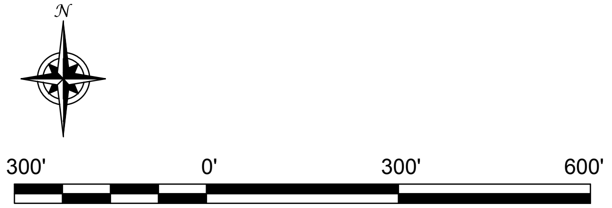
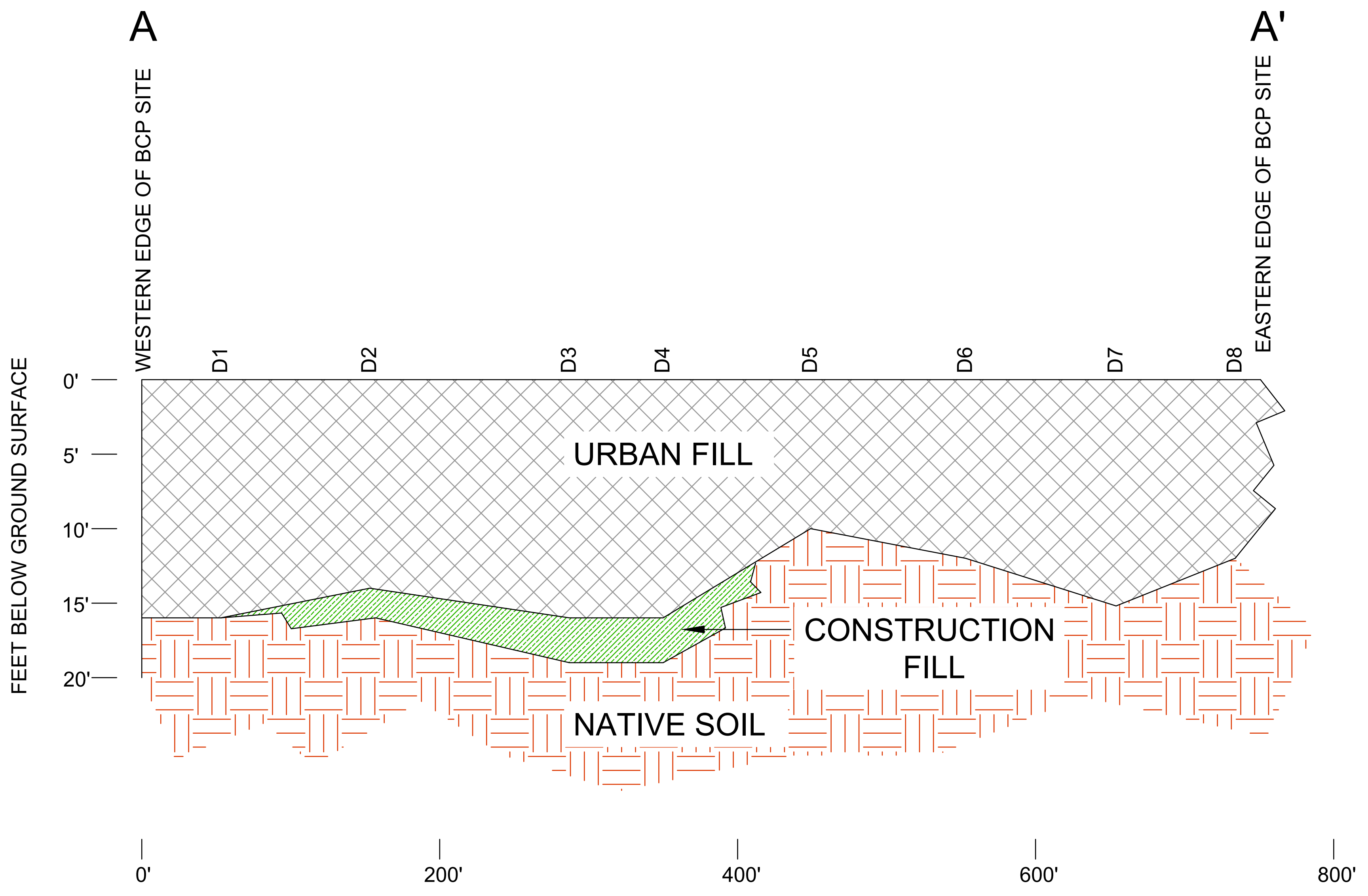
F:\CAD\Benchmark\Queen City Landing\SMP\Figure 4; Geologic Xsxn2018.dwg, DWG To PDF.pc3

LEGEND:

🟥	BCP SITE BOUNDARY
B4 ◩	BORING
TP-1 ⊞	TEST PIT
MW-1 ⊕	MONITORING WELL



SCALE: 1 INCH = 300 FEET
SCALE IN FEET
(approximate)



HORIZONTAL SCALE: 1" =1': VERTICAL SCALE 1" =10'

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GEOLOGIC CROSS-SECTION

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK
PREPARED FOR
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FIGURE 4

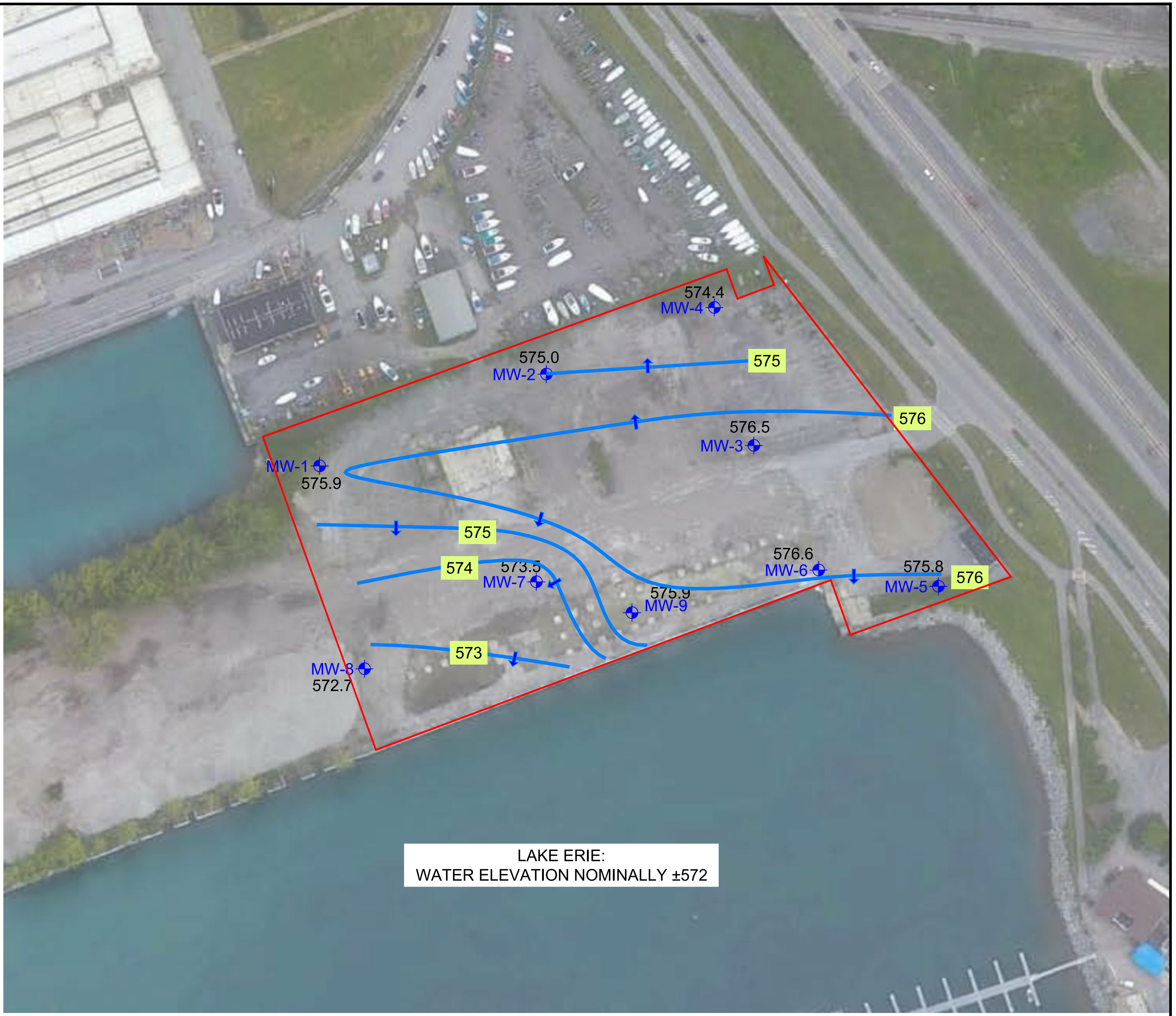
F:\CAD\Benchmark\Queen City Landing\SMP\Figure 5; GW Contour Map2018.dwg, DWG To PDF.pc3

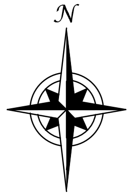
LEGEND:

🟥	BCP SITE BOUNDARY
MW-9 ⊕	RI MONITORING WELL LOCATION
574.9	GROUNDWATER ELEVATION (FEBRUARY 7, 2017)
575	GROUNDWATER ISOPOTENTIAL
←	GROUNDWATER FLOW DIRECTION

NOTES:

1. GROUNDWATER ISOPOTENTIALS BASED ON LINEAR INTERPOLATION BETWEEN MONITORING WELLS, PHYSICAL SITE FEATURES, AND ENGINEERING JUDGEMENT.





150' 0' 150' 300'

SCALE: 1 INCH = 150 FEET
SCALE IN FEET
(approximate)

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GROUNDWATER CONTOUR MAP

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
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FIGURE 5

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F:\CAD\Benchmark\Queen City Landing\SMP\Figure 6; Areas of IRM and Remedial Action 2018REV.dwg, DWG To PDF.pc3

LEGEND:

🟥	BCP SITE BOUNDARY
▨	APPROXIMATE LIMITS OF THE PETROLEUM EXCAVATION
SS-2 NORTH ◪	OFF-SITE INVESTIGATION LOCATION (DEC 2017)
D-7 ◪	SOIL SAMPLE LOCATION

SCALE: 1 INCH = 100 FEET
SCALE IN FEET
(approximate)

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AREAS OF IRM AND REMEDIAL ACTION

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK

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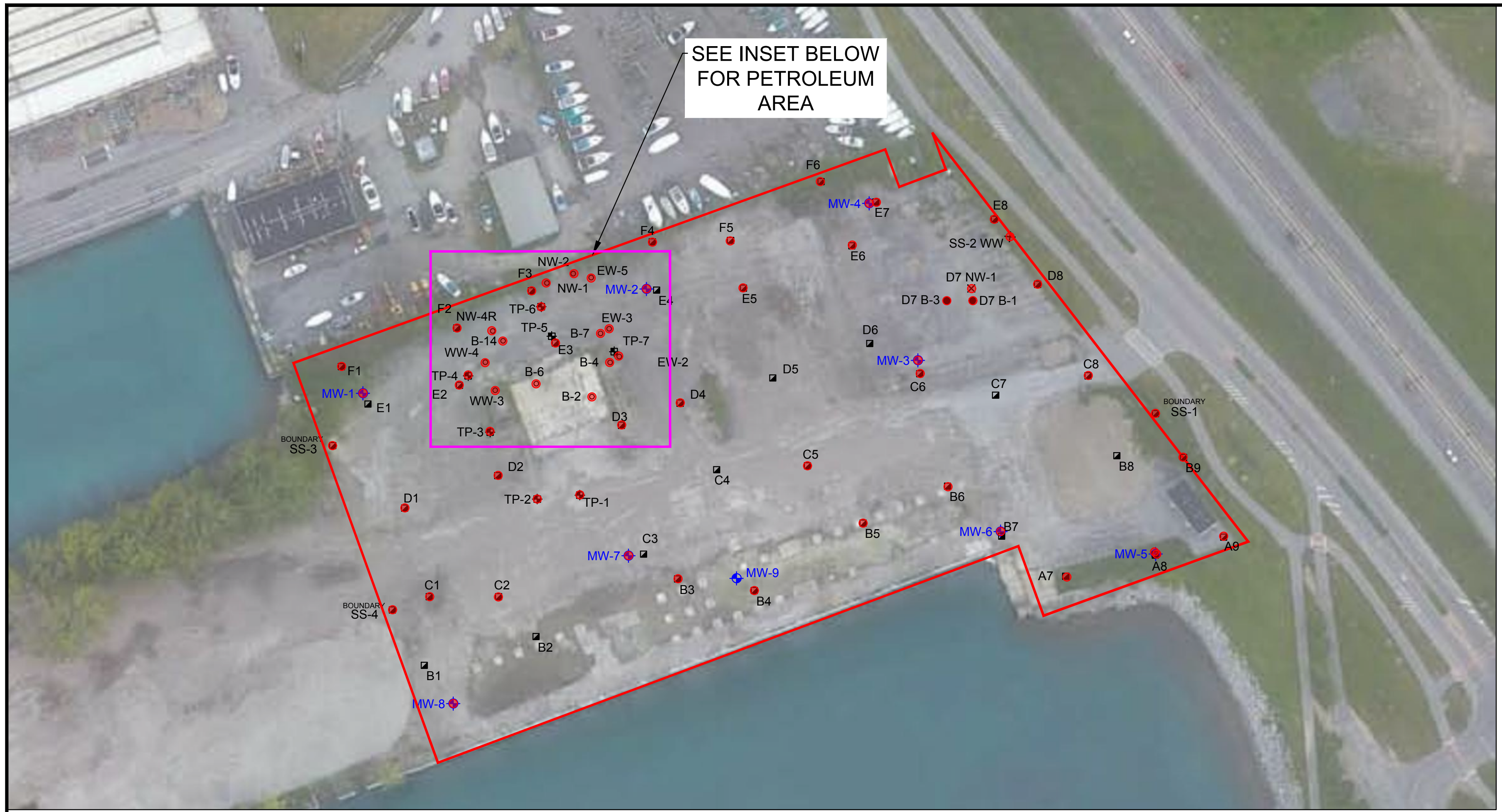
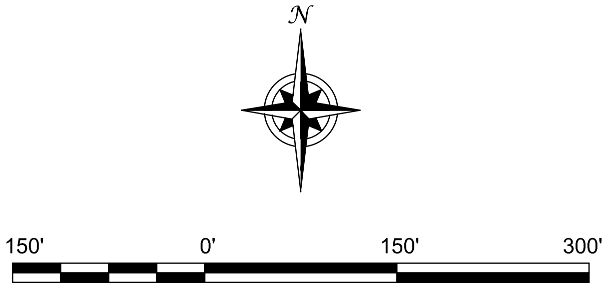
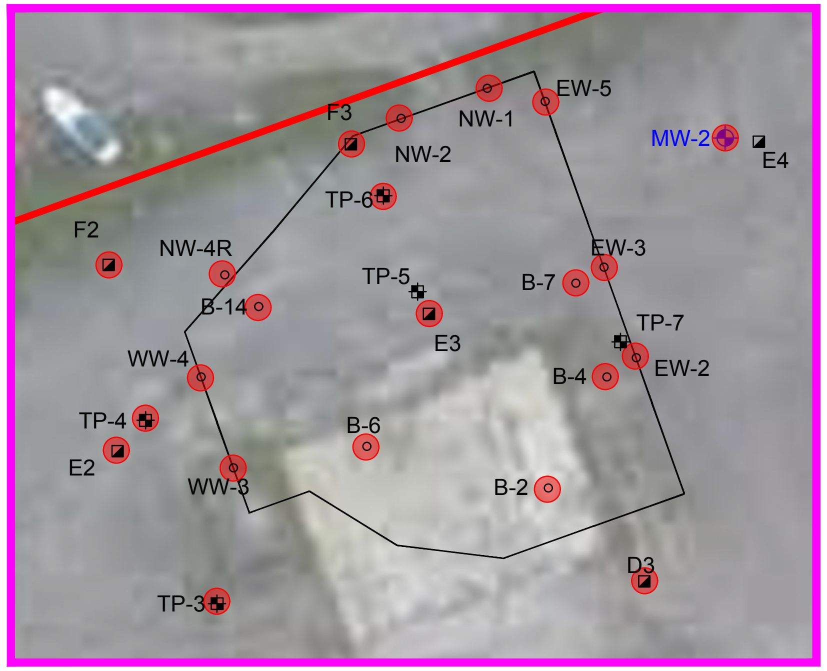
FIGURE 6

F:\CAD\Benchmark\Queen City Landing\SMP\Figure 7; USCO Exceedances In Soil Rev.dwg, DWG To PDF.pc3





SCALE: 1 INCH = 150 FEET
SCALE IN FEET
(approximate)



PETROLEUM AREA INSET
SCALE 1" IS APPROXIMATELY 60'

LEGEND:

	BCP SITE BOUNDARY
B4 ◪	BORING / SURFACE SOIL LOCATION
TP-1 ⊞	TEST PIT
MW-7 ⊕	MONITORING WELL
B-4 ○	PETROLEUM EXCAVATION END-POINT SAMPLE (SEE NOTE 1)
▭	PETROLEUM EXCAVATION AREA (IRM)
●	USCO EXCEEDED IN AT LEAST ONE SAMPLE FROM EXPLORATION LOCATION

NOTES:
1. PETROELUM END-POINT SAMPLE DESIGNATION AS FOLLOWS: EW - EAST WALL; NW - NORTH WALL; WW - WEST WALL; SW - SOUTH WALL; & B - BOTTOM.
2. USCO = UNRESTRICTED SOIL CLEANUP OBJECTIVE.
3. AERIAL IMAGE FROM GOOGLE EARTH PHOTOGRAPHY 2017.

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JOB NO.: 0424-017-001

SOIL/FILL SAMPLE LOCATIONS WITH USCO EXCEEDANCES

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK

PREPARED FOR
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FIGURE 7

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LEGEND:

🟥	BCP SITE BOUNDARY
MW-1 ⊕	MONITORING WELL

WELL DESIGNATION AND DATE SAMPLED

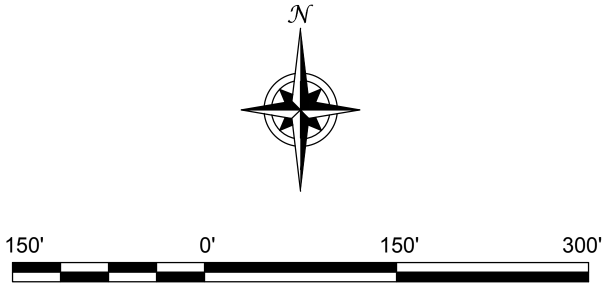
Parameter	MW-6	
	03/30/16	02/07/17
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.03
Metals (ug/l)		
Sodium	NT	254,000

ANALYTE DETECTED

CONCENTRATION DETECTED (ug/l)

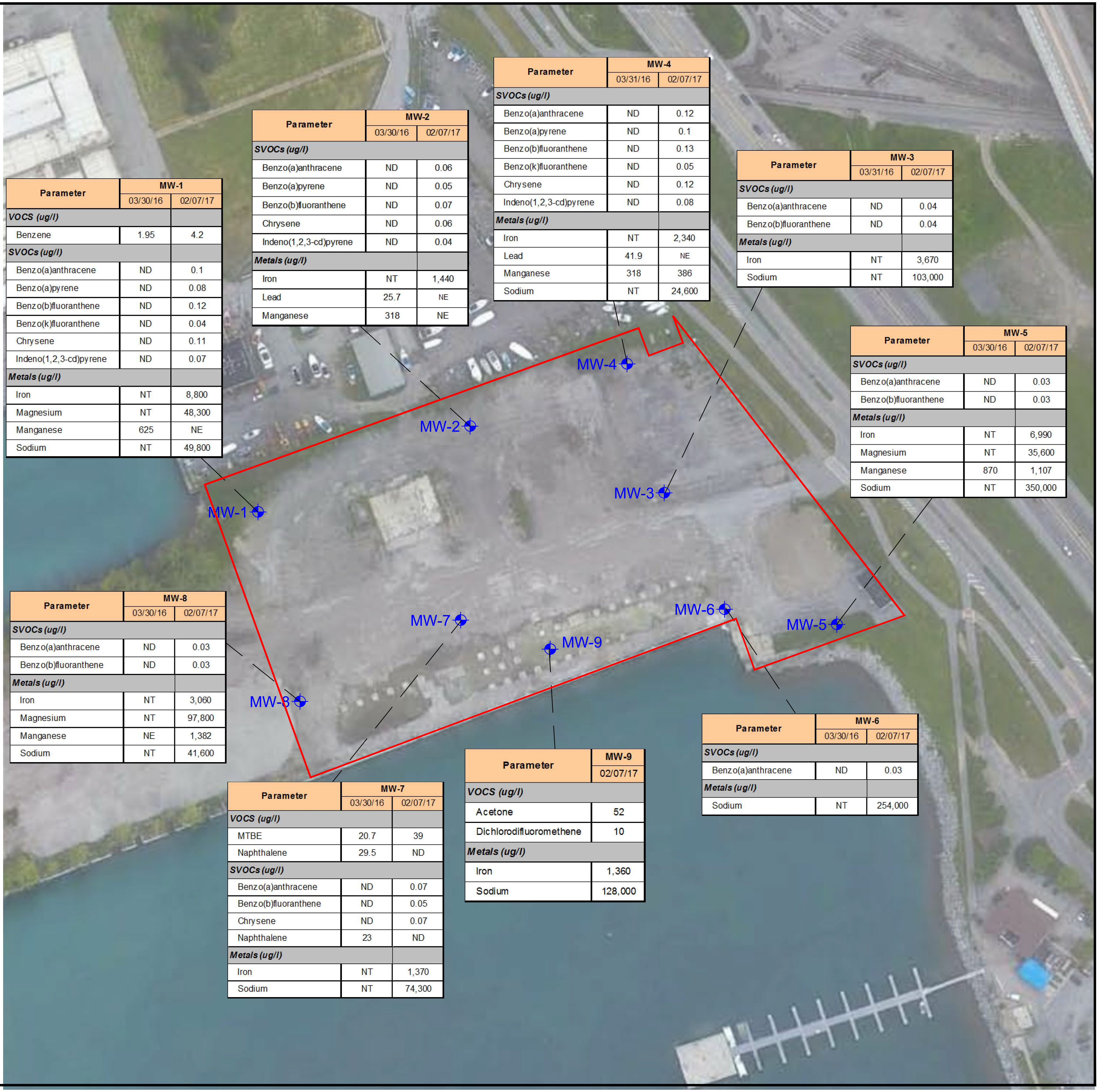
NOTES:

1. UG/L = MICROGRAMS PER LITER.
2. GROUNDWATER QUALITY EXCEEDANCE MEANS NEW YORK STATE TOGS 1.1.1. AMBIENT WATER QUALITY STANDARDS AND GUIDANCE CRITERIA (GWQS).
3. NE = GWQS NOT EXCEEDED, ND = NOT DETECTED, NT NOT TESTED.
4. VOCs = VOLATILE ORGANIC COMPOUNDS.
5. SVOCs = SEMI-VOLATILE ORGANIC COMPOUNDS.
6. MTBE = METHYL TERT BUTYL ETHER.
7. AERIAL IMAGE FROM GOOGLE EARTH PHOTOGRAPHY 2017.



SCALE: 1 INCH = 150 FEET
SCALE IN FEET
(approximate)

DATE: OCTOBER 2018
DRAFTED BY: RFL



Parameter	MW-1	
	03/30/16	02/07/17
VOCS (ug/l)		
Benzene	1.95	4.2
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.1
Benzo(a)pyrene	ND	0.08
Benzo(b)fluoranthene	ND	0.12
Benzo(k)fluoranthene	ND	0.04
Chrysene	ND	0.11
Indeno(1,2,3-cd)pyrene	ND	0.07
Metals (ug/l)		
Iron	NT	8,800
Magnesium	NT	48,300
Manganese	625	NE
Sodium	NT	49,800

Parameter	MW-2	
	03/30/16	02/07/17
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.06
Benzo(a)pyrene	ND	0.05
Benzo(b)fluoranthene	ND	0.07
Chrysene	ND	0.06
Indeno(1,2,3-cd)pyrene	ND	0.04
Metals (ug/l)		
Iron	NT	1,440
Lead	25.7	NE
Manganese	318	NE

Parameter	MW-4	
	03/31/16	02/07/17
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.12
Benzo(a)pyrene	ND	0.1
Benzo(b)fluoranthene	ND	0.13
Benzo(k)fluoranthene	ND	0.05
Chrysene	ND	0.12
Indeno(1,2,3-cd)pyrene	ND	0.08
Metals (ug/l)		
Iron	NT	2,340
Lead	41.9	NE
Manganese	318	386
Sodium	NT	24,600

Parameter	MW-3	
	03/31/16	02/07/17
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.04
Benzo(b)fluoranthene	ND	0.04
Metals (ug/l)		
Iron	NT	3,670
Sodium	NT	103,000

Parameter	MW-5	
	03/30/16	02/07/17
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.03
Benzo(b)fluoranthene	ND	0.03
Metals (ug/l)		
Iron	NT	6,990
Magnesium	NT	35,600
Manganese	870	1,107
Sodium	NT	350,000

Parameter	MW-8	
	03/30/16	02/07/17
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.03
Benzo(b)fluoranthene	ND	0.03
Metals (ug/l)		
Iron	NT	3,060
Magnesium	NT	97,800
Manganese	NE	1,382
Sodium	NT	41,600

Parameter	MW-6	
	03/30/16	02/07/17
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.03
Metals (ug/l)		
Sodium	NT	254,000

Parameter	MW-9
	02/07/17
VOCS (ug/l)	
Acetone	52
Dichlorodifluoromethene	10
Metals (ug/l)	
Iron	1,360
Sodium	128,000

Parameter	MW-7	
	03/30/16	02/07/17
VOCS (ug/l)		
MTBE	20.7	39
Naphthalene	29.5	ND
SVOCs (ug/l)		
Benzo(a)anthracene	ND	0.07
Benzo(b)fluoranthene	ND	0.05
Chrysene	ND	0.07
Naphthalene	23	ND
Metals (ug/l)		
Iron	NT	1,370
Sodium	NT	74,300

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0424-017-001

GROUNDWATER QUALITY EXCEEDANCES

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK

PREPARED FOR
QUEEN CITY LANDING, LLC

FIGURE 8

DISCLAIMER:
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LEGEND:

━ BCP SITE BOUNDARY

-·-·-·- PROPERTY LINE BOUNDARY

🟩 SOIL COVER SYSTEM

▨ EXISTING OR NEW HARDSCAPE

🟪 STONE PARKING COVER SYSTEM

🟦 STONE DRIVE COVER SYSTEM

🟧 SURGE STONE COVER SYSTEM

NOTES:

1. AERIAL IMAGE FROM GOOGLE EARTH PRO 2017.

100' 0' 100' 200'

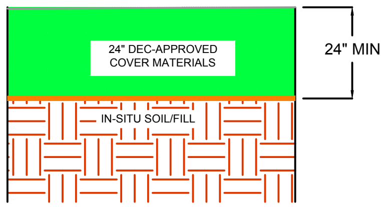
SCALE: 1 INCH = 100 FEET
SCALE IN FEET
(approximate)

COVER SYSTEM DETAILS

NTS

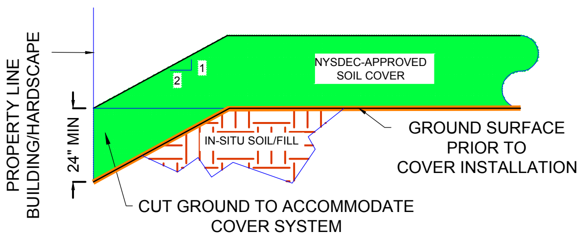
VEGETATED SOIL COVER SYSTEM DETAIL

NTS



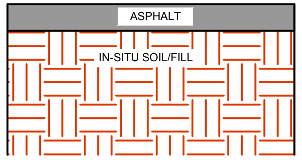
TIE-IN DETAIL

NTS



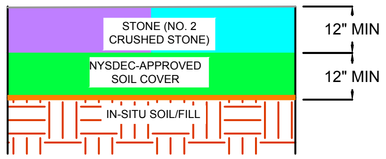
EXISTING ASPHALT DRIVE COVER SYSTEM DETAIL

NTS



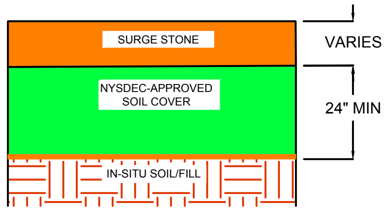
STONE COVER AND PARKING SYSTEM DETAIL

NTS



SURGE STONE COVER SYSTEM DETAIL

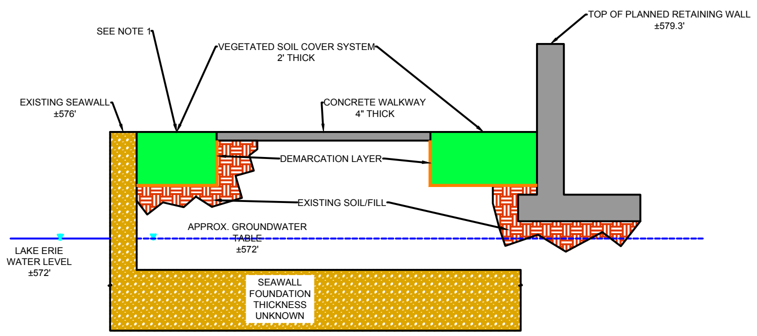
NTS



━ DEMARCATION LAYER

DETAIL A-A'

NTS



NOTE:

1. A 60-FOOT SECTION OF VEGETATED COVER ALONG THE SEAWALL WAS REPLACED BY 6" OF STONE AND 6" OF CONCRETE AT THE LOCATION SHOWN IN THE DRAWING.

DATE: OCTOBER 2018
DRAFTED BY: RFL

BENCHMARK
ENVIRONMENTAL
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SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0424-017-001

INSTITUTIONAL AND ENGINEERING CONTROL LOCATIONS - COVER SYSTEM MAP

SITE MANAGEMENT PLAN

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK

PREPARED FOR
QUEEN CITY LANDING, LLC

FIGURE 9

F:\CAD\Benchmark\Queen City Landing\SMP\Figure 10; Cover System Thickness Verification_Oct 2018.dwg, DWG To PDF.pc3

SUBGRADE SURVEY DATA				FINAL GRADE SURVEY DATA			Cover Thickness (ft)
Point Number	Northing	Easting	Sub-grade Elevation (ft.)	Northing	Easting	Final Grade Elevation (ft.)	
1	1039874	1071668	577.96	1039875	1071668	580.14	2.19
2	1039892	1071717	578.68	1039892	1071717	580.82	2.14
3	1039908	1071764	578.56	1039908	1071764	580.64	2.08
4	1039925	1071811	579.08	1039926	1071812	581.23	2.16
5	1039942	1071858	579.16	1039943	1071858	581.38	2.22
6	1039959	1071906	579.71	1039959	1071906	581.92	2.22
7	1039976	1071952	580.06	1039977	1071953	582.15	2.10
8	1039993	1072000	580.52	1039993	1072000	582.64	2.12
9	1040009	1072046	580.85	1040010	1072046	582.97	2.12
10	1040026	1072094	580.95	1040026	1072094	582.99	2.04
11	1040043	1072141	580.82	1040043	1072140	582.86	2.04
12	1040060	1072188	581.00	1040060	1072188	583.14	2.14
13	1040077	1072235	580.92	1040077	1072235	583.10	2.17
14	1040093	1072282	580.08	1040093	1072282	582.30	2.22
15	1039827	1071685	576.81	1039827	1071685	579.24	2.44
16	1039844	1071734	577.64	1039844	1071733	579.73	2.10
17	1039861	1071781	578.14	1039862	1071780	580.29	2.15
18	1039878	1071828	578.51	1039879	1071827	580.60	2.10
19	1039895	1071875	579.06	1039895	1071875	581.17	2.11
20	1039912	1071922	579.54	1039913	1071922	581.56	2.02
21	1039929	1071969	580.11	1039928	1071969	582.16	2.04
22	1039945	1072016	580.54	1039946	1072016	582.69	2.15
23	1039962	1072064	580.98	1039963	1072063	583.08	2.10
24	1039979	1072110	581.01	1039980	1072110	583.32	2.31
25	1039996	1072157	580.81	1039996	1072157	582.95	2.15
26	1040013	1072204	580.50	1040013	1072204	582.59	2.09
27	1040029	1072252	580.47	1040024	1072249	582.53	2.06
28	1040046	1072299	579.97	1040046	1072298	582.13	2.16
29	1040063	1072346	580.81	1040063	1072345	582.94	2.13
30	1040069	1072362	581.45	1040070	1072362	583.53	2.08
31	1039780	1071702	576.54	1039780	1071702	578.68	2.14
32	1039797	1071750	577.38	1039797	1071750	579.49	2.11
33	1039814	1071797	577.94	1039815	1071797	579.98	2.04
34	1039831	1071845	578.54	1039832	1071844	580.65	2.11
35	1039848	1071891	578.86	1039848	1071891	581.02	2.16
36	1039865	1071939	579.35	1039864	1071939	581.47	2.12
37	1039881	1071986	579.93	1039881	1071986	581.96	2.02
38	1039898	1072033	580.49	1039898	1072033	582.61	2.13
39	1039915	1072080	580.96	1039916	1072079	583.01	2.05
40	1039932	1072127	580.95	1039933	1072127	583.05	2.10
41	1039948	1072174	580.48	1039948	1072173	582.66	2.18
42	1039966	1072221	580.18	1039965	1072220	582.22	2.05
43	1039982	1072268	579.96	1039982	1072268	582.11	2.15
44	1039999	1072316	579.45	1039999	1072315	581.63	2.18
45	1040016	1072362	580.40	1040016	1072363	582.53	2.14
46	1040027	1072394	581.64	1040028	1072394	583.87	2.24
47	1039733	1071718	577.11	1039732	1071718	579.22	2.11
48	1039750	1071767	577.38	1039750	1071767	579.50	2.13
49	1039767	1071814	577.97	1039767	1071814	580.12	2.15
50	1039784	1071861	577.71	1039784	1071862	580.47	2.76
51	1039801	1071908	578.70	1039801	1071907	580.97	2.27
52	1039814	1071955	579.44	1039814	1071956	581.49	2.06
53	1039834	1072002	580.09	1039835	1072003	582.15	2.05
54	1039851	1072049	580.55	1039852	1072049	582.60	2.05
55	1039868	1072096	581.06	1039868	1072097	583.09	2.03
56	1039885	1072144	581.01	1039886	1072144	583.06	2.05
57	1039901	1072191	580.58	1039902	1072192	582.66	2.07
58	1039918	1072238	579.90	1039918	1072238	581.95	2.05
59	1039935	1072285	579.39	1039935	1072285	581.44	2.05
60	1039952	1072332	579.08	1039952	1072332	581.45	2.37
61	1039969	1072379	579.72	1039970	1072379	581.84	2.12
62	1039986	1072426	581.61	1039986	1072426	583.77	2.16
63	1039686	1071735	576.86	1039685	1071736	578.93	2.08
64	1039703	1071783	577.69	1039703	1071783	579.70	2.01
65	1039720	1071831	578.14	1039721	1071831	580.21	2.07
66	1039737	1071878	578.60	1039737	1071877	580.66	2.06
67	1039754	1071925	579.11	1039753	1071926	581.15	2.04
68	1039770	1071972	579.52	1039770	1071973	581.57	2.04
69	1039800	1072017	580.06	1039800	1072018	582.14	2.08
70	1039815	1072064	580.46	1039815	1072066	583.00	2.53
71	1039821	1072113	580.88	1039822	1072113	583.02	2.15
72	1039838	1072160	580.80	1039839	1072161	582.85	2.05
73	1039854	1072207	580.43	1039853	1072208	582.71	2.27
74	1039871	1072255	579.85	1039872	1072254	581.92	2.07
75	1039888	1072302	579.25	1039887	1072302	581.40	2.15
76	1039922	1072395	579.03	1039921	1072396	581.24	2.22
77	1039939	1072443	580.13	1039939	1072443	582.44	2.32
78	1039639	1071752	576.86	1039639	1071752	578.95	2.09
79	1039656	1071800	577.51	1039657	1071800	579.54	2.04
80	1039673	1071847	578.12	1039673	1071847	580.18	2.06
81	1039690	1071894	578.51	1039690	1071894	580.65	2.14
82	1039707	1071942	579.13	1039707	1071942	581.19	2.06
83	1039723	1071988	579.48	1039724	1071988	581.62	2.14
84	1039734	1072036	579.91	1039734	1072036	582.09	2.18
85	1039752	1072084	580.55	1039754	1072083	582.63	2.08
86	1039770	1072120	581.00	1039770	1072120	583.13	2.14
87	1039787	1072180	580.97	1039787	1072179	583.06	2.10
88	1039808	1072224	580.46	1039807	1072224	582.54	2.08
89	1039824	1072271	579.76	1039825	1072270	582.07	2.32
90	1039841	1072318	579.07	1039841	1072317	581.21	2.14
91	1039858	1072365	578.37	1039857	1072363	580.41	2.04
92	1039592	1071769	576.80	1039593	1071769	578.83	2.02
93	1039609	1071817	577.66	1039610	1071817	579.74	2.08
94	1039626	1071864	577.92	1039626	1071863	580.09	2.17
95	1039642	1071911	578.46	1039643	1071911	580.62	2.16
96	1039659	1071958	578.95	1039659	1071957	580.99	2.04
97	1039676	1072005	579.14	1039676	1072005	581.25	2.12
98	1039693	1072052	579.34	1039692	1072051	581.57	2.23
99	1039710	1072099	579.51	1039709	1072099	581.64	2.13
100	1039726	1072146	579.75	1039727	1072146	581.99	2.24
101	1039743	1072193	580.20	1039743	1072193	582.29	2.09
102	1039759	1072241	580.11	1039760	1072240	582.29	2.19
103	1039777	1072287	579.62	1039778	1072287	581.73	2.11
104	1039794	1072334	578.77	1039794	1072335	581.09	2.31
105	1039811	1072382	578.04	1039811	1072382	580.14	2.10
106	1039827	1072429	579.50	1039828	1072429	581.68	2.17
107	1039843	1072483	581.35	1039843	1072482	583.48	2.13
108	1039860	1072522	582.50	1039860	1072522	584.56	2.05
109	1039542	1071803	--	1039542	1071803	See Note 1	2.17
110	1039558	1071847	--	1039558	1071847	See Note 1	2.04
111	1039578	1071888	--	1039578	1071888	See Note 1	2.17
112	1039595	1071927	577.91	1039596	1071927	579.94	2.03
113	1039612	1071975	578.06	1039612	1071975	580.18	2.13
114	1039629	1072021	578.07	1039629	1072021	580.29	2.22
115	1039646	1072069	577.92	1039647	1072069	580.07	2.15
116	1039662	1072116	577.94	1039664	1072116	580.14	2.20
117	1039680	1072163	578.21	1039680	1072163	580.22	2.01
118	1039696	1072210	578.46	1039696	1072210	580.51	2.05
119	1039713	1072257	578.79	1039713	1072257	580.83	2.04
120	1039730	1072304	578.68	1039731	1072304	580.75	2.07
121	1039747	1072351	578.28	1039747	1072350	580.33	2.05
122	1039763	1072398	577.74	1039764	1072399	579.78	2.05
123	1039780	1072445	579.61	1039780	1072446	581.69	2.08
124	1039797	1072493	580.73	1039797	1072492	582.79	2.05
125	1039814	1072540	581.47	1039814	1072540	583.49	2.02
126	1039819	1072553	581.74	1039818	1072554	583.75	2.01
127	1039711	1072401	576.05	1039712	1072401	578.20	2.15
128	1039716	1072415	576.47	1039717	1072415	578.57	2.11
129	1039733	1072462	577.23	1039733	1072462	579.29	2.06
130	1039750	1072509	578.72	1039751	1072509	580.86	2.14
131	1039767	1072556	581.13	1039766	1072556	583.17	2.04
132	1039777	1072585	581.95	1039777	1072586	584.00	2.06
133	1039702	1072526	577.95	1039703	1072526	580.25	2.30
134	1039719	1072573	579.99	1039719	1072573	582.17	2.17
135	1039983	1071845	580.34	1039983	1071844	582.55	2.22
136	1040000	1071892	580.77	1040000	1071893	582.84	2.07
137	1040017	1071940	580.99	1040018	1071941	583.02	2.03
138	1040025	1071987	580.91	1040025	1071987	582.99	2.08
139	1040049	1072033	580.95	1040050	1072033	582.99	2.04
140	1040067	1072079	580.77	1040067	1072079	582.93	2.16
141	1040086	1072125	580.77	1040085	1072125	582.96	2.20
142	1040102	1072174	580.94	1040102	1072174	583.03	2.09
143	1040118	1072219	581.56	1040117	1072219	583.59	2.03
144	1040109	1072327	580.79	1040110	1072328	583.03	2.25
145	1039735	1072613	582.14	1039735	1072614	584.18	2.04
146	1039698	1072479	576.89	1039698	1072480	579.51	2.61
147	1039683	1072432	576.90	1039683	1072432	579.17	2.27
148	1039679	1072411	576.46	1039680	1072410	578.68	2.21
149	1039930	1071704	580.63	1039929	1071703	582.66	2.03
150	1039896	1071660	578.29	1039896	1071660	580.99	2.70
151	1039907	1071656	578.94	1039907	1071655	581.48	2.53
152	1039948	1071750	580.69	1039949	1071749	582.79	2.10
153	1039965	1071795	580.42	1039966	1071795	582.68	2.26
154	1039938	1072455	581.20	1039938	1072455	583.25	2.05
155	1039921	1072452	580.43	1039920	1072452	582.69	2.26
156	1039918	1072429	579.83	1039918	1072429	581.91	2.08

Note 1) The cover system was measured by Benchmark using a hand auger at points 109, 110, and 111 on October 22, 2018.

LEGEND:

🟥	BCP SITE BOUNDARY
○ 110	COVER THICKNESS MEASUREMENT LOCATION

60' 0' 60' 120'

SCALE: 1 INCH = 60 FEET
SCALE IN FEET
(approximate)

N

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0424-017-001

REVISIONS

NO.	BY	DATE	REMARKS

SEAL

DRAWN BY: RFL
DATE: NOVEMBER 2018
CHECKED BY: CB
APPROVED BY: THF

DISCLAIMER: PROPERTY OF BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC. 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 BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC.

COVER THICKNESS MAP

SITE MANAGEMENT PLAN
QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK
PREPARED FOR
QUEEN CITY LANDING, LLC

FIGURE 10

APPENDIX A

ENVIRONMENTAL EASEMENT

PEGGY A. LAGREE, ACTING ERIE COUNTY CLERK
REF:

DATE:9/13/2017
TIME:11:11:20 AM
RECEIPT: 17160083

PARALEGAL SERVICES OF BUFFALO
ACCOUNT #: 9273

ITEM - 01 785
RECD: 9/13/2017 11:12:47 AM
FILE: 2017185180 BK/PG D 11318/6434
Deed Sequence: TT2017003298
QUEEN CITY LANDING LLC
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL C
ONSERVATION

Recording Fees	90.00
TP584	10.00

Subtotal	100.00

TOTAL DUE	$100.00
PAID TOTAL	$100.00
PAID ESCROW	$100.00

REC BY: Loretta
COUNTY RECORDER

D 11318 6434

ENVIRONMENTAL EASEMENT GRANTED PURSUANT TO ARTICLE 71, TITLE 36 OF THE NEW YORK STATE ENVIRONMENTAL CONSERVATION LAW

THIS INDENTURE made this 30th day of August, 2017, between Owner(s) Queen City Landing, LLC, having an office at 3275 N. Benzing Road, Orchard Park, New York 14127, County of Erie, State of New York (the "Grantor"), and The People of the State of New York (the "Grantee."), acting through their Commissioner of the Department of Environmental Conservation (the "Commissioner", or "NYSDEC" or "Department" as the context requires) with its headquarters located at 625 Broadway, Albany, New York 12233,

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to encourage the remediation of abandoned and likely contaminated properties ("sites") that threaten the health and vitality of the communities they burden while at the same time ensuring the protection of public health and the environment; and

WHEREAS, the Legislature of the State of New York has declared that it is in the public interest to establish within the Department a statutory environmental remediation program that includes the use of Environmental Easements as an enforceable means of ensuring the performance of operation, maintenance, and/or monitoring requirements and the restriction of future uses of the land, when an environmental remediation project leaves residual contamination at levels that have been determined to be safe for a specific use, but not all uses, or which includes engineered structures that must be maintained or protected against damage to perform properly and be effective, or which requires groundwater use or soil management restrictions; and

WHEREAS, the Legislature of the State of New York has declared that Environmental Easement shall mean an interest in real property, created under and subject to the provisions of Article 71, Title 36 of the New York State Environmental Conservation Law ("ECL") which contains a use restriction and/or a prohibition on the use of land in a manner inconsistent with engineering controls which are intended to ensure the long term effectiveness of a site remedial program or eliminate potential exposure pathways to hazardous waste or petroleum; and

WHEREAS, Grantor, is the owner of real property located at the address of 975 and 1005 Fuhrmann Boulevard in the City of Buffalo, County of Erie and State of New York, known and designated on the tax map of the County Clerk of Erie as tax map parcel numbers: Section 132.06 Block 1 Lots 1.1 and 1.2, being a portion of the property conveyed to Grantor by deed dated November 27, 2007 and recorded in the Erie County Clerk's Office in Liber and Page 11137/7323. The property subject to this Environmental Easement (the "Controlled Property") comprises approximately 7.75 +/- acres, and is hereinafter more fully described in the Land Title Survey dated May 23, 2017 prepared by Francis C. Delles, L.L.S. of Millard, Mackay & Delles Land Surveyors, LLP, which will be attached to the Site Management Plan. The Controlled Property description is set forth in and attached hereto as Schedule A; and

WHEREAS, the Department accepts this Environmental Easement in order to ensure the protection of public health and the environment and to achieve the requirements for remediation established for the Controlled Property until such time as this Environmental Easement is

FILED
SEP 13 2017
ERIE COUNTY
CLERK'S OFFICE

extinguished pursuant to ECL Article 71, Title 36; and

NOW THEREFORE, in consideration of the mutual covenants contained herein and the terms and conditions of Brownfield Cleanup Agreement Index Number: C915304-06-16, Grantor conveys to Grantee a permanent Environmental Easement pursuant to ECL Article 71, Title 36 in, on, over, under, and upon the Controlled Property as more fully described herein ("Environmental Easement").

1. Purposes. Grantor and Grantee acknowledge that the Purposes of this Environmental Easement are: to convey to Grantee real property rights and interests that will run with the land in perpetuity in order to provide an effective and enforceable means of encouraging the reuse and redevelopment of this Controlled Property at a level that has been determined to be safe for a specific use while ensuring the performance of operation, maintenance, and/or monitoring requirements; and to ensure the restriction of future uses of the land that are inconsistent with the above-stated purpose.

2. Institutional and Engineering Controls. The controls and requirements listed in the Department approved Site Management Plan ("SMP") including any and all Department approved amendments to the SMP are incorporated into and made part of this Environmental Easement. These controls and requirements apply to the use of the Controlled Property, run with the land, are binding on the Grantor and the Grantor's successors and assigns, and are enforceable in law or equity against any owner of the Controlled Property, any lessees and any person using the Controlled Property.

A. (1) The Controlled Property may be used for:

Restricted Residential as described in 6 NYCRR Part 375-1.8(g)(2)(ii), Commercial as described in 6 NYCRR Part 375-1.8(g)(2)(iii) and Industrial as described in 6 NYCRR Part 375-1.8(g)(2)(iv)

(2) All Engineering Controls must be operated and maintained as specified in the Site Management Plan (SMP);

(3) All Engineering Controls must be inspected at a frequency and in a manner defined in the SMP;

(4) The use of groundwater underlying the property is prohibited without necessary water quality treatment as determined by the NYSDOH or the Erie County Department of Health to render it safe for use as drinking water or for industrial purposes, and the user must first notify and obtain written approval to do so from the Department;

(5) Groundwater and other environmental or public health monitoring must be performed as defined in the SMP;

(6) Data and information pertinent to Site Management of the Controlled Property must be reported at the frequency and in a manner defined in the SMP;

(7) All future activities on the property that will disturb remaining

contaminated material must be conducted in accordance with the SMP;

(8) Monitoring to assess the performance and effectiveness of the remedy must be performed as defined in the SMP;

(9) Operation, maintenance, monitoring, inspection, and reporting of any mechanical or physical components of the remedy shall be performed as defined in the SMP;

(10) Access to the site must be provided to agents, employees or other representatives of the State of New York with reasonable prior notice to the property owner to assure compliance with the restrictions identified by this Environmental Easement.

B. The Controlled Property shall not be used for Residential purposes as defined in 6NYCRR 375-1.8(g)(2)(i), and the above-stated engineering controls may not be discontinued without an amendment or extinguishment of this Environmental Easement.

C. The SMP describes obligations that the Grantor assumes on behalf of Grantor, its successors and assigns. The Grantor's assumption of the obligations contained in the SMP which may include sampling, monitoring, and/or operating a treatment system, and providing certified reports to the NYSDEC, is and remains a fundamental element of the Department's determination that the Controlled Property is safe for a specific use, but not all uses. The SMP may be modified in accordance with the Department's statutory and regulatory authority. The Grantor and all successors and assigns, assume the burden of complying with the SMP and obtaining an up-to-date version of the SMP from:

Site Control Section
Division of Environmental Remediation
NYSDEC
625 Broadway
Albany, New York 12233
Phone: (518) 402-9553

D. Grantor must provide all persons who acquire any interest in the Controlled Property a true and complete copy of the SMP that the Department approves for the Controlled Property and all Department-approved amendments to that SMP.

E. Grantor covenants and agrees that until such time as the Environmental Easement is extinguished in accordance with the requirements of ECL Article 71, Title 36 of the ECL, the property deed and all subsequent instruments of conveyance relating to the Controlled Property shall state in at least fifteen-point bold-faced type:

This property is subject to an Environmental Easement held by the New York State Department of Environmental Conservation pursuant to Title 36 of Article 71 of the Environmental Conservation

Law.

F. Grantor covenants and agrees that this Environmental Easement shall be incorporated in full or by reference in any leases, licenses, or other instruments granting a right to use the Controlled Property.

G. Grantor covenants and agrees that it shall, at such time as NYSDEC may require, submit to NYSDEC a written statement by an expert the NYSDEC may find acceptable certifying under penalty of perjury, in such form and manner as the Department may require, that:

(1) the inspection of the site to confirm the effectiveness of the institutional and engineering controls required by the remedial program was performed under the direction of the individual set forth at 6 NYCRR Part 375-1.8(h)(3).

(2) the institutional controls and/or engineering controls employed at such site:

(i) are in-place;

(ii) are unchanged from the previous certification, or that any identified changes to the controls employed were approved by the NYSDEC and that all controls are in the Department-approved format; and

(iii) that nothing has occurred that would impair the ability of such control to protect the public health and environment;

(3) the owner will continue to allow access to such real property to evaluate the continued maintenance of such controls;

(4) nothing has occurred that would constitute a violation or failure to comply with any site management plan for such controls;

(5) the report and all attachments were prepared under the direction of, and reviewed by, the party making the certification;

(6) to the best of his/her knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program, and generally accepted engineering practices; and

(7) the information presented is accurate and complete.

3. Right to Enter and Inspect. Grantee, its agents, employees, or other representatives of the State may enter and inspect the Controlled Property in a reasonable manner and at reasonable times to assure compliance with the above-stated restrictions.

4. Reserved Grantor's Rights. Grantor reserves for itself, its assigns, representatives, and successors in interest with respect to the Property, all rights as fee owner of the Property, including:

A. Use of the Controlled Property for all purposes not inconsistent with, or limited by the terms of this Environmental Easement;

B. The right to give, sell, assign, or otherwise transfer part or all of the underlying fee interest to the Controlled Property, subject and subordinate to this Environmental Easement;

5. Enforcement

A. This Environmental Easement is enforceable in law or equity in perpetuity by Grantor, Grantee, or any affected local government, as defined in ECL Section 71-3603, against the owner of the Property, any lessees, and any person using the land. Enforcement shall not be defeated because of any subsequent adverse possession, laches, estoppel, or waiver. It is not a defense in any action to enforce this Environmental Easement that: it is not appurtenant to an interest in real property; it is not of a character that has been recognized traditionally at common law; it imposes a negative burden; it imposes affirmative obligations upon the owner of any interest in the burdened property; the benefit does not touch or concern real property; there is no privity of estate or of contract; or it imposes an unreasonable restraint on alienation.

B. If any person violates this Environmental Easement, the Grantee may revoke the Certificate of Completion with respect to the Controlled Property.

C. Grantee shall notify Grantor of a breach or suspected breach of any of the terms of this Environmental Easement. Such notice shall set forth how Grantor can cure such breach or suspected breach and give Grantor a reasonable amount of time from the date of receipt of notice in which to cure. At the expiration of such period of time to cure, or any extensions granted by Grantee, the Grantee shall notify Grantor of any failure to adequately cure the breach or suspected breach, and Grantee may take any other appropriate action reasonably necessary to remedy any breach of this Environmental Easement, including the commencement of any proceedings in accordance with applicable law.

D. The failure of Grantee to enforce any of the terms contained herein shall not be deemed a waiver of any such term nor bar any enforcement rights.

6. Notice. Whenever notice to the Grantee (other than the annual certification) or approval from the Grantee is required, the Party providing such notice or seeking such approval shall identify the Controlled Property by referencing the following information:

County, NYSDEC Site Number, NYSDEC Brownfield Cleanup Agreement, State Assistance Contract or Order Number, and the County tax map number or the Liber and Page or computerized system identification number.

Parties shall address correspondence to:

Site Number: C915304
Office of General Counsel
NYSDEC
625 Broadway
Albany New York 12233-5500

With a copy to:

Site Control Section
Division of Environmental Remediation
NYSDEC
625 Broadway
Albany, NY 12233

All notices and correspondence shall be delivered by hand, by registered mail or by Certified mail and return receipt requested. The Parties may provide for other means of receiving and communicating notices and responses to requests for approval.

7. Recordation. Grantor shall record this instrument, within thirty (30) days of execution of this instrument by the Commissioner or her/his authorized representative in the office of the

recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

8. Amendment. Any amendment to this Environmental Easement may only be executed by the Commissioner of the New York State Department of Environmental Conservation or the Commissioner's Designee, and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

9. Extinguishment. This Environmental Easement may be extinguished only by a release by the Commissioner of the New York State Department of Environmental Conservation, or the Commissioner's Designee, and filed with the office of the recording officer for the county or counties where the Property is situated in the manner prescribed by Article 9 of the Real Property Law.

10. Joint Obligation. If there are two or more parties identified as Grantor herein, the obligations imposed by this instrument upon them shall be joint and several.

Remainder of Page Intentionally Left Blank

IN WITNESS WHEREOF, Grantor has caused this instrument to be signed in its name.

Queen City Landing, LLC:

By: Gerald A. Buchheit Jr

Print Name: Gerald A. Buchheit, Jr.

Title: Authorized Member Date: August 9, 2017

Grantor's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF)

On the 9th day of August, in the year 20 17, before me, the undersigned, personally appeared Gerald A. Buchheit, Jr., personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of which the individual(s) acted, executed the instrument.

Craig A. Slater

Notary Public - State of New York

CRAIG A. SLATER
Notary Public, State of New York
Qualified in Erie County
Commission Expires October 31, 20 18

THIS ENVIRONMENTAL EASEMENT IS HEREBY ACCEPTED BY THE PEOPLE OF THE STATE OF NEW YORK, Acting By and Through the Department of Environmental Conservation as Designee of the Commissioner,

By: ______________________________
Robert W. Schick, Director
Division of Environmental Remediation

Grantee's Acknowledgment

STATE OF NEW YORK)
) ss:
COUNTY OF ALBANY)

On the 30th day of August, in the year 2017, before me, the undersigned, personally appeared Robert W. Schick, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name is (are) subscribed to the within instrument and acknowledged to me that he/she/ executed the same in his/her/ capacity as Designee of the Commissioner of the State of New York Department of Environmental Conservation, and that by his/her/ signature on the instrument, the individual, or the person upon behalf of which the individual acted, executed the instrument.

____
Notary Public - State of New York

David J. Chiusano
Notary Public, State of New York
No. 01CH5032146
Qualified in Schenectady County
Commission Expires August 22, 2018

SCHEDULE "A" PROPERTY DESCRIPTION

ALL THAT TRACT OR PARCEL OF LAND, situate in the City of Buffalo, County of Erie and State of New York, being part of Lot No. 4 of the Ogden Gore Tract, bounded and described as follows:

BEGINNING at a point in the northerly line of Lot 4 at its intersection with the westerly line of Fuhrmann Boulevard as established by notice of appropriation filed in the Erie County Clerk's office in Liber 6750 of Deeds at page 26 (Map 310, Parcel 321);

RUNNING THENCE WESTERLY along the northerly line of Lot 4 at a bearing of S 68°47'25" W, a distance of 45.09 feet to the shore line of Lake Erie as it existed in August of 1916; thence S 20°40'35" E along said shore line as it existed in August of 2016, a distance of 1.65 feet to a point; thence S 69°19'25" W, a distance of 4.84 feet to the TRUE POINT OF BEGINNING;

CONTINUING THENCE WESTERLY at a bearing of S 69°19'25" W, a distance of 639.02 feet to a point;

THENCE SOUTHERLY at a bearing of S 20°40'35" E, a distance of 431.56 feet to a point;

THENCE EASTERLY at a bearing of N 68°42'55" E, a distance of 629.36 feet to a point;

THENCE SOUTHERLY at a bearing of S 20°40'35" E, a distance of 75.12 feet to a point on the southerly line of lands conveyed to Queen City Landing, LLC by deed recorded in the Erie County Clerk's Office in Liber 11137 of Deeds at page 7323;

THENCE EASTERLY at a bearing of N 69°19'25" E and along said southerly line of lands conveyed to Queen City Landing, LLC, a distance of 221.08 feet to a point on the westerly line of Fuhrmann Boulevard as laid out by said notice of appropriation;

THENCE NORTHERLY along said westerly line of Fuhrmann Boulevard as laid out and at a bearing of N 38°30'08" W, a distance of 525.01 feet to t o a point;

THENCE SOUTHERLY at a bearing of S 21°00'10" E, a distance of 39.86 feet to a point;

THENCE WESTERLY at a bearing of S 68°40'12" W, a distance of 50.54 feet to a point;

THENCE NORTHERLY at a bearing of N 21°11'25" W, a distance of 40.63 feet to the True Point of Beginning.

Said parcel containing an area of 7.75 acres, more or less.

APPENDIX B

LIST OF SITE CONTACTS

Name	**Phone/Email Address**
Site Owner – Queen City Landing	716-823-7704 gbuchheit@accentstripe.com
Remedial Party – Queen City Landing	716-823-7704 gbuchheit@accentstripe.com
Qualified Environmental Professional: Thomas H. Forbes, P.E. Benchmark Environmental Engineering & Science, PLLC	716-856-0635 tforbes@benchmarkturnkey.com
NYSDEC DER Project Manager: Jaspal Walia, P.E.	716-851-7220 jaspal.walia@dec.ny.gov
NYSDEC Regional HW Engineer: Chad Staniszewski, P.E.	716-851-7220 chad.staniszewski@dec.ny.gov
NYSDEC Site Control: Kelly A. Lewandowski, P.E.	518-402-9543 kelly.lewandowski@dec.ny.gov
NYSDOH Bureau of Environmental Exposure Investigation	518-402-7860 beei@health.ny.gov
Remedial Party Attorney: Craig A. Slater, Esq.	716-845-6760 cslater@cslaterlaw.com

APPENDIX C

SUBSURFACE INVESTIGATION & WELL INSTALLATION LOGS

C&S Engineers, Inc.
141 Elm Street
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

TEST PIT

Project Name:	Queen City Landing	**Test Pit No.**	**TP-1**
		Sheet 1 of:	1
		Project No.:	J53.002.003
		Start Date:	1/17/2017
Location:		**Finish Date:**	1/17/2017
Operator:			
Client:		**Inspector:**	
Equipment:			

Depth (ft)	**Sample No.**	**Symbol**	**Exc. Depth**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., caving of sidewalls, excavation difficulties, PID readings)
				Asphalt	
1				Misc. FILL, compacted	PID = 0 ppm
2				Brick, Concrete	
3					
4					
5				Brown silty loam	PID = 0 PPM
6	▨			Groundwater at approximately 6 feet	
7					
8					
9					
10					
11					
12					
13					
14					
15					

Location: 50 ft. south of concrete
No visible contamination
No petroleum odors

Sample
TP-1-5-6 ft
9:45

Analysis: Pt. 375 List

C&S Engineers, Inc.
141 Elm Street
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

TEST PIT

Test Pit No.	**TP-2**		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing	***Start Date:***	1/17/2017
Location:		***Operator:***	
Finish Date:	1/17/2017		
Client:		***Equipment:***	
Inspector:			

Depth (ft)	**Sample No.**	**Symbol**	**Exc. Depth**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., caving of sidewalls, excavation difficulties, PID readings)
				Asphalt/stone	
1					
2				Misc. FILL, grown to gray to dark gray	PID = 0 PPM
3					
4					
5				Brown sandy loam	PID = 0 PPM
6					
7	▨			Groundwater at approximately 6.5 feet	
8					
9					
10					
11					
12					
13					
14					
15					

Location: 45 ft south of southwest corner of concrete
No visible contamination
No petroleum odors

Sample
TP-2-6-7 ft
10:20

Analysis: Pt. 375 List

C&S Engineers, Inc.
141 Elm Street
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

TEST PIT

Test Pit No.	**TP-3**
Sheet 1 of:	1
Project No.:	J53.002.003
Start Date:	1/17/2017
Finish Date:	1/17/2017
Inspector:	

Project Name: Queen City Landing
Location:
Operator:
Client:
Equipment:

Depth (ft)	Sample No.	Symbol	Exc. Depth	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., caving of sidewalls, excavation difficulties, PID readings)
1				Misc. FILL, compacted	PID = 0 PPM
2					
3					
4					
5				Brown silty loam, some FILL	PID = 0 PPM
6					
7	▨			Groundwater approximately at 7 feet	
8					
9					
10					
11					
12					
13					
14					
15					

Location: 20 ft west of wall
No visible contamination
No petroleum odors

Sample
TP-3-6-7 ft
11:30

Analysis: Pt. 375 List
Hex Chrom

C&S Engineers, Inc.
141 Elm Street
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

TEST PIT

Test Pit No.	**TP-4**		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing	***Start Date:***	1/17/2017
Location:		***Operator:***	
Finish Date:	1/17/2017		
Client:		***Equipment:***	
Inspector:			

Depth (ft)	**Sample No.**	**Symbol**	**Exc. Depth**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., caving of sidewalls, excavation difficulties, PID readings)
1				Misc. FILL	PID = 0 PPM
2					2" pipe running East to West
					PID at pipe 0.3 PPM
3					
4					
5				Misc. FILL	PID = 0 PPM
6					
7	▨				
				Slag/ very compacted, some black material	
8					
9					
10					
11					
12					
13					
14					
15					

Location: 20 ft West of Northwest corner
No petroleum odors

Sample
TP-4-6-7 ft
11:50

Analysis: Pt. 375 List

C&S Engineers, Inc.
141 Elm Street
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

TEST PIT

Test Pit No. TP-5
Sheet 1 of: 1
Project No.: J53.002.003
Project Name: Queen City Landing
Start Date: 1/17/2017
Location:
Operator:
Finish Date: 1/17/2017
Client:
Equipment:
Inspector:

Depth (ft)	Sample No.	Symbol	Exc. Depth	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., caving of sidewalls, excavation difficulties, PID readings)
1				Misc. FILL	PID = 0 PPM
2					
3				Sand, black staining, petroleum odor	PID: 20-30 ppm
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					

Location: 10 ft North of foundation, 30 ft East of wall
Tank at least 15 ft long

Sample
No Sample

C&S Engineers, Inc.
141 Elm Street
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

TEST PIT

Test Pit No.	**TP-6**		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing	***Start Date:***	1/17/2017
Location:		***Operator:***	
Finish Date:	1/17/2017		
Client:		***Equipment:***	
Inspector:			

Depth (ft)	**Sample No.**	**Symbol**	**Exc. Depth**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., caving of sidewalls, excavation difficulties, PID readings)
1					
2				Misc. FILL, some compacted slag	PID up to 4 PPM
3					
4					18" pipe
5					
6	▨				
7				Compacted clay	PID = 0 PPM
8					
9					
10					
11					
12					
13					
14					
15					

Location: 50 ft North of foundation
18 " pipe found 4 ft deep
4 ppm PID readings at sample
No petroleum odors

Sample
TP-6-5-6 ft
2:30

Analysis: Pt. 375 List

C&S Engineers, Inc.
141 Elm Street
Buffalo, New York 14203
Phone: 716-847-1630
Fax: 716-847-1454
www.cscos.com

TEST PIT

Test Pit No.	**TP-7**		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing	**Start Date:**	1/17/2017
Location:		**Operator:**	
		Finish Date:	1/17/2017
Client:		**Equipment:**	
		Inspector:	

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	Sample No.	Symbol	Exc. Depth	**MATERIAL DESCRIPTION**	**COMMENTS** (e.g., caving of sidewalls, excavation difficulties, PID readings)
1					
2				Misc. FILL, some slag	PID = 0 PPM
3					
4					
5					
6				Fine Sand, brown	PID = 0 PPM
	▨			Groundwater at approximately 6.5 feet	
7	▨				
8					
9					
10					
11					
12					
13					
14					
15					

Location: 10 ft East of concrete
No visible contamination
No petroleum odors

Sample
TP-7-6-7 ft
3:00

Analysis: Pt. 375 List

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BORING LOG

Boring No.	**A7**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/20/17
Finish Date:	1/20/17
Inspector:	BR

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**				
			Drill Rig:	Geoprobe		
While Drilling:	NA		**Casing:**	2.125"	**Rock Core:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	
After Casing Removal:			**Hammer:**			

Undist:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-48"	***brown/dark brown clay FILL***	0 ppm	48" Recovered
1							
2							
	WC						
3							
4							
				0"-12"	***Brown clay FILL, some rocks/gravel***	0 ppm	48" Recovered
5	↓			12"-48"	***Brown, wet sandy clay FILL, brick***	0 ppm	
6							
7							
8							
				0"-12"	***Brown, wet sandy clay FILL, brick***	0 ppm	
9				12"-36"	***wet, brown, sandy silt***	0 ppm	48" Recovered
				36"-48"	***Grey clay***	0 ppm	
10							
11							
12							
				0"-48"	***Grey clay***	0 ppm	48" Recovered
13							
14							
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban Fill until 9 ft
18							Construction Fill -9-11ft
					Sample:		Native starts - 11 ft
19					***A7-10-11ft***		
					A7-15ft		
20					***A7-WC***		
					A7-SS		
21							
22							
23							

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BORING LOG

Boring No.	A8 - MW5		
Sheet 1 of:	1		
Project No.:	J53002002		
Project Name:	Queen City Landing Remedial investigation	**Surface Elev.:**	581
Location:	975 Fuhrmann Blvd	**Datum:**	
Client:	R&P Oak Hill	**Start Date:**	3/16/16
Drilling Firm:	NYEG	**Finish Date:**	3/16/16

Groundwater	**Depth**	**Date & Time**					
			Drill Rig:	CME-55		**Inspector:**	AD
While Drilling:	6	3/16/16 13:40	**Casing:**	4.25 HAS	**Rock Core:**	**Undist:**	
Before Casing Removal:			**Sampler:**	2' SS	**Other:**		
After Casing Removal:			**Hammer:**				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			2	0-4"	***Topsoil***	0 ppm	13:00 Start
1			4	4-16"	***Moist-brown/dark brown-silty clay FILL***	0 ppm	thunderstorming
			4				16" recovered
2			5				
			3	0-12"	***Clay FILL with rocks and gravel***	0 ppm	12" recovered
3			4				
			3				
4			4				
	▨		1	0-10"	***Moist to wet-brown-Clay-some silt***	0 ppm	13" recovered
5	▨		1	10-13"	***Red brown-silty CLAY-trace sand and rock***	0 ppm	
	▨		1				
6	▨ ↓		1				
			2	0-5"	***Brown-CLAY-trace black material (coal?)***	0 ppm	24" recovered
7			2	5-8"	***Blue and white coarse SAND***	0 ppm	
			2	8-24"	***Red brown-coarse Sand and Clay***	0 ppm	
8			3				
			6	0-3"	***Red brown- wet-coarse sand and clay***	0 ppm	24" recovered
9			6	3-24"	***Wet -Coarse sand and small rounded rocks/pebbles (Native)***	0 ppm	
	▨		7				
10	▨		10				
	▨		3	0-3"	***Slug***	0 ppm	14" recovered
11	▨		3	3-14"	***Wet-multicolor-coarse sand and small rounded***	0 ppm	
	▨		4		***rocks/pebbles***		
12	▨		4				
			7	0-17"	***Wet-multicolor-coarse sand and small rounded rocks/pebbles***	0 ppm	22" recovered
13			3	17-22"	***Grey-green-brown CLAY AND SILT***	0 ppm	
	▨		1				
14	▨		1				
	▨		2	0-10"	***Wet- grey/brown CLAY and SILT***	0 ppm	24" recovered
15	▨		1	10-24"	***Wet-fine-silty SAND***	0 ppm	
	▨		1				
16	▨		2				
					END OF BORING AT 16 FEET		
17							
18					***Sample:***		Urban Fill until 13 ft
					MW5-4-6FT		Native at 13 ft
19					***MW5-9-12FT***		
					MW5-14-16FT		
20							
21							
22							
23							

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BORING LOG

Boring No.	**A9**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/26/17
Finish Date:	1/26/17
Inspector:	AS

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	***Depth***	***Date & Time***				
While Drilling:			***Drill Rig:***	Geoprobe		
Before Casing Removal:			***Casing:***	2.125"	***Rock Core:***	***Undist:***
After Casing Removal:			***Sampler:***	Acetate liner	***Other:***	GNSS Position:
			Hammer:		1039740.98 FT N, 1072586.53 FT E,	

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-19"	***Gravel, brown, dry, silty sand***	0 ppm	Time: 13:35
1				19"-24"	***Brown, dense, silty clay***	0 ppm	36" Recovered
				24"-26"	***Red brick***	0 ppm	
2				26"-32"	***Brown, moist, sand***	0 ppm	
				32"-36"	***Brown, dense, silty clay***	0 ppm	
3							
4							
				0"-8"	***Brown, moist, silty sand, gravel, red brick, stones, black***	0 ppm	
5					***and orange colored***	0 ppm	35" Recovered
				8"-26"	***Light brown to brown, coarse sand or fine gravel, dry***	0 ppm	
6				26"-35"	***Red brick, gravel, dark brown, silty sand, black***	0 ppm	
7							
	▨						
8	▨						
				0"-2"	***Slug***	0 ppm	
9				2"-13"	***Gravel, brown, moist, silty sand***	0 ppm	46" Recovered
				13"-39"	***Stones in sand, gravel, brown, moist to wet, medium grained***	0 ppm	
10				39"-46"	***Dark brown, moist, sand, fine to medium grained***	0 ppm	
11							
12							
				0"-33"	***Slug from caving in***	0 ppm	
13				33"-46"	***Grey to dark grey, moist, sand, fine to medium grained***	0 ppm	46" Recovered
							Caving in while drilling,
14							multiple attempts
15							
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		
							Urban fill to 8 ft
18							Construction fill 8-12 ft
					Sample:		Native starts at 12 ft
19					***A9-SS***		
					A9-7-8 FT		
20					***A9-15 FT***		
21							
22							
23							

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BORING LOG

Project Name:	Queen City Landing Remedial investigation	**Boring No.**	**B1 - MW8**
		Sheet 1 of:	1
		Project No.:	J53002002
Location:	975 Fuhrmann Blvd	**Surface Elev.:**	576
		Datum:	
Client:	R&P Oak Hill	**Start Date:**	3/23/16
Drilling Firm:	NYEG	**Finish Date:**	3/23/16
		Inspector:	CM

Groundwater	**Depth**	**Date & Time**				
While Drilling:	2	3/23/16	**Drill Rig:**	Geoprobe 7720DT		
Before Casing Removal:			**Casing:**	3.25"	**Rock Core:**	
After Casing Removal:			**Sampler:**	~4.8 ft liners	**Undist:**	
			Hammer:		**Other:**	

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		**MATERIAL DESCRIPTION**		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0-12"	***Moist-fine-brown sand trace silt-some roots***	0 ppm	40" Recovered
1	▨			12-17"	***Fine-dark brown-sand-trace slag***	0 ppm	
	▨			17-40"	***Saturated-fine to med sand***	0 ppm	
2	▨ ↓						
3							
4							
5							
				0-55"	***Saturated-fine to med sand***	0 ppm	58" recovered
6				55-58"	***Saturated-grey-fine sand-trace silt-shells***	0 ppm	
7							
8							
9							
10							
				0-18"	***Saturated-brown-sand-slug***	0 ppm	58" recovered
11				18-56"	***Saturated-fine-black sand-trace to no Silt-shells***	0 ppm	
				56-58"	***Soft-grey-silty clay and FILL mix***	0 ppm	
12							
	▨						
13	▨						
14							
	▨						
15	▨						
				0-16"	***Slug***	0 ppm	58" recovered
16				16-22"	***Soft-grey-silty clay and FILL mix-angular gravel 1"and smaller***	0 ppm	
				22-24"	***Gravel-grey-angular 1/4" and smaller***	0 ppm	
17				24-27"	***Fine-grey sand***	0 ppm	
				27-31"	***Gravel-grey-angular 1/4" and smaller***	0 ppm	
18				31-58"	***Dense-grey-silty clay***	0 ppm	
19							
20							
					END OF BORING AT 20 FEET		driller lost 9" of casing
21							location unknown in hole
					Sample:		
22					***MW8-0.5-2ft***		Urban fill to 20 feet
					MW8-12-13ft		
23					***MW8-14-15ft***		

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BORING LOG

Boring No.	**B2**		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing Remedial Investigation	***Surface Elev.:***	
Location:	Queen City Landing, East Site, Buffalo, New York	***Datum:***	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	***Start Date:***	1/26/17
Drilling Firm:	Nature's Way Environmental	***Finish Date:***	1/26/17

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	Geoprobe			***Inspector:***	AS
While Drilling:			***Casing:***	2.125"	***Rock Core:***		***Undist:***	
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***	GNSS Position: (Building)		
After Casing Removal:			***Hammer:***		1039639.65 FT N, 1071890.05 FT E,			

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-20"	***Brown, wet, sand, dark streaks***	0 ppm	Time: 8:43
1				20"-23"	***Grey, wet, silty clay***	0 ppm	31" Recovered
				23"-31"	***FILL - brick, brown, silty clay, wet, gravel***	0 ppm	Weather: 37 Degrees F
2							Snow shower/wind
3	▨						
	▨						
4	▨						
	↓			0-10"	***Loose, brown, silty sand***	0 ppm	
5				10-28"	***FILL - stone, brick, silty clay, green/tourquise color and***	0 ppm	28" Recovered
					black		
6							Shredded liner hit with hammer
							(sediment contents mixed)
7							
8							
				0"-45"	***Loose, saturated, brown, sand, embedded brick, gravel, and***	0 ppm	
9					***rock***		49" Recovered
				45"-49"	***Brown, moist, soft, sand, dark streaks***	0 ppm	
10							
11							
12							
					Sand	No PID	
13					***Drilling stopped because running sands;***		
14							Shredded liner hit with hammer
							(sediment contents mixed)
15							
16							
17					***END OF BORING between 12-16 FEET***		
18							Urban fill to 12 feet
					Sample:		running sands start at 12 feet
19					***B2-2.5-4 FT***		
					DUP-E-012617		
20							
21							
22							
23							

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BORING LOG

Project Name:	Queen City Landing Remedial Investigation	**Boring No.**	**B3**
Location:	Queen City Landing, East Site, Buffalo, New York	**Sheet 1 of:**	1
Client:	R&P Oak Hill Development, LLC	**Project No.:**	J53.002.003
Drilling Firm:	Nature's Way Environmental	**Surface Elev.:**	
		Datum:	GROUND SURFACE
		Start Date:	1/26/17
		Finish Date:	1/26/17
		Inspector:	AS

Groundwater	**Depth**	**Date & Time**				
			Drill Rig:	Geoprobe		
While Drilling:			**Casing:**	2.125"	**Rock Core:**	**Undist:**
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	GNSS Position: (Building)
After Casing Removal:			**Hammer:**		1039699.75 FT N, 1072033.88 FT E,	

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-7"	***Gravel, rock, brown, moist, sand, large stone (1 inch dia)***	0 ppm	Time: 10:00
1				7"-8"	***Brown, dense, moist, silty clay***	0 ppm	42" Recovered
				8"-22"	***Dark brown, silty clay, embedded gravel***	0 ppm	
2				22"-42"	***Gravel, dense, tourquise and black colored, moist sand***	0 ppm	
3							
	▨						
4							
				0"-24"	***Light tan (white), coarse sand, tourquoise and black***	0 ppm	
5					***colored, loose, wet, stone with 1 inch diameter***	0 ppm	24" Recovered
6							
7					***REFUSAL AT 6 FEET***		
8							
9					***Sample:***		
					B3-3-4 FT		Urban fill to 6 feet
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							

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BORING LOG

Boring No.	**B4/MW-9**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/24/17
Finish Date:	1/24/17
Inspector:	CM

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**				
			Drill Rig:	Geoprobe		
While Drilling:			**Casing:**	2.125"	**Rock Core:**	**Undist:**
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	
After Casing Removal:			**Hammer:**			

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			2	0"-8"	***Moist FILL***	0 ppm	Time: 8:42
1			4				8" Recovered
			6				Weather: 32 Degrees F
2			2				Snow
	▨		23	0"-10"	***FILL - black staining, saturated, petroleum-like odor***	11.5 ppm	
3			13				10" Recovered
			6				
4			10				
			2	0"-4"	***Slight sheen on split spoon wall***	2.8 ppm	
5			3				4" Recovered
			6				
6	↓		9				
			2	0"-12"	***Soft, water saturated clay, silt, some coarse sand***	0 ppm	
7			3				12" Recovered
			3				
8			3				
			1	0"-7"	***Soft, water saturated clay, silt trace, some coarse sand***	0 ppm	
9			2	7"-12"	***Black silt and organic matter***		15" Recovered
			1	12"-15"	***Coarse sand and gravel***		
10			7				
			5	0"-24"	***Fine to small, coarse sand, some gravel, silt***	0 ppm	
11			10				24" Recovered
			10				
12			5				
			1	0"-24"	***Running sands***	0 ppm	
13			2		***Fine to small, coarse sand, some gravel, silt***		24" Recovered
			1				
14			3				
			1	0"-24"	***Running sands***	0 ppm	
15			1		***Fine to small, coarse sand, some gravel, silt***		24" Recovered
			1				
16			2				
17					***END OF BORING AT 16 FEET***		
18					***Sample:***		urban fill to 12 ft
					B4-2-4 ft		
19							
20							
21							
22							
23							

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BORING LOG

Boring No. B5
Sheet 1 of: 1
Project No.: J53.002.003
Project Name: Queen City Landing Remedial Investigation
Surface Elev.:
Location: Queen City Landing, East Site, Buffalo, New York
Datum: GROUND SURFACE
Client: R&P Oak Hill Development, LLC
Start Date: 1/26/17
Drilling Firm: Nature's Way Environmental
Finish Date: 1/26/17
Drill Rig: Geoprobe
Inspector: AS

Groundwater	***Depth***	***Date & Time***
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

Casing: 2.125"
Rock Core:
Undist:
Sampler: Acetate liner
Other: GNSS Position: (Building) 1039755.57 FT N, 1072222.03 FT E,
Hammer:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-12"	***Gravel, 1.5" diameter and smaller, brown, moist, silty sand***	0 ppm	Time: 11:11
1				12"-17"	***Brown, soft, moist, silty clay***	0 ppm	34" Recovered
				17"-34"	***Brown, wet, silty sand, brick, gravel***	0 ppm	
2							
3							
4							
				0"-8"	***Loose, silty, embedded gravel***	0 ppm	
5				8"-21"	***Brown, wet, silty clay, soft, embedded brick, wood chips,***	0 ppm	21" Recovered
					and rocks		
6							
	▨						
7							
8							
				0"-13"	***Brown, wet, silty clay, soft, embedded brick, wood chips,***	0 ppm	
9					***and rocks***		39" Recovered
				13"-20"	***Grey, loose, silty sand***	0 ppm	
10				20"-39"	***Brown, wet to moist, medium grained sand, embedded***	0 ppm	
					gravel, brick - FILL		
11							
12	↓						
				0"-3"	***Brown, loose, sand***	0 ppm	
13				3"-27"	***Gravel/rock, sand***	0 ppm	39" Recovered
				27"-39"	***brown, moist, soft, silty clay***	0 ppm	
14							
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban fill to 12 feet
18					***Sample:***		Construction fill to 16
					B5-6-8 FT		
19							
20							
21							
22							
23							

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BORING LOG

		Boring No.	**B6**
		Sheet 1 of:	1
		Project No.:	J53.002.003
Project Name:	Queen City Landing Remedial Investigation	**Surface Elev.:**	
Location:	Queen City Landing, East Site, Buffalo, New York	**Datum:**	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	**Start Date:**	1/26/17
Drilling Firm:	Nature's Way Environmental	**Finish Date:**	1/26/17

Groundwater	**Depth**	**Date & Time**	**Drill Rig:**	Geoprobe			**Inspector:**	AS
While Drilling:			**Casing:**	2.125"	**Rock Core:**		**Undist:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	GNSS Position:		
After Casing Removal:			**Hammer:**		1039794.52 FT N, 1072306.00 FT E			

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-15"	***Gravel, stones, brown sand, brick***	0 ppm	Time: 11:49
1				15"-29"	***Dense, silty clay, dark brown, wood chips, black rock***	0 ppm	29" Recovered
2							
3							
4							
				0"-5"	***Slug/gravel***	0 ppm	
5	↓			5"-21"	***Brown, wet, dense, silty sand***	0 ppm	40" Recovered
	▨			21"-40"	***Brown, wet, sand, dark streaks***	0 ppm	
6	▨						
7							
8							
				0"-10"	***Loose, brown, sand***	0 ppm	
9				10"-31"	***Brown, wet, sand, embedded gravel, FILL-small brick***	0 ppm	46" Recovered
					pieces, rocks		
10				31"-46"	***Grey, dense, moist, silty clay***	0 ppm	
11							
12							
					Loose, silty clay, wet	0 ppm	
13					***Brown sand, gravel***		Hammer; liner broken
							(eventhough properly cleaned
14							before drilling this depth)
15							
16							
17					***END OF BORING AT 16 FEET***		
18					***Sample:***		Urban fill to 10 feet
					B6-5-6 FT		construction fill to 16
19							
20							
21							
22							
23							

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BORING LOG

		Boring No.	**B7 - MW6**
		Sheet 1 of:	3
		Project No.:	J53002002
Project Name:	Queen City Landing Remedial investigation	***Surface Elev.:***	576
Location:	975 Fuhrmann Blvd	***Datum:***	
Client:	R&P Oak Hill	***Start Date:***	3/16/16
Drilling Firm:	NYEG	***Finish Date:***	3/16/16

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	CME-55		***Inspector:***	AD
While Drilling:	5	3/16/16 15:45	***Casing:***	4.25 HAS	***Rock Core:***	***Undist:***	
Before Casing Removal:			***Sampler:***	2' SS	***Other:***		
After Casing Removal:			***Hammer:***				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			N/A	N/A	***0.4 ft of asphalt***		15:15 Start
1			4	0-12"	***Asphalt pieces***	0 ppm	cloudy
			5				12" recovered
2			6				
			15	0-5"	***Asphalt pieces***	0 ppm	16" recovered
3			7	5-10"	***Gravel and concrete***	0 ppm	
			33	10-16"	***Wet rock and gravel***	0 ppm	
4			N/A		***spoon stopped at 3.5'***		
			50/0.2	N/A	***6" of concrete***		11" recovered
5	▨ ↓		15	0-11"	***Coarse Sand and Gravel - moist***	0 ppm	
	▨		15				
6	▨		5				
	▨		7	0-10"	***Coarse Sand and Gravel - wet***	0 ppm	13" recovered
7	▨		4	10-13"	***Wet-fine-brown-SAND***	0 ppm	
			6				
8			7				
	▨		2	0-2"	***Fine-wet-brown-SAND-trace clay***	0 ppm	12" recovered
9	▨		5	2-12"	***Fine-wet-dark brown-SAND***	0 ppm	
	▨		7				
10	▨		8				
			3	0-7"	***Fine-wet-dark brown-SAND***	0 ppm	24" recovered
11			2	7-8"	***Rock***	0 ppm	
			3	9-22"	***Fine-wet-dark brown-SAND***	0 ppm	
12			4	22-24"	***Grey/green/brown CLAY-wet***	0 ppm	
			7	0-9"	***Brown/black-medium grain SAND***	0 ppm	24" recovered
13			10	9-24"	***Wet-grey-CLAY***	0 ppm	
	▨		9				
14	▨		4				
	▨		1	0-6"	***Saturated/loose fine-brown-SAND (slug)***	0 ppm	12" recovered
15	▨		1	6-12"	***Wet-grey-CLAY***	0 ppm	
	▨		1				
16	▨		1				
			22	0-5"	***FILL (slug)***	0 ppm	sands in bottom-removed with water/spoons
17			14	5-8"	***Sandy CLAY-wet to saturated***	0 ppm	
			9				8" recovered
18			10				
			15	0-7"	***Angular gravel- brown- sandy CLAY***	0 ppm	15" recovered
19			3	7-15"	***Grey-soft sandy CLAY***	0 ppm	
			4				
20			4				
21							
22							
23							

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BORING LOG

Boring No.	**B7 - MW6**
Sheet 2 of:	3
Project No.:	
Project Name:	
Location:	
Client:	
Start Date:	
Finish Date:	
Inspector:	CM

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
24					
			1		
25			1	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			1		
26			1		
27					
28					
29					
			WH		
30			WH	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			WH		
31			WH		
32					
33					
34					
			WH		
35			WH	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			WH		
36			WH		
37					
38					
39					
			WH		
40			WH	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			WH		
41			WH		
42					
43					
44					
			4		
45			12	0-24" ***Dense-saturated-brown silty CLAY*** 0 ppm	24" recovered
			11		
46			13		
47					
48					
49					

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BORING LOG

Boring No.	**B7 - MW6**
Sheet 3 of:	3
Project No.:	
Project Name:	
Location:	
Client:	
Start Date:	
Finish Date:	
Inspector:	

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
			WH		
50			WH	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			WH		
51			WH		
52					
53					
54					
			WH		
55			1	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			WH		
56			WH		
57					
58					
59					
			WH		
60			WH	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			1		
61			1		
62					
63					
64					
			WH		
65			WH	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			WH		
66			WH		
67					
68					
69					
70					
				BEDROCK AT 70 FEET	
71					
					Fill to 7 ft
72				***Sample:***	Construction fill to 14
				MW6-4.5-7FT	Native at 14
73				***MW6-8-10FT***	
				MW6-14-16FT	
74					
75					

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BORING LOG

Boring No.	**B8**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/20/17
Finish Date:	1/20/17
Inspector:	BR

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**						
			Drill Rig:	Geoprobe				
While Drilling:			**Casing:**	2.125"	**Rock Core:**		**Undist:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**			
After Casing Removal:			**Hammer:**					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		**MATERIAL DESCRIPTION**		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-48"	***FILL - brick, concrete, some brown, sandy clay***	0 ppm	Time:
1							48" Recovered
2							
3							
4							
				0"-48"	***'FILL - brick, concrete, some brown, sandy clay***	0 ppm	
5							48" Recovered
6							
7							
8							
				0"-48"	***Brown, sandy clay FILL***	0 ppm	
9							48" Recovered
10							
11							
12							
				0"-12"	***Grey clay***	0 ppm	
13				12"-36"	***FILL - sandy, brick***	0 ppm	48" Recovered
				36"-48"	***Wet, brown, clay***	0 ppm	
14							
15	↓						
	▨						
16							
17					***END OF BORING AT 16 FEET***		
18							Urban fill to 15 ft
					Sample:		Native 15 ft
19					***B8-15 ft***		
20							
21							
22							
23							

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BORING LOG

Boring No.	**B9**
Sheet 1 of:	1
Project No.:	J53.002.003

Project Name:	Queen City Landing Remedial Investigation	***Surface Elev.:***	
Location:	Queen City Landing, East Site, Buffalo, New York	***Datum:***	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	***Start Date:***	1/20/17
Drilling Firm:	Nature's Way Environmental	***Finish Date:***	1/20/17

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	Geoprobe			***Inspector:***	BR
While Drilling:			***Casing:***	2.125"	***Rock Core:***		***Undist:***	
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***			
After Casing Removal:			***Hammer:***					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
1				0"-48"	***Asphalt - FILL conc. (black)***	0 ppm	Time:
							48" Recovered
2							Weather:
3							
4							
5				0"-36"	***Asphalt - FILL conc. (black)***	0 ppm	
				36"-48"	***Brown clay***	0 ppm	48" Recovered
6							
7							
8							
9				0"-12"	***Brown clay***	0 ppm	
				12"-36"	***Sandy - FILL - stone/pebbles***	0 ppm	48" Recovered
10				26"-48"	***Dark brown, sandy silt***	0 ppm	
11	▨						
12							
13				0"-12"	***Dark brown, sandy silt***	0 ppm	
				12"-36"	***Sandy - FILL - stone/pebbles***	0 ppm	48" Recovered
14				36"-48"	***Grey clay***	0 ppm	
15							
16							
17							
					END OF BORING AT 16 FEET		
18							
							Urban fill to 9 ft
19					***Sample:***		Construction fill to 15 feet
					B9-10-11ft		Native at 15 ft
20							
21							
22							
23							

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BORING LOG

Boring No.	**C1**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/20/17
Finish Date:	1/20/17
Inspector:	BR

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	Geoprobe			
While Drilling:			***Casing:***	2.125"	***Rock Core:***		***Undist:***
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***		
After Casing Removal:			***Hammer:***				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-30"	***FILL***	0 ppm	Time:
1				30"-36"	***Sand lens (0.5' thick)***	0 ppm	48" Recovered
				36"-48"	***FILL***	0 ppm	Weather:
2							
3							
4							
				0"-36"	***FILL***	0 ppm	
5					***Black sandy material at 7 feet, no odor and no PID***		48" Recovered
				36"-48"	***Brown clay***	0 ppm	
6							
	▨						
7							
8							
				0"-48"	***FILL, black sandy material***	0 ppm	
9							48" Recovered
10							
11							
12							
				0"-36"	***FILL, black sandy material***	0 ppm	
13				36"-48"	***Grey clay***	0.5 ppm	48" Recovered
14							
15							
16							
17					***END OF BORING AT 16 FEET***		
18					***Sample:***		Urban fill to 15 feet
					C1-6-7 ft		Native at 15 ft
19					***C1-WC***		
20							
21							
22							
23							

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BORING LOG

Boring No.	**C2**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/26/17
Finish Date:	1/26/17
Inspector:	AS

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

Drill Rig:	Geoprobe				
Casing:	2.125"	**Rock Core:**		**Undist:**	
Sampler:	Acetate liner	**Other:**	GNSS Position:		
Hammer:		1039680.61 FT N, 1071852.99 FT E,			

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-5"	***Asphalt, gravel, black***	0 ppm	Time: 15:02
1				5"-23"	***brown to dark brown, moist, silty sand, embedded gravel***	0 ppm	46" Recovered
				23"-33"	***Brown, sand, moist, clay in areas, 1/4 inch dia stones***	0 ppm	
2				33"-46"	***Dark grey, dense, silty sand and gravel***	0 ppm	
3							
4							
				0"-1"	***Gravel***	0 ppm	
5				1"-13"	***Brown, moist to wet, sand, medium grained***	0 ppm	48" Recovered
				13"-24"	***Dark brown, dense, silty clay, sand***	0 ppm	
6				24"-48"	***Red brown, brown, silty clay, sand, stones, embedded***	0 ppm	
					sparsely, red brick at 29"		
7	▨						
	▨						
8							
				0"-2"	***Dark brown, wet to moist, silty sand***	0 ppm	
9				2"-27"	***Brown, soft, moist, silty clay***	0.1 ppm	48" Recovered
				27"-39"	***Gravel, varied sizes up to 1 inch diameter, dark brown,***	0 ppm	
10					***silty clay***		
				39"-48"	***brown, very soft, silty clay***	0.1 ppm	
11							
12							
				0"-30"	***Loose, very soft, silty clay with sand***	0 ppm	
13				30"-32"	***White, dense, coarse, sand and rocks***		48" Recovered
14							Spilled out from liner
15							
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		Urban Fill to 16 feet
18							
					Sample:		
19					***C2-6.5-7.5 FT***		
					C2-15 FT		
20							
21							
22							
23							

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BORING LOG

Boring No.	C3- MW7
Sheet 1 of:	3
Project No.:	J53002002

Project Name:	Queen City Landing Remedial investigation	**Surface Elev.:**	576
Location:	975 Fuhrmann Blvd	**Datum:**	
Client:	R&P Oak Hill	**Start Date:**	3/17/16
Drilling Firm:	NYEG	**Finish Date:**	3/18/16

Groundwater	**Depth**	**Date & Time**	**Drill Rig:**	CME-55			**Inspector:**	AD
While Drilling:	5	3/17 8:00	**Casing:**	4.25 HAS	**Rock Core:**		**Undist:**	
Before Casing Removal:			**Sampler:**	2' SS	**Other:**			
After Casing Removal:			**Hammer:**					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			N/A	N/A	***0.3 ft Asphalt***		745 start 48F Sunny
1			6	0-4"	***Dry-brown-med to coarse SAND and rocks***	0 ppm	13" Recovered
			6	4-12"	***Dry to moist-dark brown-silty SAND***	0 ppm	
2			4	12-13"	***Dry-brown SAND-some clay***	0 ppm	
	▨		6	0-5"	***Med to coarse SAND and rock***	0 ppm	24" recovered
3	▨		6	5-24"	***Dry-dark brown-clayey silty FILL-trace sand-bricks-coal***	0 ppm	
	▨		17				
4	▨		15				
			8	0-6"	***Dry-brown-silty SAND***	0 ppm	14" recovered
5	↓		12	6-14"	***Moist-brown-fine to med SAND- trace wet Clay-bricks-coal***	0 ppm	
			15				
6			5				
			5	0-2"	***Wet-brown-coarse sand and gravel***	0 ppm	13" recovered
7			2	2-13"	***Wet-brown-silty CLAY-trace sand***	0 ppm	
			2				
8			2				
			11	0-8"	***Wet- brown-CLAY and coarse SAND***	0 ppm	17" recovered
9			10	8-17"	***Concrete pieces with bricks - wet***	0 ppm	
			8				
10			5				
			9	0-5"	***Wet-light brown CLAY***	0 ppm	18" recovered
11			8	5-7"	***Dark brown-silty CLAY***	0 ppm	
			6	7-18"	***Wet-bricks and gravel***	0 ppm	
12			4				
	▨		6	0-6"	***Wet-coarse SAND and Brick-some clay***	0 ppm	12" recovered
13	▨		3	6-12"	***Bricks***	0 ppm	
	▨		1				
14	▨		5				
	▨		14	0-17"	***Wet to saturated-coarse SAND and gravel-bricks***	0 ppm	20" recovered
15	▨		2	17-20"	***Wet-black-med to coarse SAND-some silt***	0 ppm	
	▨		4				
16	▨		5				
			5	0-6"	***Wet to saturated-coarse SAND and gravel-bricks***	0 ppm	12" recovered
17			4	6-12"	***Wet-brown to black-medium grain SAND and GRAVEL,***	0 ppm	
			5		***concrete pieces***		
18			5				
			3	0-12"	***Silt and small rounded pebbles***	0 ppm	24" recovered
19			3	12-24"	***Moist-light brown-silty CLAY-trace fine sand***	0 ppm	
			5				
20			6				
21							
22							
23							

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BORING LOG

Boring No. C3 - MW7
Sheet 2 of: 3
Project No.:
Project Name:
Location:
Client:
Start Date:
Finish Date:
Inspector: CM

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
24							
			8	24"	***Slug - No recovery***	0 ppm	No recovery
25			5				
			2				
26			3				
27							
28							
29							
			1			0 ppm	24" recovered
30			1	0-24"	***Saturated-light brown-CLAY***		
			1				
31			WH				
32							
33							
34							
			3			0 ppm	12' recovered
35			WH	0-12"	***Saturated-light brown-CLAY***		
			WH				
36			WH				
37							
38							
39							
			1				24" recovered
40			WH	0-24"	***Saturated-light brown-CLAY***	0 ppm	
			WH				
41			WH				
42							
43							
44							
			2	0-18"	***Slug***	0 ppm	6" Recovered
45			2	18-24"	***Moist to wet-light brown-CLAY-little Silt***	0 ppm	
			3				
46			5				
47							
48							
49							

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BORING LOG

Boring No.	**C3 - MW7**
Sheet 3 of:	3
Project No.:	
Project Name:	
Location:	
Client:	
Start Date:	
Finish Date:	
Inspector:	

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
50			WH	0-24"	***Saturated-light brown-CLAY***	0 ppm	24" recovered
			WH				
51			WH				
			1				
52							
53							
54							
55			3	0-24"	***Saturated-light brown-CLAY***	0 ppm	24" recovered
			2				Stopped with augers in hole
56			1				3/17 12:00
			2				
57							
58							
59							
60			WH	0-24"	***Saturated to loose - brown- silty CLAY***	0 ppm	24" recovered
			WH				
61			WH				
			WH				
62							
63							
64							
65			WH	0-24"	***Saturated to loose - brown- silty CLAY***	0 ppm	24" recovered
			WH				
66			WH				
			WH				
67							
68							
69							
70			WH	0-15"	***Saturated to loose - brown- silty CLAY***	0 ppm	24" recovered
			WH	15-24"	***Saturated to loose- grey-sandy CLAY-trace limestone***	0 ppm	
71			WH		***pieces (1" and smaller)***		
			4				
72							
73							
					BEDROCK AT 72.5 FEET		
74					***Sample:***		Urban fill to 19 ft
					MW7-2-4FT		Native at 19 ft
75					***MW7-12-14FT***		
					MW7-14-16FT		

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BORING LOG

Boring No.	**C4**		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing Remedial Investigation	***Surface Elev.:***	
Location:	Queen City Landing, East Site, Buffalo, New York	***Datum:***	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	***Start Date:***	1/6/17
Drilling Firm:	Nature's Way Environmental	***Finish Date:***	1/6/17

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	Geoprobe		***Inspector:***	AS
While Drilling:			***Casing:***	2.125"	***Rock Core:***	***Undist:***	
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***	CNSS Pos.	
After Casing Removal:			***Hammer:***		1039809.06 FT N, 1072074.86 FT E		

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-4"	***Gravel***	0 ppm	Time: 9:44 am
1				4"-48"	***FILL - concrete and coal pieces, red brick pieces,***	0 ppm	48" Recovered
					brown to dark brown, dense, sand, rock with 1" diameter	0 ppm	Weather: 11 Degrees F
2							Fair; Sunny
3							
4							
				0"-10"	***FILL - concrete and coal pieces, red brick pieces and rocks,***	0 ppm	
5	↓				***brown to dark brown, dense, sand***		31" Recovered
				10"-20"	***Dark brown, moist to wet, silty clay***	0 ppm	
6				20"-25"	***Dark brown, wet, sand***	0 ppm	
				25"-31"	***Black to dark brown, moist, silty clay***	0 ppm	
7							
	▨						
8	▨						
				0"-8"	***Dark brown, loose, silt with trace sand***	0 ppm	
9				8"-26"	***FILL - gravel, brick, clay***	0 ppm	26" Recovered
10							
11							
12							
				0"-8"	***Dark brown, loose, silt***	0 ppm	
13				8"-23"	***FILL - red brick, sand, gravel***	0 ppm	27" Recovered
				23"-27"	***Grey, soft, silty clay***	0 ppm	
14							
15							
16							
17					***END OF BORING AT 16 FEET***		
18							urban fill to 14 ft
					Sample:		Native at 14 ft
19					***C4-7-8ft***		
20							
21							
22							
23							

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BORING LOG

Boring No.	**C5**
Sheet 1 of:	1
Project No.:	J53.002.003

Project Name:	Queen City Landing Remedial Investigation	**Surface Elev.:**	
Location:	Queen City Landing, East Site, Buffalo, New York	**Datum:**	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	**Start Date:**	1/20/17
Drilling Firm:	Nature's Way Environmental	**Finish Date:**	1/20/17

Groundwater	**Depth**	**Date & Time**	**Drill Rig:**	Geoprobe			**Inspector:**	BR
While Drilling:			**Casing:**	2.125"	**Rock Core:**		**Undist:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**			
After Casing Removal:			**Hammer:**					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
1				0"-48"	***FILL - dark, brick, slag, asphalt***	0 ppm	Time:
							48" Recovered
2							Weather: Rain
3							
4							
5				0"-48"	***FILL - brick and brown clay***	0 ppm	
							48" Recovered
6							
7							
8							
9				0"-48"	***FILL - brick and brown clay***	0 ppm	
							48" Recovered
10							
11							
12	▨						
	▨						
13				0"-24"	***FILL - brick and brown clay***	0 ppm	
				24"-48"	***Grey clay***	0 ppm	48" Recovered
14							
15							
16							
17							
					END OF BORING AT 16 FEET		
18							Urban fill to 14 feet
							Native at 14 feet
19							
					Sample:		
20					***C5-11 ft***		
					C5-WC		
21							
22							
23							

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BORING LOG

Boring No.	**C6-MW3**		
Sheet 1 of:	1		
Project No.:	J53002002		
Project Name:	Queen City Landing Remedial investigation	***Surface Elev.:***	578
Location:	975 Fuhrmann Blvd	***Datum:***	
Client:	R&P Oak Hill	***Start Date:***	3/15/16
Drilling Firm:	NYEG	***Finish Date:***	3/16/16

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	CME-55		***Inspector:***	AD
While Drilling:	3.8	3/15/16	***Casing:***	4.25 HAS	***Rock Core:***		***Undist:***
Before Casing Removal:			***Sampler:***	2' SS	***Other:***		
After Casing Removal:	7	03/15/16	***Hammer:***				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			N/A	N/A	***0.3ft of asphalt***		1520 start
1			6	0-1"	***Gravel subbase***	0 ppm	40 F
			8	1-8"	***Wet-black-coarse SAND***	0 ppm	21" recovered
2			5	8-21"	***Moist-redbrown-coarse Sand-some Silt-bricks***	0 ppm	
			4	0-14"	***Saturated sandy FILL-trace clay-brown-brick-concrete-coal***	0 ppm	14" recovered
3			10		***pieces***		
			15				
4			12				
			5	0-9"	***Wet-coarse SAND and GRAVEL***	0 ppm	16" recovered
5			2	9-16"	***Wet to saturated-coarse sandy FILL-brick-coal***	4.6 ppm	
			3				
6			1				
			1	0-2"	***Wet to saturated-coarse sandy FILL-brick-coal***	0 ppm	2 " recovered
7	↓		1				
			2				
8			1				
			2	0-10"	***Wet to saturated-coarse sandy FILL-brick-coal***	0 ppm	19" recovered
9			2	10-19"	***Wet-brown-medium grain SAND-some black staining and***	0.2 ppm	
			2		***possible petroleum odor***		
10			2				
			5	0-6"	***Wet-brown-medium grain SAND-some black staining and possible***		0.1 ppm
11			6	6-11"	***Loose-brown-fine SAND- some black staining***	0 ppm	18" recovered
			2	11-17"	***Saturated-fine SAND***	0 ppm	
12			2	17-18"	***Black sandy material***		
			2	0-12"	***Wet-brown-fine brown SAND-some brick***	0 ppm	24" recovered
13			2	12-13"	***Black SAND***	0 ppm	
			3	13-20"	***Brown-fine SAND***	0 ppm	
14			2	20-24"	***Grey CLAY***	0 ppm	
			--	0-20"	***Wet-brown-SAND-some brick***	0 ppm	24" recovered
15			--	20-24"	***Grey CLAY***	0 ppm	
			--				
16			--				
					END OF BORING AT 16 FEET		
17							
18							
							Urban fill to 14 ft
19							Native at 14 ft
20					***Sample:***		
					MW3-5-7FT		
21					***MW3-12-14FT***		
					MW3-14-16FT		
22							
23							

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BORING LOG

Boring No.	C7
Sheet 1 of:	1
Project No.:	J53.002.003
Project Name:	Queen City Landing Remedial Investigation
Surface Elev.:	
Location:	Queen City Landing, East Site, Buffalo, New York
Datum:	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC
Start Date:	1/20/17
Drilling Firm:	Nature's Way Environmental
Finish Date:	1/20/17
Inspector:	BR

Groundwater	**Depth**	**Date & Time**				
			Drill Rig:	Geoprobe		
While Drilling:			**Casing:**	2.125"	**Rock Core:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	
After Casing Removal:			**Hammer:**			

Undist:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-24"	***FILL - asphalt***	0 ppm	Time:
1				24"-48"	***FILL - brown, silty clay***	0 ppm	48" Recovered
							Weather: Rain
2							
3							
4							
				0"-48"	***FILL - brown, silty clay***	0 ppm	
5							48" Recovered
6							
7							
8							
				0"-48"	***FILL - brown, silty clay***	0 ppm	
9							48" Recovered
10							
11							
12							
				0"-12"	***FILL - brown, silty clay***	0 ppm	
13				12"-48"	***Grey clay***	0 ppm	48" Recovered
14							
15							
16							
17					***END OF BORING AT 16 FEET***		
18							Urban fill to 13 ft
					Sample:		Native at 13 ft
19					***C7-10-12 ft***		
20							
21							
22							
23							

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BORING LOG

Boring No.	**C8**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	11/7/16
Finish Date:	11/7/16
Inspector:	AD

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	Geoprobe			***Undist:***	
While Drilling:			***Casing:***	2.125"	***Rock Core:***			
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***			
After Casing Removal:			***Hammer:***					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-14"	***Asphalt and gravel subbase***	0 ppm	Time: 2:00
1				14"-22"	***FILL - clay and sand, gravel, brick***	0 ppm	30" Recovered
				22"-30"	***Light brown, fine sand***	0 ppm	
2							
3							
4							
				0"-25"	***Light brown, fine sand, trace pieces of coal, trace gravel***	0 ppm	
5							25" Recovered
6							
7							
8	↓						
				0"-14"	***Loose, fine, brown sand***	0.1 ppm	
9				14"-28"	***Multicolor coarse sand, wet, some medium sized grains***	0.1 ppm	28" Recovered
10							
11							
12							
				0"-4"	***Medium grain, brown sand***	0 ppm	
13				4"-20"	***Loose sand***	0 ppm	48" Recovered
				20"-30"	***Coarse, rounded, multicolor sand/gravel***	0 ppm	
14				30"-48"	***Brown (some gtreen), soft, clay, trace silt***	0 ppm	
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban fill to 2 ft
18							Construction Fill to 14 ft
					Sample:		Native at 14 ft
19					***C8-7-8 ft***		
					C8-15-16 ft		
20							
21							
22							
23							

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BORING LOG

Boring No.	**D1**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/25/17
Finish Date:	1/25/17
Inspector:	AS

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	***Depth***	***Date & Time***				
While Drilling:			***Drill Rig:***	Geoprobe		
Before Casing Removal:			***Casing:***	2.125"	***Rock Core:***	***Undist:***
After Casing Removal:			***Sampler:***	Acetate liner	***Other:***	GNSS Position:
			Hammer:			1039773.70 FT N, 1071757.17 FT E

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-26"	***FILL - gravel, stone, brown, silty clay, dense, moist, red***	0 ppm	Time: 13:36
1					***brick, gravel)***		39" Recovered
				26"-39"	***Brown, moist, silty sand, dark streaks, concrete***	0 ppm	
2							
	▨						
3	▨						
	▨						
4	▨ ↓						
				0"-11"	***Brown, moist to wet, saturated from 2"-10", silty clay,***	0 ppm	
5					***red and black mottles, embedded brick pieces***		41" Recovered
				11"-41"	***Brown to red brown, moist, denser, silty clay with sand***	0 ppm	
6					***grains, medium grained***		
7							
8							
				0"-23"	***Brown, silty clay, wet (4"-10" loose), rock located at 12"***	0 ppm	
9				23"-24"	***Red brick***	0 ppm	24" Recovered
10							
11							
12							
				0"-6"	***Brown, wet, silty clay***	0 ppm	
13				6"-13"	***dark brown, silty clay, gravel***	0 ppm	27" Recovered
				13"-17"	***Dark brown, wet, silty clay, no odors***	0 ppm	
14				17"-27"	***Dark brown, moist, silty sand***	0 ppm	
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban fill to 16 feet
18							
					Sample:		
19					***D1-SS***		
					D1-3-4 FT		
20					***DUP-C-012517***		
21							
22							
23							

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BORING LOG

Boring No.	**D2**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/25/17
Finish Date:	1/25/17
Inspector:	AS

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	***Depth***	***Date & Time***						
			Drill Rig:	Geoprobe				
While Drilling:			***Casing:***	2.125"	***Rock Core:***		***Undist:***	
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***	GNSS Position:		
After Casing Removal:			***Hammer:***		1039803.69 FT N, 1071851.16 FT E			

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-7"	***Brown, moist, silty clay, gravel and concrete***	0 ppm	Time: 14:24
1				8"-11"	***Brown, silty clay, dense, red brick***	0 ppm	41" Recovered
				11"-41"	***Brown, moist, dense, silty clay, sandy in areas, gravel,***	0 ppm	
2					***stone, black and red mottles***		
	▨						
3	▨						
4							
				0"-8"	***Slug***	0 ppm	
5				8"-38"	***Brown, moist to wet, silty sand***	0 ppm	44" Recovered
				38"-44"	***Brown, moist, silty clay***	0 ppm	
6							
7							
8	↓						
				0"-21"	***Brown, silty clay, loose, medium to coarse sand***	0 ppm	
9				21"-33"	***Dark brown, gravel and rock, silty sand, red brick***	0 ppm	44" Recovered
				33"-44"	***Dark brown, moist, sand, medium grained, metal piece***	0 ppm	
10					***on bottom, sharp***		
11							
12							
				0"-18"	***Brown, sand, wet to loose, loose from 0"-5"***	0 ppm	
13				18"-20"	***Gravel, asphalt, black, stones and sand***	0 ppm	40" Recovered
				20"-40"	***Brown, wet, sand, medium grained***	0 ppm	
14							
	▨						
15	▨						
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		
							Urban Fill to 14 ft
18							Possibly construction fill
					Sample:		14-16 ft
19					***D2-3 FT***		
					D2-15 FT		
20					***DUP-D-012517***		
21							
22							
23							

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BORING LOG

Project Name:	Queen City Landing Remedial Investigation	**Boring No.**	**D3**
		Sheet 1 of:	1
		Project No.:	J53.002.003
Location:	Queen City Landing, East Site, Buffalo, New York	**Surface Elev.:**	
Client:	R&P Oak Hill Development, LLC	**Datum:**	GROUND SURFACE
Drilling Firm:	Nature's Way Environmental	**Start Date:**	1/25/17
		Finish Date:	1/25/17
		Inspector:	AS

Groundwater	**Depth**	**Date & Time**	**Drill Rig:**	Geoprobe		
While Drilling:			**Casing:**	2.125"	**Rock Core:**	**Undist:**
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	
After Casing Removal:			**Hammer:**			

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	MATERIAL DESCRIPTION			COMMENTS (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-4"	***Black, asphalt, gravel,***	0 ppm	Time: 15:27
1				4"-10"	***Gravel, brown, silty sand, stones***	0 ppm	38" Recovered
				10"-34"	***Brown, silty clay, red brick, tan sand, concrete***	0 ppm	
2				34"-38"	***White concrete, brown, dry, dense, silty clay***	0 ppm	
3							
	▨						
4	▨						
				0"-7"	***Brown, moist, dense, silty clay***	0 ppm	
5	↓			7"-17"	***Brown, dense, silty clay, red mottles***	0 ppm	36" Recovered
				17"-28"	***Light brown, wet, silty sand***	0 ppm	
6				28"-36"	***Red brick, sand for last inch***	0 ppm	
7							
8							
				0"-34"	***Loose, silty clay, brown sand, small red brick, rock and***	0 ppm	
9					***gravel throughout, stones of varied sizes***		34" Recovered
10							
11							
12							
				0"-7"	***Brown, wet, sand, red brick, tiny gravel pieces***	0 ppm	
13				7"-17"	***Gravel and stone***	0 ppm	40" Recovered
				17"-33"	***Gravel and stone, smaller, wet, silty clay***	0 ppm	
14				33"-40"	***Dark brown, soft, silty sand***	0 ppm	
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban fill to 16 ft
18							
					Sample:		
19					***D3-4 FT***		
					D3-WC		
20							
21							
22							
23							

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BORING LOG

Project Name:	Queen City Landing Remedial Investigation	**Boring No.**	D4
Location:	Queen City Landing, East Site, Buffalo, New York	**Sheet 1 of:**	1
Client:	R&P Oak Hill Development, LLC	**Project No.:**	J53.002.003
Drilling Firm:	Nature's Way Environmental	**Surface Elev.:**	
		Datum:	GROUND SURFACE
		Start Date:	1/6/17
		Finish Date:	1/6/17
		Inspector:	AS

Groundwater	Depth	Date & Time					
			Drill Rig:	Geoprobe			
While Drilling:			**Casing:**	2.125"	**Rock Core:**		**Undist:**
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**		
After Casing Removal:			**Hammer:**				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-43"	***FILL - gravel, red brown clay, red brick pieces, stones,***	0 ppm	Time: 11:15 am
1	↓			43"-47"	***Dark brown, moist to wet, silty clay, dense***	0 ppm	47" Recovered
					one large 2" length rock located at 45-47"	0 ppm	Initial boring crooked, moved
2							approximately 6 inches north
3							
4							
				0"-12"	***Loose, FILL - silty sand, grravel, stone pieces***	0 ppm	
5					***Layer of brown, moist sand from 7-9"***	0 ppm	12" Recovered
6							
7							
8							
				0"-8"	***Brown, loose, silt with trace sand***	0 ppm	
9				8"-28"	***FILL - brown to dark brown, brick, wet, silty clay***	0 ppm	28" Recovered
10							
	▨						
11	▨						
	▨						
12	▨						
				0"-37"	***FILL - stone pieces, silt, gravel, brown sand,***	0 ppm	
13					***loose from 0-21"***		46" Recovered
				37"-46"	***Dark brown, soft, silty clay***	0 ppm	
14							
15	▨						
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		
							Urban fill to 16 feet
18							
					Sample:		
19					***D4-10-12 FT***		
					DUP - B - 010617		
20					***D4-15 FT (+MS/MSD)***		
21							
22							
23							

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BORING LOG

Boring No. D5
Sheet 1 of: 1
Project No.: J53.002.003
Surface Elev.:
Datum: GROUND SURFACE
Start Date: 11/7/16
Finish Date: 11/7/16
Inspector: AD

Project Name: Queen City Landing Remedial Investigation
Location: Queen City Landing, East Site, Buffalo, New York
Client: R&P Oak Hill Development, LLC
Drilling Firm: Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

Drill Rig: Geoprobe
Casing: 2.125"
Rock Core:
Undist:
Sampler: Acetate liner
Other:
Hammer:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		**MATERIAL DESCRIPTION**		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-9"	***Topsoil and gravel***	0 ppm	Time: 15:30
1	↓			9"-29"	***FILL - wet, brick, silty sand, gravel, concrete***	0.1 ppm	29" Recovered
2							
3							
4							
				0"-11"	***Wet, brick, and fine sand, dark brown***	0.1 ppm	
5				11"-37"	***Fine, black/brown sand, trace brick***	0 ppm	37" Recovered
6							
	▨						
7	▨						
	▨						
8	▨						
9					***END OF BORING AT 8 FEET***		
10							Urban fill to 8 feet
					Sample:		
11					***D5-6-8 ft***		
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							

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BORING LOG

Project Name:	Queen City Landing Remedial Investigation	**Boring No.**	**D6**
Location:	Queen City Landing, East Site, Buffalo, New York	**Sheet 1 of:**	1
Client:	R&P Oak Hill Development, LLC	**Project No.:**	J53.002.003
Drilling Firm:	Nature's Way Environmental	**Surface Elev.:**	
		Datum:	GROUND SURFACE
		Start Date:	11/7/16
		Finish Date:	11/7/16
		Inspector:	AD

Groundwater	**Depth**	**Date & Time**				
			Drill Rig:	Geoprobe		
While Drilling:			**Casing:**	2.125"	**Rock Core:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	
After Casing Removal:			**Hammer:**		**Undist:**	

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-10"	***Asphalt and gravel subbase***	0 ppm	Time: 12:40
1				10"-33"	***FILL - sand clay and silt with ash, staining, coal***	0.1 ppm	33" Recovered
							Weather: 55-60 Degrees F
2							
	▨						
3	▨						
	▨						
4	▨						
				0"-3"	***FILL - sand clay and silt with ash, staining, coal***	0 ppm	
5				3"-25"	***Silty brown clay with some grey/green/black spots,***	0 ppm	32" Recovered
					little gravel		
6				25"-32"	***Coarse, sand and gravel, brown/multicolor***	0 ppm	
7							
8							
				0"-10"	***Coarse sand and gravel, trace silty clay***	0 ppm	
9				10"-42"	***Coarse sand, dark brown to black***	0 ppm	48" Recovered
				42"-48"	***Same clay as elsewhere, grey/green, hard clay***	0 ppm	
10							
11							
12							
13					***END OF BORING AT 12 FEET***		
							Urban fill to 12 feet
14							
					Sample:		
15					***D6-2-4 ft***		
16							
17							
18							
19							
20							
21							
22							
23							

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BORING LOG

Project Name:	Queen City Landing Remedial Investigation	**Boring No.**	D7
Location:	Queen City Landing, East Site, Buffalo, New York	**Sheet 1 of:**	1
Client:	R&P Oak Hill Development, LLC	**Project No.:**	J53.002.003
Drilling Firm:	Nature's Way Environmental	**Surface Elev.:**	
		Datum:	GROUND SURFACE
		Start Date:	11/7/16
		Finish Date:	11/7/16
		Inspector:	AD

Groundwater	**Depth**	**Date & Time**		
While Drilling:	8	11/7 @ 10:00	**Drill Rig:**	Geoprobe
Before Casing Removal:			**Casing:**	2.125"
After Casing Removal:			**Sampler:**	Acetate liner
			Hammer:	

Rock Core:

Undist:

Other:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-13"	***Asphalt and gravel subbase***	0 ppm	Time: 9:30
1				13"-21"	***Hard, brown clay with coal pieces and ash***	0.1 ppm	39" Recovered
				21"-39"	***Soft, fine, brown sand, moist***	0.1 ppm	
2							
3							
4							
				0"-11"	***Soft, fine, brown sand, moist***	0.1 ppm	
5	↓			11"-22"	***Brick, coarse sand, fill, wet, rock***	0 ppm	27" Recovered
				22"-27"	***Wet, silty sand, brown, marbled with dark brown***	0.1 ppm	
6							
7							
8							
				0"-20"	***Loose, silt, brown***	0.1 ppm	
9				20"-27"	***Fine, brown sand, wet to saturated***	0.1 ppm	48" Recovered
				27"-42"	***Dark brown/grey/black, sand, sticky? Odors***	4.2 ppm	
10				42"-48"	***Black, rounded coarse sand***	0.6 ppm	Headspace: 1.8 ppm
	▨						
11	▨						
12							
				0"-25"	***Loose sand***	0 ppm	
13				25"-38"	***Dark brown, coarse sand with rounded gravel***	0.2 ppm	48" Recovered
				38"-44"	***Grey, brown, silty clay***	0.2 ppm	
14				44"-48"	***Hard, grey, brown clay***	0.2 ppm	
15							
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		
18							Urban fill to 15 feet
					Sample:		Native at 15 feet
19					***D7-10-11 ft***		
					D7-15-16 ft		
20							
21							
22							
23							

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BORING LOG

Boring No. D8
Sheet 1 of: 1
Project No.: J53.002.003
Project Name: Queen City Landing Remedial Investigation
Location: Queen City Landing, East Site, Buffalo, New York
Client: R&P Oak Hill Development, LLC
Drilling Firm: Nature's Way Environmental
Surface Elev.:
Datum: GROUND SURFACE
Start Date: 11/7/16
Finish Date: 11/7/16
Inspector: AD

Groundwater	**Depth**	**Date & Time**
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

Drill Rig: Geoprobe
Casing: 2.125" **Rock Core:** **Undist:**
Sampler: Acetate liner **Other:**
Hammer:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-12"	***Asphalt and gravel subbase***	0 ppm	Time: 13:10
1				12"-18"	***Coarse, brown/white sand***	0 ppm	36" Recovered
				18"-35"	***Red brown, fine, sand***	0 ppm	
2				35"-36"	***Sandy clay, brown***	0 ppm	
3							
4							
				0"-5"	***Red brown, fine, sand***	0 ppm	
5				5"-12"	***Hard clay***	0 ppm	34" Recovered
	▨			12"-22"	***Coal pieces, ashy/sand, brick***	0 ppm	
6	▨			22"-34"	***Light brown, silt, trace clay***	0 ppm	
	▨						
7	▨						
	▨						
8	▨						
				0"-17"	***Light brown, silt, trace clay***	0 ppm	
9				17"-25"	***Dark brown/black, sand, coarse, peat?***	0 ppm	38" Recovered
				25"-38"	***Rounded gravel and coarse sand, dark brown***	0 ppm	
10							
11							
12							
13					***END OF BORING AT 12 FEET***		
							Urban fill to 12 feet
14							
					Sample:		
15					***D8-5-8ft***		
16							
17							
18							
19							
20							
21							
22							
23							

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BORING LOG

Boring No.	**E1 - MW1**
Sheet 1 of:	1
Project No.:	J53002002

Project Name:	Queen City Landing Remedial investigation	***Surface Elev.:***	580
Location:	975 Fuhrmann Blvd	***Datum:***	
Client:	R&P Oak Hill	***Start Date:***	3/15/16
Drilling Firm:	NYEG	***Finish Date:***	3/15/16

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	CME-55			***Inspector:***	AD
While Drilling:	9	3/15 10:15	***Casing:***	4.25 HAS	***Rock Core:***		***Undist:***	
Before Casing Removal:			***Sampler:***	2' SS	***Other:***			
After Casing Removal:			***Hammer:***					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			6	0-2"	***Topsoil***		930 am Start
1			10	2-24"	***Dry clay and sand FILL-brick-rock***	0.2 ppm	Rain 45 F
			14				24" Recovered
2			10				
			8	0-12"	***Moist sandy FILL-small rocks-brick***	0 ppm	14" Recovered
3			6	12-14"	***Moist-brown-clayey SAND***	0 ppm	clayey cuttings-wet
			5				
4			9				
	▨		4	0-4"	***Dark brown-wet-SAND-trace Clay***	0.1 ppm	19" Recovered
5	▨		6	4-9"	***Dark brown-moist-SAND***	0 ppm	
	▨		7	9-19"	***Moist-brown-Sandy FILL-brick-coal pieces***	0.2 ppm	
6	▨		2				
	▨		3	0-5"	***Moist-brown-Sandy FILL-brick-coal pieces***	0 ppm	15 " Recovered
7	▨		6	5-8"	***Piece of wood***	0ppm	
	▨		7	8-15"	***Wet-black-coarse SAND-large brick pieces-coal***	0.1 ppm	
8	▨		6				
			10	0-9"	***Moist-brown-sandy CLAY-some rounded pebbles, piece***	0 ppm	13" Recovered
9	↓		9		***of wood at 9"***		
			4	9-13"	***Wet-black/brown-CLAY***	0 ppm	
10			3				
	▨		2	0-8"	***Moist-brown-sandy CLAY-bricks***	0 ppm	22" Recovered
11	▨		2	8-22"	***Wet-black-SAND-trace bricks***	0 ppm	10.5"- hard crunchy fill
	▨		1				
12	▨		3				
			2	0-24"	***Wet to saturated-black-CLAY AND SAND (coarse)***	0.1 ppm	24" Recovered
13			3				slight petroleum
			6				or industrial odor
14			5				
			3	0-6"	***Wet-brown-SAND-brick pieces***	0 ppm	17" Recovered
15			3	6-17"	***Wet-black/grey-SAND***	0 ppm	
	▨		6				
16	▨		3				
					END OF BORING AT 16 FEET		
17							
							Urban fill to 16 feet
18					***Sample:***		
					MW1-4-8FT		
19					***MW1-10-12FT***		
					MW1-15-16FT		
20							
21							
22							
23							

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BORING LOG

Boring No.	E2
Sheet 1 of:	1
Project No.:	J53.002.003
Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/6/17
Finish Date:	1/6/17
Inspector:	AS
Drill Rig:	Geoprobe
Casing:	2.125"
Sampler:	Acetate liner
Hammer:	
Rock Core:	
Undist:	
Other:	

Groundwater	**Depth**	**Date & Time**
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-25"	***FILL - brown, silty sand, red mottles, dry gravel***	0 ppm	Time: 2:03 PM
1				25"-37"	***Dark brown, dry, silty clay, dense***	0 ppm	46" Recovered
				37"-46"	***Dark brown, silty clay, stones and large rocks, sand***	0 ppm	
2							
3							
4							
				0"-18"	***FILL - brown, moist, silty clay with trace sand, red brick***	0 ppm	
5					***pieces and stone***		38" Recovered
				18"-22"	***White and grey, stone and gravel***	0 ppm	
6				22"-38"	***FILL - dark brown, silty sand, red brick pieces, wood chips***	0 ppm	
7	▨						
	▨						
8	↓						
				0"-8"	***Brown, loose, sandy silt, red brick pieces***	0 ppm	
9				8"-19"	***Dark brown, moist, silty clay, soft, red brick pieces***	0 ppm	37" Recovered
				19"-22"	***Red brown, moist, clay, dense***	0 ppm	
10				22"-37"	***Brown, silty sand, dense***	0 ppm	
11							
12							
				0"-10"	***Brown, loose, silty sand,small red brick pieces***	0 ppm	
13				10"-35"	***Brown, wet to moist, silty sand***	0 ppm	35" Recovered
14							
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban fill to 13 feet,
18							Construction/native at 13
					Sample:		
19					***E2-7.5-8.5 FT***		
					Mislabeled (Actual depth 6.5 FT		
20					***to 7.5 FT)***		
21							
22							
23							

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BORING LOG

Boring No.	**E3**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/6/17
Finish Date:	1/6/17
Inspector:	AS

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	Geoprobe			
While Drilling:			***Casing:***	2.125"	***Rock Core:***		***Undist:***
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***	PID dying - may have affected ppm readings	
After Casing Removal:			***Hammer:***				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		**MATERIAL DESCRIPTION** c - coarse m - medium f - fine S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-24"	***FILL - red brick pieces, stone and rock pieces, brown sand,***	ppm:	Time: 12:40 PM
1					***black staining***	0.1	42" Recovered
				24"-42"	***Brown, moist, sandy silt, soft, smooth***	0	
2							
3							
4							
				0"-28"	***Brown, sandy silt, moist to wet, black staining, soft***	14.5	
5				28"-48"	***Grey, moist, dense fine sand and silt***	Peak 23.7	48" Recovered
	▨						
6	▨						
7							
8	↓						
				0"-19"	***Grey, wet to moist, fine sand and silt, red brick piece at 19"***	7.7	
9							19" Recovered
10							
11							
12							
				0"-24"	***Brown, loose, clayey silt with sand, fine***		
13				24"-35"	***Brown, soft, silty sand***		35" Recovered
14							
15							
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		Urban fill to 12 feet
							construction fill 12-16 feet
18							
					Sample:		
19					***E3-5-6 FT***		
					E3-15 FT		
20							
21							
22							
23							

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BORING LOG

Boring No.	E4-MW2		
Sheet 1 of:	1		
Project No.:	J53002002		
Project Name:	Queen City Landing Remedial investigation	**Surface Elev.:**	581
Location:	975 Fuhrmann Blvd	**Datum:**	
Client:	R&P Oak Hill	**Start Date:**	3/15/16
Drilling Firm:	NYEG	**Finish Date:**	3/15/16

Groundwater	**Depth**	**Date & Time**						
			Drill Rig:	CME-55			**Inspector:**	AD
While Drilling:	11	3/15 14:00	**Casing:**	4.25 HAS	**Rock Core:**		**Undist:**	
Before Casing Removal:			**Sampler:**	2' SS	**Other:**			
After Casing Removal:			**Hammer:**					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
1			6	0-1"	***Topsoil with rocks***		12:45:00 PM START
			45	1-12"	***Rocks, black/grey concrete***	0.2 ppm	45 F Rain
2			15				12" recovered
			6				
3	▨		8	0-14"	***Sandy FILL-bricks-slight odor-moist***	0.4 ppm	14" recovered
	▨		7				
4	▨		6				slight industrial odor
	▨		42				
5			10	0-9"	***Wet-brown-coarse sandy FILL-bricks***	0.1 ppm	22" recovered
			6	9-11"	***Bricks and coal pieces***	0.2 ppm	
6	▨		3	11-22"	***Moist-brown/black sandy FILL-trace silt***	0.2 ppm	
	▨		5				
7	▨		8	0-14"	***Moist-brown/black sandy FILL-trace silt-bricks***	0 ppm	14" recovered
	▨		8				Cutitngs are black
8	▨		8				
	▨		4				
9			2		***No Recovery/1" clay and sand-wet-brown***		No Recovery
			1				
10			1				
			1				
11			1	0-1"	***Saturated-black-SAND***	0 ppm	1" recovered
	↓		1				
12			1				
			1				
13			1	0-9"	***Brown-silty SAND***	0 ppm	20" recovered
			3	9-14"	***Saturated-black-SILT***	0 ppm	
14			4	14-20"	***Wet-black/brown-fine SAND***	0 ppm	
			8				
15			4	0-3"	***Medium to coarse-saturated-grey/black-SAND***	0 ppm	3" recovered
			3				
16			1				
			1				
17	▨		2	0-24"	***Grey/black-saturated-fine SAND***	0.1 ppm	24" recovered
	▨		2				
18	▨		3				
	▨		4				
19					***END OF BORING AT 18 FEET***		
20							Urban fill to 18 feet
					Sample:		
21					***MW2-2-4FT***		
					MW2-5-8FT		
22					***MW2-16-18FT***		
23							

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BORING LOG

Project Name:	Queen City Landing Remedial Investigation	**Boring No.**	E5
		Sheet 1 of:	1
		Project No.:	J53.002.003
		Surface Elev.:	
Location:	Queen City Landing, East Site, Buffalo, New York	**Datum:**	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	**Start Date:**	11/7/16
Drilling Firm:	Nature's Way Environmental	**Finish Date:**	11/7/16

Groundwater	**Depth**	**Date & Time**					
			Drill Rig:	Geoprobe		**Inspector:**	AD
While Drilling:			**Casing:**	2.125"	**Rock Core:**	**Undist:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**		
After Casing Removal:			**Hammer:**				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-9"	***Asphalt/gravel/topsoil***	0 ppm	Time: 14:45
1				9"-33"	***FILL - clayey, brick, gravel, etc.***	0 ppm	33" Recovered
							Weather: 60 Degrees F
2							
3							
4	↓						
				0"-20"	***Saturated, clayey silt, with brick and gravel***	0.1 ppm	
5				20"-32"	***Silty sand, black***	0.1 ppm	32" Recovered
6							
7							
8							
				0"-2"	***Silty sand, fine, wet***	0.1 ppm	
9					****Whole sample with water and loose that poured out***		2" Recovered
10							
11							
12							
				0"-7"	***Rocky/gravel***	0 ppm	
13				7"-22"	***Silty clay, wet, brown***	0 ppm	22" Recovered
14							
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban fill to 12 feet
18							Native at 12 ft
					Sample:		
19					***E5-3-4 ft***		
					E5-15-16 ft		
20							
21							
22							
23							

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BORING LOG

Boring No.	**E6**
Sheet 1 of:	1
Project No.:	J53.002.003
Project Name:	Queen City Landing Remedial Investigation
Surface Elev.:	
Location:	Queen City Landing, East Site, Buffalo, New York
Datum:	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC
Start Date:	11/7/16
Drilling Firm:	Nature's Way Environmental
Finish Date:	11/7/16
Drill Rig:	Geoprobe
Inspector:	AD
Casing:	2.125"
Rock Core:	
Undist:	
Sampler:	Acetate liner
Other:	GNSS Position: 1040035.47 FT N, 1072211.74 FT E
Hammer:	

Groundwater	***Depth***	***Date & Time***
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-12"	***Asphalt and gravel subbase***	0.1 ppm	Time: 10:40
1				12"-22"	***FILL - clay, brick, rock, etc.***	0.1 ppm	28" Recovered
				22"-28"	***Light brown/red, silty clay, trace gravel***	0.1 ppm	
2							
3							
4							
	↓			0"-2"	***Light brown/red, silty clay, trace gravel***	0 ppm	
5				2"-8"	***Wet, coarse sand***	0.1 ppm	32" Recovered
				8"-17"	***Dark brown, medium to coarse, grey sand***	0.1 ppm	
6				17"-23"	***Fine, brown/black, sand***	0.2 ppm	
				23"-32"	***Black foundry sand, medium grain***	0.1 ppm	
7							
	▨						
8	▨						
				0"-16"	***Loose, black, coarse sand***	0.1 ppm	
9				16"-30"	***Coarse, black sand with gravel***	0 ppm	48" Recovered
				30"-46"	***Saturated silty clay***	0 ppm	
10				46"-48"	***Grey, brown, hard clay***	0 ppm	Tree piece @ 35"
11							
12							
				0"-24"	***Slug, wet***		
13				24"-40"	***Grey, brown, hard clay***		48" Recovered
				40"-48"	***Grey/green/brown, silty clay***		
14							*Driller struggled with this one
15							
16							
17					***END OF BORING AT 16 FEET***		
							Urban fill to 14 feet
18							Native at 14 feet
					Sample:		
19					***E6-7-8 ft***		
					E6-WC (7-10 ft)		
20							
21							
22							
23							

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BORING LOG

Boring No.	**E7-MW4**
Sheet 1 of:	1
Project No.:	J53002002
Surface Elev.:	580
Datum:	
Start Date:	3/16/16
Finish Date:	3/16/16
Inspector:	AD

Project Name:	Queen City Landing Remedial investigation
Location:	975 Fuhrmann Blvd
Client:	R&P Oak Hill
Drilling Firm:	NYEG

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	CME-55		
While Drilling:	7	3/16 10	***Casing:***	4.25 HAS	***Rock Core:***	***Undist:***
Before Casing Removal:			***Sampler:***	2' SS	***Other:***	
After Casing Removal:			***Hammer:***			

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		**MATERIAL DESCRIPTION**		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			N/A	N/A	***0.4 ft Asphalt***		9:10 Start
1			10	0-6"	***FILL-rocks-bricks***	0 ppm	45 F Partly Sunny
			12				6" Recovered
2			6				
	▨		10	0-7"	***Coarse sandy FILL - rocks -brick - some CLAY***	0 ppm	7" recovered
3	▨		5				
	▨		4				
4	▨		3				
	▨		3	0-12"	***Moist coarse sandy FILL - rocks -brick - some CLAY***	0 ppm	16" recovered
5	▨		4	12-16"	***Med to fine grain-brown-SAND-bricks***	0 ppm	
			8				
6			43				
			42	0-10"	***Wet-FILL-bricks-large rock- some brown Sand***	0.1 ppm	10"recovered
7	↓		45				
			13				
8			9				
			6	0-4"	***Wet-CLAY & Brick***	0 ppm	19" recovered
9	▨		7	4-19"	***Wet -multicolor-med to coarse grain-SAND-pebbles and***	0 ppm	
	▨		7		***rocks***		
10	▨		9				
			4	0-10"	***Wet-coarse-multicolor-SAND-brick-trace clay***	0 ppm	24" recovered
11			4	10-24"	***Coarse-brown-SAND and rounded small rocks-trace brick***	0 ppm	
			5				
12			9				
			10	0-20"	***Coarse-brown-SAND and rounded small rocks-trace brick***	0 ppm	24" recovered
13			9	20-24"	***Moist-med grain-black-SAND***	0.3 ppm	
			10				
14			12				
			2	0-9"	***Wet-brown-fine SAND***	0 ppm	17" recovered
15			3	9-17"	***Grey CLAY***	0 ppm	
	▨		2				
16	▨		3				
					END OF BORING AT 16 FEET		
17							
							Urban fill to 15 feet
18							Native at 15 feet
					Sample:		
19					***MW4-2-5ft***		
					MW4-8.5-10FT		
20					***MW4-15FT***		
21							
22							
23							

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BORING LOG

Boring No.	E8
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	11/7/16
Finish Date:	11/7/16
Inspector:	AD

Project Name: Queen City Landing Remedial Investigation
Location: Queen City Landing, East Site, Buffalo, New York
Client: R&P Oak Hill Development, LLC
Drilling Firm: Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**		
While Drilling:			**Drill Rig:**	Geoprobe
Before Casing Removal:			**Casing:**	2.125"
After Casing Removal:			**Sampler:**	Acetate liner
			Hammer:	

Rock Core:
Undist:
Other:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-9"	***Asphalt and gravel subbase***	0 ppm	Time: 8:50
1				9"-38"	***FILL - coarse sand, grey sand, brown clay, gravel,***	0.1 ppm	38" Recovered
					brick, and coal		Weather: 45 Degrees F
2							Sunny
3							
4							
				0"-9"	***FILL - coarse sand, grey sand, brown clay, gravel,***	0.1 ppm	
5					***brick, and coal, slight odor, moist***	0 ppm	37" Recovered
				9"-11"	***Brick***	0.1 ppm	
6				11"-37"	***FILL - coarse sand, grey sand, brown clay, gravel,***		
					brick, and coal, dry to moist, trace rock, trace ash		
7							
	▨						
8	▨						
				0"-12"	***FILL - wet, dark brown, gravel and sand***	0 ppm	
9	↓			12"-26"	***FILL - dark brown, wet, gravel, little sand***	0 ppm	28" Recovered
				26"-28"	***Wet, rounded stone, small to large coarse sand***		
10							
11							Groundwater @ 11 feet
12							
				0"-24"	***Wet, dark brown, coarse sand, rounded stone (seems***	0 ppm	
13					***native)***		43" Recovered
				24"-33"	***Soft, moist, brown, silty clay***	0 ppm	
14				33"-43"	***soft, moist, brown clay***	0 ppm	
15							
16							
17					***END OF BORING AT 16 FEET***		Urban fill to 12 feet
							Native at 12 feet
18							
					Sample:		
19					***E8-7-8 ft***		
20							
21							
22							
23							

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BORING LOG

Boring No.	F1		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing Remedial Investigation	**Surface Elev.:**	
Location:	Queen City Landing, East Site, Buffalo, New York	**Datum:**	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	**Start Date:**	1/25/17
Drilling Firm:	Nature's Way Environmental	**Finish Date:**	1/25/17

Groundwater	**Depth**	**Date & Time**					
			Drill Rig:	Geoprobe		**Inspector:**	AS
While Drilling:			**Casing:**	2.125"	**Rock Core:**		**Undist:**
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	GNSS Position:	
After Casing Removal:			**Hammer:**		1039913.82 FT N, 1071694.19 FT E,		

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-4"	***Topsoil, grass, rock (1 in diameter)***	0 ppm	Time: 10:54
1				4"-7"	***Brown, moist, silty clay***	0 ppm	38" Recovered
				7"-15"	***FILL - red brick, concrete, brown clay, brown silty sand***	0 ppm	
2				15"-38"	***Light brown, dense, sandy clay, silty clay***	0 ppm	
3							
4							
				0"-2"	***Light brown, dense, sandy clay, silty clay***	0 ppm	
5				2"-22"	***Light brown to red brown, silty clay, embedded rock, brick,***	0 ppm	32" Recovered
					ash - FILL		
6				22"-32"	***Brown, moist, silty clay, embedded stones (coal?), brick***	0.1 ppm	
7							
8							
				0"-6"	***FILL - brown, moist, silty clay, red brick, stone (concrete),***	0 ppm	
9					***and gravel pieces***		36" Recovered
				6"-26"	***Brown to dark brown, moist to wet, silty clay***	0 ppm	
10	↓			26"-29"	***Black gravel***	0.1 ppm	Odors
				29"-36"	***Grey, wet, concrete pieces to red brick***	0.1 ppm	
11							
12							
				0"-9"	***Loose, sheen visible, gravel, brown silt***	0.1 ppm	
13				9"-36"	***Dark brown to brown, sandy silt, embedded gravel***	0.3 ppm	38" Recovered
				36"-38"	***Brown to dark brown, silty clay***	0.8 ppm	
14							Petro odors
15	▨						
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		
							Urban fill to 16 feet
18							
					Sample:		
19					***F1-14.5-16 FT***		
20							
21							
22							
23							

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BORING LOG

Boring No.	**F2**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/25/17
Finish Date:	1/25/17
Inspector:	AS

Project Name: Queen City Landing Remedial Investigation
Location: Queen City Landing, East Site, Buffalo, New York
Client: R&P Oak Hill Development, LLC
Drilling Firm: Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**				
While Drilling:			**Drill Rig:**	Geoprobe		
Before Casing Removal:			**Casing:**	2.125"	**Rock Core:**	
After Casing Removal:			**Sampler:**	Acetate liner	**Undist:**	
			Hammer:		**Other:**	GNSS Position: 1039952.63 FT N, 1071810.65 FT E,

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-3"	***Topsoil, asphalt, gravel***	0 ppm	Time: 9:53
1				3"-12"	***Brown, moist, silty clay, dense, embedded gravel, white***	0 ppm	36" Recovered
					concrete, ash		
2				12"-36"	***Brown, moist, silty sand, red brick, dark staining, no***	0.1ppm	
					petro odors		
3							
4							
				0"-12"	***FILL - dark brown, moist, silty sand, brick, gravel***	0 ppm	
5				12"-15"	***Brown, moist, clay, silt, and fine sand***	0 ppm	35" Recovered
				15"-21"	***Dark brown, clayey silt, rocks***	0 ppm	
6				21"-25"	***Black gravel, asphalt, clayey silt, rocks***	0 ppm	
				25"-35"	***Brown, moist, silty clay, red mottles***	0.1ppm	
7	▨						
	▨						
8	▨						
	↓			0"-9"	***FILL - dark, silty clay, brown, sandy silt***	0 ppm	
9				9"-15"	***Loose, brown, sandy silt, embedded gravel pieces up to 1" in***	0 ppm	42" Recovered
					diameter		
10				15"-42"	***Light brown, sand, moist to wet,***	0 ppm	
11							
12							
				0"-11"	***Loose, brown, sand, medium grain***	0 ppm	
13				11"-46"	***Brown to grey, sand, mixed with grey, moist, sandy silt***	0 ppm	46" Recovered
14							
	▨						
15	▨						
16							
17					***END OF BORING AT 16 FEET***		Urban fill to 9.5 feet
							Construction fill to 16
18							
					Sample:		
19					***F2-6.5-8 FT***		
					F2-15 FT		
20							
21							
22							
23							

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BORING LOG

Boring No.	**F3**		
Sheet 1 of:	1		
Project No.:	J53.002.003		
Project Name:	Queen City Landing Remedial Investigation	***Surface Elev.:***	
Location:	Queen City Landing, East Site, Buffalo, New York	***Datum:***	GROUND SURFACE
Client:	R&P Oak Hill Development, LLC	***Start Date:***	1/25/17
Drilling Firm:	Nature's Way Environmental	***Finish Date:***	1/25/17

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	Geoprobe		***Inspector:***	AS
While Drilling:			***Casing:***	2.125"	***Rock Core:***	***Undist:***	
Before Casing Removal:			***Sampler:***	Acetate liner	***Other:***	GNSS Position:	
After Casing Removal:			***Hammer:***		1039990.43 FT N, 1071885.46 FT E		

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"		**MATERIAL DESCRIPTION**		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-2"	***Brown, topsoil/roots***	0 ppm	Time: 8:42
1				2"-6"	***Brown, gravel, stones pieces ranging up to 1" in diameter***	0 ppm	31" Recovered
				6"-15"	***FILL - brown, moist, silty sand, small gravel***	0 ppm	Weather: 36 Degrees F
2				15"-23"	***Light brown, dense, clay, gravel***	0 ppm	Cloudy
				23"-31"	***Brown, moist, silty sand, red mottles and brick***	0 ppm	
3							
4							
				0"-21.5"	***FILL - moist, red brown, dense, cla, brown, silty sand,***	0 ppm	
5	↓				***red brick, gravel, stones up to 1" in diameter, concrete***		25" Recovered
				21.5"-25"	***Dark brown, wet, sandy silt, embedded gravel***	0 ppm	
6							
7	▨						
	▨						
8	▨						
				0"-4"	***Brown, wet, sandy silt, small coarse stones, red brick***	0 ppm	
9					***pieces***		36" Recovered
				4"-36"	***Brown, wet to moist, silty sand, dark streaks***	0 ppm	
10							
11							
12							
				0"-12"	***Brown, wet, silty sand,***	0 ppm	
13				12"-23"	***Brown, moist, silty sand, medium to fine grained***	0 ppm	48" Recovered
				23"-48"	***Brown to grey, moist, silty sand, sea-like odors***	0 ppm	
14							
15							
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		
18							
					Sample:		Urban fill to 12 feet
19					***F3-SS***		Construction fill to 16
					F3-6.5-8 FT		
20					***F3-15 FT***		
					F3-WC		
21					***F3-3 FT***		
22							
23							

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BORING LOG

Boring No.: F4
Sheet 1 of: 1
Project No.: J53.002.003
Project Name: Queen City Landing Remedial Investigation
Surface Elev.:
Location: Queen City Landing, East Site, Buffalo, New York
Datum: GROUND SURFACE
Client: R&P Oak Hill Development, LLC
Start Date: 1/25/17
Drilling Firm: Nature's Way Environmental
Finish Date: 1/25/17

Groundwater	Depth	Date & Time
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

Drill Rig: Geoprobe
Inspector: AS
Casing: 2.125"
Rock Core:
Undist:
Sampler: Acetate liner
Other: GNSS Position: 1040037.62 FT N, 1072006.48 FT E
Hammer:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-2" ***Asphalt, black gravel***	0 ppm	Time: 12:39
1				2"-12" ***FILL - brown, dry, sandy silt, stones, gravel, red brick,***	0 ppm	48" Recovered
				concrete		
2				12"-48" ***FILL - Brown, dense, dryo to moist, silty clay, ash (concrete),***	0 ppm	
	▨			***red mottles***		
3						
4						
				0"-4" ***Brown, moist, red brick, silty clay***	0.1 ppm	
5				5"-7" ***Black, asphalt and gravel***	0 ppm	39" Recovered
				7"-14" ***Brown, soft to dense, silty clay, embedded stone and***	0 ppm	
6				***gravel***		
				14"-25" ***Dark brown, dry to moist, sandy silt***	0 ppm	
7				25"-39" ***Brown, moist, sandy silt, fine to medium sand, dark streaks***	0 ppm	
8						
	↓			0"-7" ***Slug***	0 ppm	
9				7"-38" ***Brown, wet to loose, silty sand, grey streaks***	0 ppm	38" Recovered
10						
11						
12						
				0"-27" ***Wet, moist otherwise, rock and gravel pieces, sparse***	0 ppm	
13				27"-46" ***Brown to grey, medium grain, sand, red brown streaks***	0 ppm	46" Recovered
14						
15						
16						
17				***END OF BORING AT 16 FEET***		
18						
				Sample:		Urban fill to 14 feet
19				***F4-SS***		Construction fill/native to 16
				F4-3 FT		
20						
21						
22						
23						

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BORING LOG

Boring No.	**F5**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	1/26/17
Finish Date:	1/26/17
Inspector:	AS

Project Name:	Queen City Landing Remedial Investigation
Location:	Queen City Landing, East Site, Buffalo, New York
Client:	R&P Oak Hill Development, LLC
Drilling Firm:	Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**
While Drilling:		
Before Casing Removal:		
After Casing Removal:		

Drill Rig:	Geoprobe		
Casing:	2.125"	**Rock Core:**	
Undist:			
Sampler:	Acetate liner	**Other:**	GNSS Position:
Hammer:			1040041.08 FT N, 1072087.43 FT E

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-27"	***FILL - brown to grey, dry, silty sand, gravel, concrete***	0 ppm	Time:15:46
1				27"-29"	***Red brick***	0 ppm	32" Recovered
				29"-32"	***Brown, moist, silty sand***	0.1 ppm	
2							
3							
4							
				0"-4"	***Slug***	0.1 ppm	
5				4"-20"	***Brown, moist, silty clay, embedded concrete or white rock***	0.1 ppm	38" Recovered
				20"-24"	***Red brick***	0 ppm	
6				24"-38"	***Red brown to brown, moist, sand***	0 ppm	Petro odors
7	▨						
	▨						
8	▨ ↓						
				0"-32"	***Brown, moist to wet, fine to medium grained sand,***	0 ppm	
9					***sparsely embedded brick***		32" Recovered
10							
11							
12							
				0"-11"	***Slug (FILL/rock/gravel)***	0 ppm	
13				11"-33"	***Brown, moist to wet, sand***	0 ppm	36" Recovered
				33"-36"	***Dense, silty sand (loam), embedded clay***	0 ppm	
14							
15							
	▨						
16	▨						
17					***END OF BORING AT 16 FEET***		
							Urban fill to 16
18							
					Sample:		
19					***F5-SS***		
					F5-6.5-8 FT		
20					***F5-15 FT***		
21							
22							
23							

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BORING LOG

Boring No.	**F6**
Sheet 1 of:	1
Project No.:	J53.002.003
Surface Elev.:	
Datum:	GROUND SURFACE
Start Date:	11/7/16
Finish Date:	11/7/16
Inspector:	AD

Project Name: Queen City Landing Remedial Investigation
Location: Queen City Landing, East Site, Buffalo, New York
Client: R&P Oak Hill Development, LLC
Drilling Firm: Nature's Way Environmental

Groundwater	**Depth**	**Date & Time**	**Drill Rig:**	Geoprobe		
While Drilling:			**Casing:**	2.125"	**Rock Core:**	
Before Casing Removal:			**Sampler:**	Acetate liner	**Other:**	GNSS Position:
After Casing Removal:			**Hammer:**		1040099.41 FT N, 1072179.17 FT E	

Undist:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0"-10"	***Topsoil and gravel***	0.1 ppm	Time: 11:45
1				10"-44"	***FILL - Hard, dense, clay and coal and rock, trace ash,***	0.1 ppm	44" Recovered
					coarse sand		Weather: 55 Degrees F
2							Sunny
3							
4							
				0"-25"	***FILL - Hard, dense, more clay content and coal and rock,***	0 ppm	
5					***trace ash, coarse sand***	0.1 ppm	39" Recovered
				25"-39"	***Moist, light brown, silty clay***		
6							
7							
8	↓						
				0"-3"	***Wet, silty clay, trace gravel***	0 ppm	
9				3"-16"	***Saturated brown and black sand, fine***	0 ppm	25" Recovered
				16"-38"	***Wet, coarse, black/brown, sand***	0 ppm	
10							
11							
	▨						
12	▨						
13					***END OF BORING AT 12 FEET***		
							Urban fill to 12 feet
14							
					Sample:		
15					***F6-SS***		
					F6-11-12 ft		
16							
17							
18							
19							
20							
21							
22							
23							

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BORING LOG
GENERAL INFORMATION & KEY

Casing, Sampling and Other Equipment

H.S.A: Hollow Stem Auger (record I.D.)
S.S.A: Solid Stem Auger (record O.D.)
Steel: Hollow Steel Flush Joint Casing (recorded I.D.)
Open: Open Hole / No Casing (record I.D.)
S.S.: Split Spoon (record I.D.)
Hammer: Auto - Automatic, Manual - Manual (rope & cat-head)
Undist: Tube - Shelby, Oste - Osteberg (record I.D. & length)

Rock Cores

Standard	I.D.	Wire Line	I.D.
EW / EX	1-13/32"	--	--
AW / AX	1-25/32"	AQ	1-1/8"
BW / BX	2-7/32"	BQ	1-1/2"
NW / NX	2-27/32"	NQ	1-31/32"
HW / HX	2-25/32"	HQ	2-5/8"

Symbol Legend & Abbreviations

▮ Split Spoon Sample

▥ Undisturbed Sample

▮▯▮▯▮▯▮▯ Rock Core

Abbreviations	Color
W.O.R. - Weight of Rods	br - brown
W.O.H. - Weight of Rods & Hammer	rd - red
N - Standard Penetration Test N-value	gr - gray
N.W.E. - No Water Encountered	grn - green
do - ditto (same as above)	blk - black
Rec - Recovery	wht - white
RQD - Rock Quality Designation	
PP - Pocket Penetrometer	
Tor - Torvane	

Description of Soil Density

Relative Soil Density determined while advancing the soil boring by using ASTM Method D-1586, *Standard Penetration Test N-Value*. The N-Value is calculated by adding the hammer blow counts of the 2nd and 3rd sampling intervals together for driving a 2" O.D. sampler with a 140 lb. hammer falling 30" --OR-- by obtaining Pocket Penetrometer or Torvane Readings.

Course Grained Soils
Greater than half the material larger than No. 200 Sieve (sand and gravel)

N-Value	Relative Density
< 4	Very Loose
4 to 10	Loose
11 to 30	Medium Dense
31 to 50	Dense
> 50	Very Dense

Fine Grained Soils

N-Value	Undrained Shear Strength (q_u)				Relative Density
	psi	psf	tsf or kg/cm^2	kN/m^2	
< 2	< 2.5	< 375	< 0.2	< 20	Very Soft
2 to 4	2.5 - 5	375 - 750	0.20 - 0.40	20 - 40	Soft
5 to 8	5 -10	750 - 1,500	0.40 - 0.75	40 - 75	Firm -or- Medium Stiff
9 to 15	10 - 20	1,500 - 3,000	0.75 - 1.50	75 - 150	Stiff
16 to 30	20 - 40	3,000 - 6,000	1.50 - 3.00	150 - 300	Very Stiff
> 30	> 40	> 6,000	> 3	> 3,000	Hard

Description of Soil Type

Material	Grain Size	Material	Grain Size	Material	Grain Size	Material	Grain Size
Boulder	> 8"	**Gravel**		**Sand**		**Silt & Clay**	< #200
Cobble	8" - 3"	Course	3" - 1-1/2"	Course	#4 - #10	Note: # indicates U.S. Standard Sieve with size shown.	
		Medium	1-1/2" - 3/4"	Medium	#10 - #40		
		Fine	3/4" - #4	Fine	#40 - #200		

Bed Rock Classification Terms & Field Test / Field Observation

Term	Field Test / Field Observation
Hardness	
Soft	Can be Scratched by Fingernail
Medium Hard	Easily Scratched by Pen Knife or Nail
Hard	Difficultly Scratched by Pen Knife or Nail
Very Hard	Cannot be Scratched by Pen Knife or Nail
Weathering	
Very Weathered	Based on observations (e.g., amount of disintegration, iron staining, core recovery, clay seams, amount of material within joints, etc.)
Weathered	
Sound	
Bedding (Natural Breaks in Rock Layers)	
Laminated	< 1 inch
Thinly Bedded	1 inch to 4 inches
Bedded	4 inches to 12 inches
Thickly Bedded	12 inches to 36 inches
Massive	> 36 inches

Rock Mass Classification based on RQD

RQD	Rock Mass Quality
< 25%	very poor
25% - 50%	poor
50% - 75%	fair
75% - 90%	good
90% - 100%	excellent

$$\text{RQD} = \frac{\Sigma \text{ of pieces} \geq 4''}{\text{total length of run}}$$

ASTM Method D-6032, *Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Cores*

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BORING LOG

Boring No.	**MW1**
Sheet 1 of:	1
Project No.:	J53002002

Project Name:	Queen City Landing Remedial investigation	***Surface Elev.:***	580
Location:	975 Fuhrmann Blvd	***Datum:***	
Client:	R&P Oak Hill	***Start Date:***	3/15/16
Drilling Firm:	NYEG	***Finish Date:***	3/15/16

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	CME-55			***Inspector:***	AD
While Drilling:	9	3/15 10:15	***Casing:***	4.25 HAS	***Rock Core:***		***Undist:***	
Before Casing Removal:			***Sampler:***	2' SS	***Other:***			
After Casing Removal:			***Hammer:***					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			6	0-2"	***Topsoil***		930 am Start
1			10	2-24"	***Dry clay and sand FILL-brick-rock***	0.2 ppm	Rain 45 F
			14				24" Recovered
2			10				
			8	0-12"	***Moist sandy FILL-small rocks-brick***	0 ppm	14" Recovered
3			6	12-14"	***Moist-brown-clayey SAND***	0 ppm	clayey cuttings-wet
			5				
4			9				
	▨		4	0-4"	***Dark brown-wet-SAND-trace Clay***	0.1 ppm	19" Recovered
5	▨		6	4-9"	***Dark brown-moist-SAND***	0 ppm	
	▨		7	9-19"	***Moist-brown-Sandy FILL-brick-coal pieces***	0.2 ppm	
6	▨		2				
	▨		3	0-5"	***Moist-brown-Sandy FILL-brick-coal pieces***	0 ppm	15 " Recovered
7	▨		6	5-8"	***Piece of wood***	0ppm	
	▨		7	8-15"	***Wet-black-coarse SAND-large brick pieces-coal***	0.1 ppm	
8	▨		6				
			10	0-9"	***Moist-brown-sandy CLAY-some rounded pebbles, piece***	0 ppm	13" Recovered
9	↓		9		***of wood at 9"***		
			4	9-13"	***Wet-black/brown-CLAY***	0 ppm	
10			3				
	▨		2	0-8"	***Moist-brown-sandy CLAY-bricks***	0 ppm	22" Recovered
11	▨		2	8-22"	***Wet-black-SAND-trace bricks***	0 ppm	10.5"- hard crunchy fill
	▨		1				
12	▨		3				
			2	0-24"	***Wet to saturated-black-CLAY AND SAND (coarse)***	0.1 ppm	24" Recovered
13			3				slight petroleum
			6				or industrial odor
14			5				
			3	0-6"	***Wet-brown-SAND-brick pieces***	0 ppm	17" Recovered
15			3	6-17"	***Wet-black/grey-SAND***	0 ppm	
	▨		6				
16	▨		3				
					END OF BORING AT 16 FEET		
17							
18					***Sample***		
					MW1-4-8FT 10:00 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")		
19					***MW1-10-12FT*** 10:15 ALL		
					MW1-15-16FT 10:50 ALL		
20							
21							
22							
23							

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BORING LOG

Boring No.	**MW2**
Sheet 1 of:	1
Project No.:	J53002002

Project Name:	Queen City Landing Remedial investigation	**Surface Elev.:**	581
Location:	975 Fuhrmann Blvd	**Datum:**	
Client:	R&P Oak Hill	**Start Date:**	3/15/16
Drilling Firm:	NYEG	**Finish Date:**	3/15/16

Groundwater	**Depth**	**Date & Time**	**Drill Rig:**	CME-55			**Inspector:**	AD
While Drilling:	11	3/15 14:00	**Casing:**	4.25 HAS	**Rock Core:**		**Undist:**	
Before Casing Removal:			**Sampler:**	2' SS	**Other:**			
After Casing Removal:			**Hammer:**					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			6	0-1"	***Topsoil with rocks***		12:45:00 PM START
1			45	1-12"	***Rocks, black/grey concrete***	0.2 ppm	45 F Rain
			15				12" recovered
2			6				
	▨		8	0-14"	***Sandy FILL-bricks-slight odor-moist***	0.4 ppm	14" recovered
3	▨		7				
	▨		6				slight industrial odor
4	▨		42				
			10	0-9"	***Wet-brown-coarse sandy FILL-bricks***	0.1 ppm	22" recovered
5			6	9-11"	***Bricks and coal pieces***	0.2 ppm	
	▨		3	11-22"	***Moist-brown/black sandy FILL-trace silt***	0.2 ppm	
6	▨		5				
	▨		8	0-14"	***Moist-brown/black sandy FILL-trace silt-bricks***	0 ppm	14" recovered
7	▨		8				Cutitngs are black
	▨		8				
8	▨		4				
			2		***No Recovery/1" clay and sand-wet-brown***		No Recovery
9			1				
			1				
10			1				
			1	0-1"	***Saturated-black-SAND***	0 ppm	1" recovered
11	↓		1				
			1				
12			1				
			1	0-9"	***Brown-silty SAND***	0 ppm	20" recovered
13			3	9-14"	***Saturated-black-SILT***	0 ppm	
			4	14-20"	***Wet-black/brown-fine SAND***	0 ppm	
14			8				
			4	0-3"	***Medium to coarse-saturated-grey/black-SAND***	0 ppm	3" recovered
15			3				
			1				
16			1				
	▨		2	0-24"	***Grey/black-saturated-fine SAND***	0.1 ppm	24" recovered
17	▨		2				
	▨		3				
18	▨		4				
					END OF BORING AT 18 FEET		
19							
20					***Sample***		
					MW2-2-4FT 13:10 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")		
21					***MW2-5-8FT*** 13:20 ALL		
					MW2-16-18FT 14:00 ALL		
22							
23							

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BORING LOG

Project Name:	Queen City Landing Remedial investigation	**Boring No.**	**MW3**
		Sheet 1 of:	1
		Project No.:	J53002002
		Surface Elev.:	578
Location:	975 Fuhrmann Blvd	**Datum:**	
Client:	R&P Oak Hill	**Start Date:**	3/15/16
Drilling Firm:	NYEG	**Finish Date:**	3/16/16
		Inspector:	AD

Groundwater	**Depth**	**Date & Time**						
			Drill Rig:	CME-55				
While Drilling:	3.8	3/15/16	**Casing:**	4.25 HAS	**Rock Core:**		**Undist:**	
Before Casing Removal:			**Sampler:**	2' SS	**Other:**			
After Casing Removal:	7	03/15/16	**Hammer:**					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			N/A	N/A	***0.3ft of asphalt***		1520 start
1			6	0-1"	***Gravel subbase***	0 ppm	40 F
			8	1-8"	***Wet-black-coarse SAND***	0 ppm	21" recovered
2			5	8-21"	***Moist-redbrown-coarse Sand-some Silt-bricks***	0 ppm	
			4	0-14"	***Saturated sandy FILL-trace clay-brown-brick-concrete-coal***	0 ppm	14" recovered
3			10		***pieces***		
			15				
4			12				
			5	0-9"	***Wet-coarse SAND and GRAVEL***	0 ppm	16" recovered
5			2	9-16"	***Wet to saturated-coarse sandy FILL-brick-coal***	4.6 ppm	
	▨		3				
6	▨		1				
	▨		1	0-2"	***Wet to saturated-coarse sandy FILL-brick-coal***	0 ppm	2 " recovered
7	▨ ↓		1				
			2				
8			1				
			2	0-10"	***Wet to saturated-coarse sandy FILL-brick-coal***	0 ppm	19" recovered
9			2	10-19"	***Wet-brown-medium grain SAND-some black staining and***	0.2 ppm	
			2		***possible petroleum odor***		
10			2				
			5	0-6"	***Wet-brown-medium grain SAND-some black staining and possible***		0.1 ppm
11			6	6-11"	***Loose-brown-fine SAND- some black staining***	0 ppm	18" recovered
			2	11-17"	***Saturated-fine SAND***	0 ppm	
12			2	17-18"	***Black material***		
	▨		2	0-12"	***Wet-brown-fine brown SAND-some brick***	0 ppm	24" recovered
13	▨		2	12-13"	***Black SAND***	0 ppm	
	▨		3	13-20"	***Brown-fine SAND***	0 ppm	
14	▨		2	20-24"	***Grey CLAY***	0 ppm	
	▨		--	0-20"	***Wet-brown-SAND-some brick***	0 ppm	24" recovered
15	▨		--	20-24"	***Grey CLAY***	0 ppm	
	▨		--				
16	▨		--				
					END OF BORING AT 16 FEET		
17							
18							
19							
20					***Sample***		
					MW3-5-7FT 15:40 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")		
21					***MW3-12-14FT*** 16:20 ALL		
					MW3-14-16FT 16:30 ALL		
22							
23							

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BORING LOG

Boring No.	**MW4**
Sheet 1 of:	1
Project No.:	J53002002
Surface Elev.:	580
Datum:	
Start Date:	3/16/16
Finish Date:	3/16/16
Inspector:	AD

Project Name:	Queen City Landing Remedial investigation
Location:	975 Fuhrmann Blvd
Client:	R&P Oak Hill
Drilling Firm:	NYEG

Groundwater	***Depth***	***Date & Time***				
While Drilling:	7	3/16 10	***Drill Rig:***	CME-55		
Before Casing Removal:			***Casing:***	4.25 HAS	***Rock Core:***	
After Casing Removal:			***Sampler:***	2' SS	***Other:***	
			Hammer:			

Undist:

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		**MATERIAL DESCRIPTION**		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			N/A	N/A	***0.4 ft Asphalt***		9:10 Start
1			10	0-6"	***FILL-rocks-bricks***	0 ppm	45 F Partly Sunny
			12				6" Recovered
2			6				
	▨		10	0-7"	***Coarse sandy FILL - rocks -brick - some CLAY***	0 ppm	7" recovered
3	▨		5				
	▨		4				
4	▨		3				
	▨		3	0-12"	***Moist coarse sandy FILL - rocks -brick - some CLAY***	0 ppm	16" recovered
5	▨		4	12-16"	***Med to fine grain-brown-SAND-bricks***	0 ppm	
			8				
6			43				
			42	0-10"	***Wet-FILL-bricks-large rock- some brown Sand***	0.1 ppm	10"recovered
7	↓		45				
			13				
8			9				
			6	0-4"	***Wet-CLAY & Brick***	0 ppm	19" recovered
9	▨		7	4-19"	***Wet -multicolor-med to coarse grain-SAND-pebbles and***	0 ppm	
	▨		7		***rocks***		
10	▨		9				
			4	0-10"	***Wet-coarse-multicolor-SAND-brick-trace clay***	0 ppm	24" recovered
11			4	10-24"	***Coarse-brown-SAND and rounded small rocks-trace brick***	0 ppm	
			5				
12			9				
			10	0-20"	***Coarse-brown-SAND and rounded small rocks-trace brick***	0 ppm	24" recovered
13			9	20-24"	***Moist-med grain-black-SAND***	0.3 ppm	
			10				
14			12				
			2	0-9"	***Wet-brown-fine SAND***	0 ppm	17" recovered
15			3	9-17"	***Grey CLAY***	0 ppm	
	▨		2				
16	▨		3				
					END OF BORING AT 16 FEET		
17							
18							
					Sample		
19					***MW4-2-5ft*** 9:40 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")		
					MW4-8.5-10FT 9:52 ALL		
20					***MW4-15FT*** 10:05 ALL		
21							
22							
23							

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BORING LOG

		Boring No.	**MW5**
		Sheet 1 of:	1
		Project No.:	J53002002
Project Name:	Queen City Landing Remedial investigation	***Surface Elev.:***	581
Location:	975 Fuhrmann Blvd	***Datum:***	
Client:	R&P Oak Hill	***Start Date:***	3/16/16
Drilling Firm:	NYEG	***Finish Date:***	3/16/16

Groundwater	***Depth***	***Date & Time***	***Drill Rig:***	CME-55		***Inspector:***	AD
While Drilling:	6	3/16/16 13:40	***Casing:***	4.25 HAS	***Rock Core:***	***Undist:***	
Before Casing Removal:			***Sampler:***	2' SS	***Other:***		
After Casing Removal:			***Hammer:***				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			2	0-4"	***Topsoil***	0 ppm	13:00 Start
1			4	4-16"	***Moist-brown/dark brown-silty CLAY***	0 ppm	thunderstorming
			4				16" recovered
2			5				
			3	0-12"	***Clay with rocks and gravel***	0 ppm	12" recovered
3			4				
			3				
4			4				
	▨		1	0-10"	***Moist to wet-brown-Clay-some silt***	0 ppm	13" recovered
5	▨		1	10-13"	***Red brown-silty CLAY-trace sand and rock***	0 ppm	
	▨		1				
6	▨ ↓		1				
			2	0-5"	***Brown-CLAY-trace black material (coal?)***	0 ppm	24" recovered
7			2	5-8"	***Blue and white coarse SAND***	0 ppm	
			2	8-24"	***Red brown-coarse Sand and Clay***	0 ppm	
8			3				
			6	0-3"	***Red brown- wet-coarse sand and clay***	0 ppm	24" recovered
9			6	3-24"	***Wet -Coarse sand and small rounded rocks/pebbles***	0 ppm	
	▨		7				
10	▨		10				
	▨		3	0-3"	***Slug***	0 ppm	14" recovered
11	▨		3	3-14"	***Wet-multicolor-coarse sand and small rounded***	0 ppm	
	▨		4		***rocks/pebbles***		
12	▨		4				
			7	0-17"	***Wet-multicolor-coarse sand and small rounded rocks/pebbles***	0 ppm	22" recovered
13			3	17-22"	***Grey-green-brown CLAY AND SILT***	0 ppm	
			1				
14			1				
	▨		2	0-10"	***Wet- grey/brown CLAY and SILT***	0 ppm	24" recovered
15	▨		1	10-24"	***Wet-fine-silty SAND***	0 ppm	
	▨		1				
16	▨		2				
					END OF BORING AT 16 FEET		
17							
18							
					Sample		
19					***MW5-4-6FT*** 13:10 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")		
					MW5-9-12FT 13:40 ALL		
20					***MW5-14-16FT*** 14:00 ALL		
21							
22							
23							

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BORING LOG

Boring No.	MW6		
Sheet 1 of:	3		
Project No.:	J53002002		
Project Name:	Queen City Landing Remedial investigation	**Surface Elev.:**	576
Location:	975 Fuhrmann Blvd	**Datum:**	
Client:	R&P Oak Hill	**Start Date:**	3/16/16
Drilling Firm:	NYEG	**Finish Date:**	3/16/16

Groundwater	**Depth**	**Date & Time**					
			Drill Rig:	CME-55		**Inspector:**	AD
While Drilling:	5	3/16/16 15:45	**Casing:**	4.25 HAS	**Rock Core:**	**Undist:**	
Before Casing Removal:			**Sampler:**	2' SS	**Other:**		
After Casing Removal:			**Hammer:**				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	**MATERIAL DESCRIPTION**			**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
			N/A	N/A	***0.4 ft of asphalt***		15:15 Start
1			4	0-12"	***Asphalt pieces***	0 ppm	cloudy
			5				12" recovered
2			6				
			15	0-5"	***Asphalt pieces***	0 ppm	16" recovered
3			7	5-10"	***Gravel and concrete***	0 ppm	
			33	10-16"	***Wet rock and gravel***	0 ppm	
4			N/A		***spoon stopped at 3.5'***		
			50/0.2	N/A	***6" of concrete***		11" recovered
5	↓		15	0-11"	***Coarse Sand and Gravel - moist***	0 ppm	
	▨		15				
6	▨		5				
	▨		7	0-10"	***Coarse Sand and Gravel - wet***	0 ppm	13" recovered
7	▨		4	10-13"	***Wet-fine-brown-SAND***	0 ppm	
			6				
8			7				
	▨		2	0-2"	***Fine-wet-brown-SAND-trace clay***	0 ppm	12" recovered
9	▨		5	2-12"	***Fine-wet-dark brown-SAND***	0 ppm	
	▨		7				
10	▨		8				
			3	0-7"	***Fine-wet-dark brown-SAND***	0 ppm	24" recovered
11			2	7-8"	***Rock***	0 ppm	
			3	9-22"	***Fine-wet-dark brown-SAND***	0 ppm	
12			4	22-24"	***Grey/green/brown CLAY-wet***	0 ppm	
			7	0-9"	***Brown/black-medium grain SAND***	0 ppm	24" recovered
13			10	9-24"	***Wet-grey-CLAY***	0 ppm	
			9				
14			4				
	▨		1	0-6"	***Saturated/loose fine-brown-SAND***	0 ppm	12" recovered
15	▨		1	6-12"	***Wet-grey-CLAY***	0 ppm	
	▨		1				
16	▨		1				
			22	0-5"	***FILL***	0 ppm	sands in bottom-removed with water/spoons
17			14	5-8"	***Sandy CLAY-wet to saturated***	0 ppm	
			9				8 recovere
18			10				
			15	0-7"	***Angular gravel- brown- sandy CLAY***	0 ppm	15" recovered
19			3	7-15"	***Grey-soft sandy CLAY***	0 ppm	
			4				
20			4				
21							
22							
23							

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		Sheet 2 of:	3
		Project No.:	
Project Name:		***Start Date:***	
Location:		***Finish Date:***	
Client:		***Inspector:***	CM

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
24					
			1		
25			1	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			1		
26			1		
27					
28					
29					
			WH		
30			WH	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			WH		
31			WH		
32					
33					
34					
			WH		
35			WH	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			WH		
36			WH		
37					
38					
39					
			WH		
40			WH	0-24" ***Soft-saturated-grey-silty CLAY*** 0 ppm	24" recovered
			WH		
41			WH		
42					
43					
44					
			4		
45			12	0-24" ***Dense-saturated-brown silty CLAY*** 0 ppm	24" recovered
			11		
46			13		
47					
48					
49					

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BORING LOG

Boring No.	**MW6**
Sheet 3 of:	3
Project No.:	
Project Name:	
Location:	
Client:	
Start Date:	
Finish Date:	
Inspector:	

Depth (ft)	Sample No.	Symbol	Blows on Sampler per 6"	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
			WH		
50			WH	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			WH		
51			WH		
52					
53					
54					
			WH		
55			1	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			WH		
56			WH		
57					
58					
59					
			WH		
60			WH	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			1		
61			1		
62					
63					
64					
			WH		
65			WH	0-24" ***Loose-soft-brown-silty CLAY*** 0 ppm	24" recovered
			WH		
66			WH		
67					
68					
69					
70					
				BEDROCK AT 70 FEET	
71					
72					
				Sample	
73				***MW6-4.5-7FT*** 0.656 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")	
				MW6-8-10FT 0.66 ALL	
74				***MW6-14-16FT*** 0.677 ALL	
75					

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BORING LOG

Boring No.	MW7		
Sheet 1 of:	3		
Project No.:	J53002002		
Project Name:	Queen City Landing Remedial investigation	**Surface Elev.:**	576
Location:	975 Fuhrmann Blvd	**Datum:**	
Client:	R&P Oak Hill	**Start Date:**	3/17/16
Drilling Firm:	NYEG	**Finish Date:**	3/18/16

Groundwater	**Depth**	**Date & Time**					
			Drill Rig:	CME-55		**Inspector:**	AD
While Drilling:	5	3/17 8:00	**Casing:**	4.25 HAS	**Rock Core:**		**Undist:**
Before Casing Removal:			**Sampler:**	2' SS	**Other:**		
After Casing Removal:			**Hammer:**				

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine	**MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
1			N/A	N/A	***0.3 ft Asphalt***		745 start 48F Sunny
			6	0-4"	***Dry-brown-med to coarse SAND and rocks***	0 ppm	13" Recovered
2			6	4-12"	***Dry to moist-dark brown-silty SAND***	0 ppm	
			4	12-13"	***Dry-brown SAND-some clay***	0 ppm	
3	▨		6	0-5"	***Med to coarse SAND and rock***	0 ppm	24" recovered
			6	5-24"	***Dry-dark brown-clayey silty FILL-trace sand-bricks-coal***	0 ppm	
4			17				
			15				
5	↓		8	0-6"	***Dry-brown-silty SAND***	0 ppm	14" recovered
			12	6-14"	***Moist-brown-fine to med SAND- trace wet Clay-bricks-coal***	0 ppm	
6			15				
			5				
7			5	0-2"	***Wet-brown-coarse sand and gravel***	0 ppm	13" recovered
			2	2-13"	***Wet-brown-silty CLAY-trace sand***	0 ppm	
8			2				
			2				
9			11	0-8"	***Wet- brown-CLAY and coarse SAND***	0 ppm	17" recovered
			10	8-17"	***Concrete pieces with bricks - wet***	0 ppm	
10			8				
			5				
11			9	0-5"	***Wet-light brown CLAY***	0 ppm	18" recovered
			8	5-7"	***Dark brown-silty CLAY***	0 ppm	
12			6	7-18"	***Wet-bricks and gravel***	0 ppm	
			4				
13	▨		6	0-6"	***Wet-coarse SAND and Brick-some clay***	0 ppm	12" recovered
			3	6-12"	***Bricks***	0 ppm	
14			1				
			5				
15	▨		14	0-17"	***Wet to saturated-coarse SAND and gravel-bricks***	0 ppm	20" recovered
			2	17-20"	***Wet-black-med to coarse SAND-some silt***	0 ppm	
16			4				
			5				
17			5	0-6"	***Wet to saturated-coarse SAND and gravel-bricks***	0 ppm	12" recovered
			4	6-12"	***Wet-brown to black-medium grain SAND and GRAVEL,***	0 ppm	
18			5		***concrete pieces***		
			5				
19			3	0-12"	***Silt and small rounded pebbles***	0 ppm	24" recovered
			3	12-24"	***Moist-light brown-silty CLAY-trace fine sand***	0 ppm	
20			5				
			6				
21							
22							
23							

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BORING LOG

Boring No.	**MW7**
Sheet 2 of:	3
Project No.:	
Project Name:	
Start Date:	
Location:	
Finish Date:	
Client:	
Inspector:	CM

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**	c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, \$ - Silt, G - Gravel, C - Clay, cly - clayey a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
24					
			8	24" ***Slug - No recovery*** 0 ppm	No recovery
25			5		
			2		
26			3		
27					
28					
29					
			1	0 ppm	24" recovered
30			1	0-24" ***Saturated-light brown-CLAY***	
			1		
31			WH		
32					
33					
34					
			3	0 ppm	12' recovered
35			WH	0-12" ***Saturated-light brown-CLAY***	
			WH		
36			WH		
37					
38					
39					
			1		24" recovered
40			WH	0-24" ***Saturated-light brown-CLAY*** 0 ppm	
			WH		
41			WH		
42					
43					
44					
			2	0-18" ***Slug*** 0 ppm	6" Recovered
45			2	18-24" ***Moist to wet-light brown-CLAY-little Silt*** 0 ppm	
			3		
46			5		
47					
48					
49					

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BORING LOG

Boring No.	**MW7**
Sheet 3 of:	3
Project No.:	
Project Name:	
Location:	
Client:	
Start Date:	
Finish Date:	
Inspector:	

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		c - coarse m - medium f - fine **MATERIAL DESCRIPTION** S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey	a - and - 35-50% s - some - 20-35% l - little - 10-20% t - trace - 0-10%	**COMMENTS** (e.g., N-value, recovery, moisture, core run, RQD, % recovered)
			WH	0-24"	***Saturated-light brown-CLAY***	0 ppm	24" recovered
50			WH				
			WH				
51			1				
52							
53							
54							
			3	0-24"	***Saturated-light brown-CLAY***	0 ppm	24" recovered
55			2				Stopped with augers in hole
			1				3/17 12:00
56			2				
57							
58							
59							
			WH	0-24"	***Saturated to loose - brown- silty CLAY***	0 ppm	24" recovered
60			WH				
			WH				
61			WH				
62							
63							
64							
			WH	0-24"	***Saturated to loose - brown- silty CLAY***	0 ppm	24" recovered
65			WH				
			WH				
66			WH				
67							
68							
69							
			WH	0-15"	***Saturated to loose - brown- silty CLAY***	0 ppm	24" recovered
70			WH	15-24"	***Saturated to loose- grey-sandy CLAY-trace limestone***	0 ppm	
			WH		***pieces (1" and smaller)***		
71			4				
72							
73					***BEDROCK AT 72.5 FEET***		
					Sample		
74					***MW7-2-4FT*** 0.333 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")		
					MW7-12-14FT 8:35 ALL		
75					***MW7-14-16FT*** 9:15 ALL		

C&S COMPANIES

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BORING LOG

Boring No.	**MW8**
Sheet 1 of:	1
Project No.:	J53002002
Surface Elev.:	576
Datum:	
Start Date:	3/23/16
Finish Date:	3/23/16
Inspector:	CM

Project Name:	Queen City Landing Remedial investigation
Location:	975 Fuhrmann Blvd
Client:	R&P Oak Hill
Drilling Firm:	NYEG

Groundwater	**Depth**	**Date & Time**						
While Drilling:			**Drill Rig:**	Geoprobe 7720DT				
Before Casing Removal:			**Casing:**	3.25"	**Rock Core:**		**Undist:**	
After Casing Removal:			**Sampler:**	~4.8 ft liners	**Other:**			
			Hammer:					

(N -- No. of blows to drive sampler 12" w/140 lb. hammer falling 30" ASTM D-1586, Standard Penetration Test)

c - coarse
m - medium
f - fine

a - and - 35-50%
s - some - 20-35%
l - little - 10-20%
t - trace - 0-10%

S - Sand, $ - Silt, G - Gravel, C - Clay, cly - clayey

Depth (ft)	**Sample No.**	**Symbol**	**Blows on Sampler per 6"**		**MATERIAL DESCRIPTION**		**COMMENTS** (e.g., N-value, recovery, relative moisture, core run, RQD, % recovered)
				0-12"	***Moist-fine-brown SAND-trace silt-some roots***	0 ppm	40" Recovered
1	▨			12-17"	***Fine-dark brown-SAND-trace slag***	0 ppm	3/23 start
	▨			17-40"	***Saturated-fine to med SAND***	0 ppm	
2	▨						
3							
4							
5	↓						
				0-55"	***Saturated-fine to med SAND***	0 ppm	58" recovered
6				55-58"	***Saturated-grey-fine SAND-trace silt-shells***	0 ppm	
7							
8							
9							
10							
				0-18"	***Saturated-brown-SAND-slug***	0 ppm	58" recovered
11				18-56"	***Saturated-fine-black SAND-trace to no Silt-shells***	0 ppm	
				56-58"	***Soft-grey-silty CLAY and FILL mix***	0 ppm	
12							
	▨						
13	▨						
14							
	▨						
15	▨						
				0-16"	***Slug***	0 ppm	58" recovered
16				16-22"	***Soft-grey-silty CLAY and FILL mix-angular gravel 1"and smaller***	0 ppm	
				22-24"	***Gravel-grey-angular 1/4" and smaller***	0 ppm	
17				24-27"	***Fine-grey SAND***	0 ppm	
				27-31"	***Gravel-grey-angular 1/4" and smaller***	0 ppm	
18				31-58"	***Dense-grey-silty CLAY***	0 ppm	
19							
20							
					END OF BORING AT 20 FEET		driller lost 9" of casing
21							location unknown in hole
					Sample		
22					***MW8-0.5-2ft*** 9:00 VOCs, SVOCs, pest/herb, Metals, cyanide, pcbs ("ALL")		
					MW8-12-13ft 9:15 ALL		
23					***MW8-14-15ft*** 9:45 ALL		

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BORING LOG
GENERAL INFORMATION & KEY

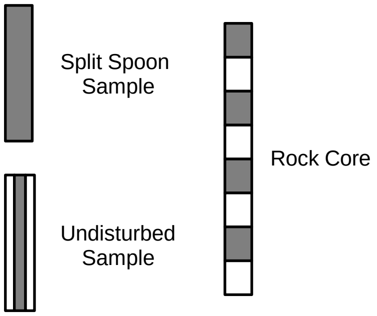
Casing, Sampling and Other Equipment

H.S.A: Hollow Stem Auger (record I.D.)
S.S.A: Solid Stem Auger (record O.D.)
Steel: Hollow Steel Flush Joint Casing (recorded I.D.)
Open: Open Hole / No Casing (record I.D.)
S.S.: Split Spoon (record I.D.)
Hammer: Auto - Automatic, Manual - Manual (rope & cat-head)
Undist: Tube - Shelby, Oste - Osteberg (record I.D. & length)

Rock Cores

Standard	I.D.	Wire Line	I.D.
EW / EX	1-13/32"	--	--
AW / AX	1-25/32"	AQ	1-1/8"
BW / BX	2-7/32"	BQ	1-1/2"
NW / NX	2-27/32"	NQ	1-31/32"
HW / HX	2-25/32"	HQ	2-5/8"

Symbol Legend & Abbreviations



Abbreviations

W.O.R. - Weight of Rods
W.O.H. - Weight of Rods & Hammer
N - Standard Penetration Test N-value
N.W.E. - No Water Encountered
do - ditto (same as above)
Rec - Recovery
RQD - Rock Quality Designation
PP - Pocket Penetrometer
Tor - Torvane

Color

br - brown
rd - red
gr - gray
grn - green
blk - black
wht - white

Description of Soil Density

Relative Soil Density determined while advancing the soil boring by using ASTM Method D-1586, *Standard Penetration Test N-Value*. The N-Value is calculated by adding the hammer blow counts of the 2nd and 3rd sampling intervals together for driving a 2" O.D. sampler with a 140 lb. hammer falling 30" --OR-- by obtaining Pocket Penetrometer or Torvane Readings.

Course Grained Soils

Greater than half the material larger than No. 200 Sieve (sand and gravel)

N-Value	Relative Density
< 4	Very Loose
4 to 10	Loose
11 to 30	Medium Dense
31 to 50	Dense
> 50	Very Dense

Fine Grained Soils

N-Value	Undrained Shear Strength (q_u)				Relative Density
	psi	psf	tsf or kg/cm^2	kN/m^2	
< 2	< 2.5	< 375	< 0.2	< 20	Very Soft
2 to 4	2.5 - 5	375 - 750	0.20 - 0.40	20 - 40	Soft
5 to 8	5 -10	750 - 1,500	0.40 - 0.75	40 - 75	Firm -or- Medium Stiff
9 to 15	10 - 20	1,500 - 3,000	0.75 - 1.50	75 - 150	Stiff
16 to 30	20 - 40	3,000 - 6,000	1.50 - 3.00	150 - 300	Very Stiff
> 30	> 40	> 6,000	> 3	> 3,000	Hard

Description of Soil Type

Material	Grain Size	Material	Grain Size	Material	Grain Size	Material	Grain Size
Boulder	> 8"	**Gravel**		**Sand**		**Silt & Clay**	< #200
Cobble	8" - 3"	Course	3" - 1-1/2"	Course	#4 - #10	Note: # indicates U.S. Standard Sieve with size shown.	
		Medium	1-1/2" - 3/4"	Medium	#10 - #40		
		Fine	3/4" - #4	Fine	#40 - #200		

Bed Rock Classification Terms & Field Test / Field Observation

Term	Field Test / Field Observation
Hardness	
Soft	Can be Scratched by Fingernail
Medium Hard	Easily Scratched by Pen Knife or Nail
Hard	Difficultly Scratched by Pen Knife or Nail
Very Hard	Cannot be Scratched by Pen Knife or Nail
Weathering	
Very Weathered	Based on observations (e.g., amount of disintegration, iron staining, core recovery, clay seams, amount of material within joints, etc.)
Weathered	
Sound	
Bedding (Natural Breaks in Rock Layers)	
Laminated	< 1 inch
Thinly Bedded	1 inch to 4 inches
Bedded	4 inches to 12 inches
Thickly Bedded	12 inches to 36 inches
Massive	> 36 inches

Rock Mass Classification based on RQD

RQD	Rock Mass Quality
< 25%	very poor
25% - 50%	poor
50% - 75%	fair
75% - 90%	good
90% - 100%	excellent

$$RQD = \frac{\Sigma \text{ of pieces} \geq 4"}{\text{total length of run}}$$

ASTM Method D-6032, *Standard Test Method for Determining Rock Quality Designation (RQD) of Rock Cores*

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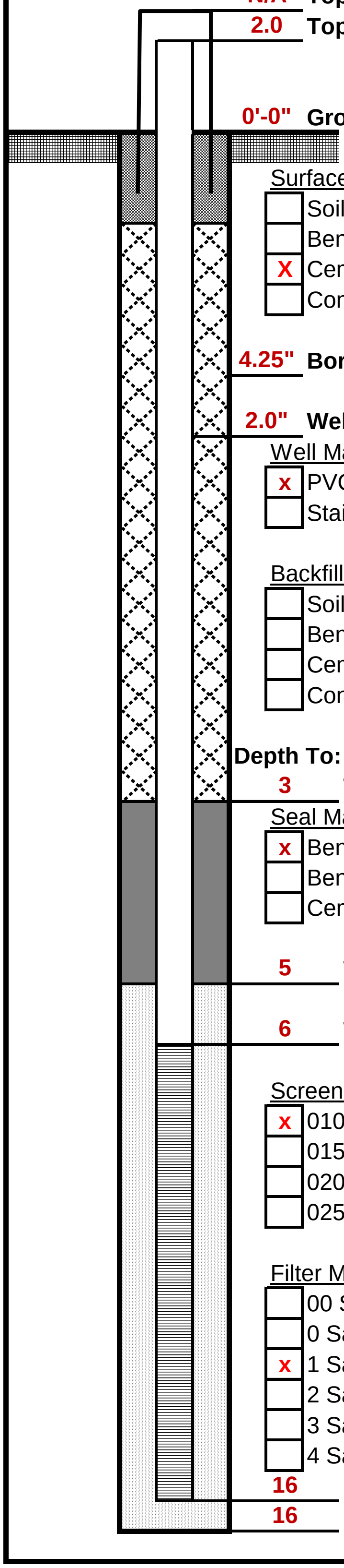
GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

Project Name:	Queen City Landing Remedial Investigation	**Well No.**	**MW1**
		Project No.:	J53002002
		Surface Elev.:	580 (estimate)
		Datum:	
Location:	975 Furhmann Blvd	**Start Date:**	3/15/16
Client:	R&P Oakhill	**Finish Date:**	3/15/16
Drilling Firm:	NYEG	**Inspector:**	AD
Drill Rig:	CME-55	**Casing:**	4.25 HAS

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: purged 20 gallons; did not clear; water was blackish-brown. Well in northwest corner of Site.

Depth to water below is measured from top of riser.



N/A **Top Protective Casing**

2.0 **Top of Riser**

0'-0" **Ground Surface**

Surface Backfill Material
- ☐ Soil Cuttings
- ☐ Bentonite Slurry
- ☒ Cement/Bentonite Grout
- ☐ Concrete

4.25" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
- ☒ PVC
- ☐ Stainless Steel

Backfill Material **(N/A)**
- ☐ Soil Cuttings
- ☐ Bentonite Slurry
- ☐ Cement/Bentonite Grout
- ☐ Concrete

Depth To:

3 **Top of Seal**

Seal Material
- ☒ Bentonite Chips/Pellets
- ☐ Bentonite Slurry
- ☐ Cement/Bentonite Grout

5 **Top of Filter Pack**

6 **Top of Screen**

Screen Slot Size
- ☒ 010 in
- ☐ 015 in
- ☐ 020 in
- ☐ 025 in

Filter Material
- ☐ 00 Sand Pack
- ☐ 0 Sand Pack
- ☒ 1 Sand Pack
- ☐ 2 Sand Pack
- ☐ 3 Sand Pack
- ☐ 4 Sand Pack

16 **Bottom of Screen**

16 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/17	15:00	9.6		N/A

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GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

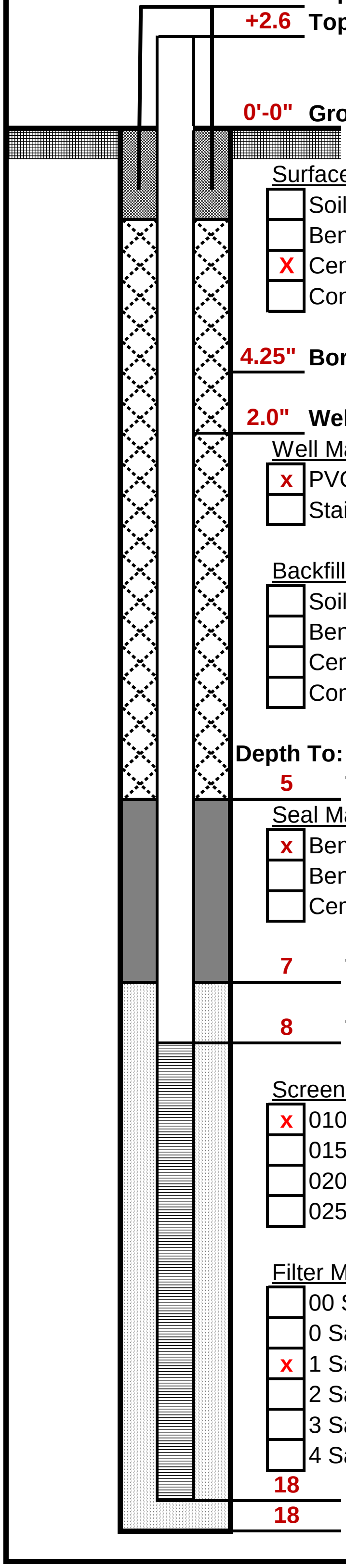
Well No.	**MW2**
Project No.:	J53002002
Surface Elev.:	581 (estimate)
Datum:	
Start Date:	3/15/16
Finish Date:	3/15/16
Inspector:	AD
Casing:	4.25 HAS

Project Name: Queen City Landing Remedial Investigation
Location: 975 Furhmann Blvd
Client: R&P Oakhill
Drilling Firm: NYEG
Drill Rig: CME-55

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: dedicated bailer for purging, purged 15 gallons; water was semi-turbid, better than at the start. Well along northern boundary of site.

Depth to water below is measured from top of riser.



N/A **Top Protective Casing**
+2.6 **Top of Riser**
0'-0" **Ground Surface**

Surface Backfill Material
☐ Soil Cuttings
☐ Bentonite Slurry
☒ Cement/Bentonite Grout
☐ Concrete

4.25" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
☒ PVC
☐ Stainless Steel

Backfill Material **(N/A)**
☐ Soil Cuttings
☐ Bentonite Slurry
☐ Cement/Bentonite Grout
☐ Concrete

Depth To:
5 **Top of Seal**

Seal Material
☒ Bentonite Chips/Pellets
☐ Bentonite Slurry
☐ Cement/Bentonite Grout

7 **Top of Filter Pack**

8 **Top of Screen**

Screen Slot Size
☒ 010 in
☐ 015 in
☐ 020 in
☐ 025 in

Filter Material
☐ 00 Sand Pack
☐ 0 Sand Pack
☒ 1 Sand Pack
☐ 2 Sand Pack
☐ 3 Sand Pack
☐ 4 Sand Pack

18 **Bottom of Screen**
18 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/17	14:00	7.9		N/A

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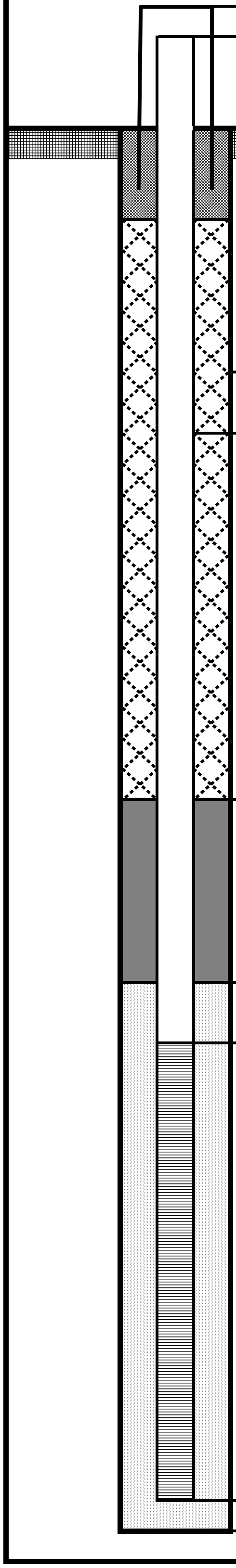
GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

Well No.	**MW3**
Project No.:	J53002002
Surface Elev.:	578 (estimate)
Datum:	
Start Date:	3/15/16
Finish Date:	3/16/15
Inspector:	AD
Casing:	4.25 HAS

Project Name: Queen City Landing Remedial Investigation
Location: 975 Furhmann Blvd
Client: R&P Oakhill
Drilling Firm: NYEG
Drill Rig: CME-55

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: dedicated bailer for purging, purged 22.5 gallons; water was semi-turbid, better than at the start. Well just north of fence in center of property.
Depth to water below is measured from top of riser.



N/A **Top Protective Casing**
+2.1 **Top of Riser**
0'-0" **Ground Surface**

Surface Backfill Material
☐ Soil Cuttings
☐ Bentonite Slurry
☒ Cement/Bentonite Grout
☐ Concrete

4.25" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
☒ PVC
☐ Stainless Steel

Backfill Material **(N/A)**
☐ Soil Cuttings
☐ Bentonite Slurry
☐ Cement/Bentonite Grout
☐ Concrete

Depth To:
3 **Top of Seal**

Seal Material
☒ Bentonite Chips/Pellets
☐ Bentonite Slurry
☐ Cement/Bentonite Grout

6.5 **Top of Filter Pack**

8 **Top of Screen**

Screen Slot Size
☒ 010 in
☐ 015 in
☐ 020 in
☐ 025 in

Filter Material
☐ 00 Sand Pack
☐ 0 Sand Pack
☒ 1 Sand Pack
☐ 2 Sand Pack
☐ 3 Sand Pack
☐ 4 Sand Pack

18 **Bottom of Screen**
18 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/17	16:00	6.1		N/A

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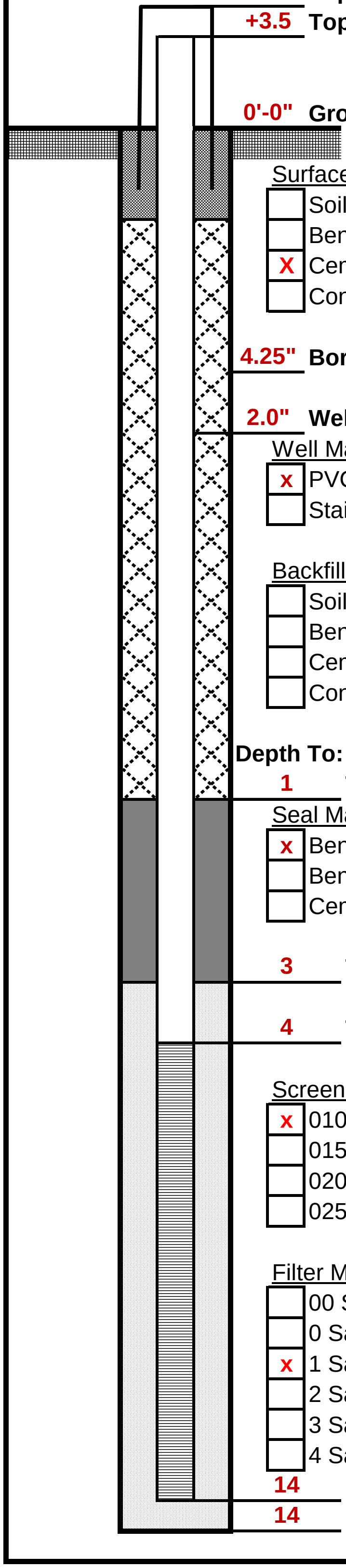
GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

Well No.	**MW4**
Project No.:	J53002002
Surface Elev.:	580 (estimate)
Datum:	
Start Date:	3/16/16
Finish Date:	3/16/15
Inspector:	AD

Project Name: Queen City Landing Remedial Investigation
Location: 975 Furhmann Blvd
Client: R&P Oakhill
Drilling Firm: NYEG
Drill Rig: CME-55
Casing: 4.25 HAS

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: dedicated bailer for purging, purged 17.5 to 20 gallons; water was turbid, no better than at the start. Well near northern boundary of property, closest to substation.
Depth to water below is measured from top of riser.



N/A **Top Protective Casing**
+3.5 **Top of Riser**
0'-0" **Ground Surface**

Surface Backfill Material
☐ Soil Cuttings
☐ Bentonite Slurry
☒ Cement/Bentonite Grout
☐ Concrete

4.25" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
☒ PVC
☐ Stainless Steel

Backfill Material **(N/A)**
☐ Soil Cuttings
☐ Bentonite Slurry
☐ Cement/Bentonite Grout
☐ Concrete

Depth To:
1 **Top of Seal**

Seal Material
☒ Bentonite Chips/Pellets
☐ Bentonite Slurry
☐ Cement/Bentonite Grout

3 **Top of Filter Pack**

4 **Top of Screen**

Screen Slot Size
☒ 010 in
☐ 015 in
☐ 020 in
☐ 025 in

Filter Material
☐ 00 Sand Pack
☐ 0 Sand Pack
☒ 1 Sand Pack
☐ 2 Sand Pack
☐ 3 Sand Pack
☐ 4 Sand Pack

14 **Bottom of Screen**
14 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/18	8:00	8.65		N/A

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GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

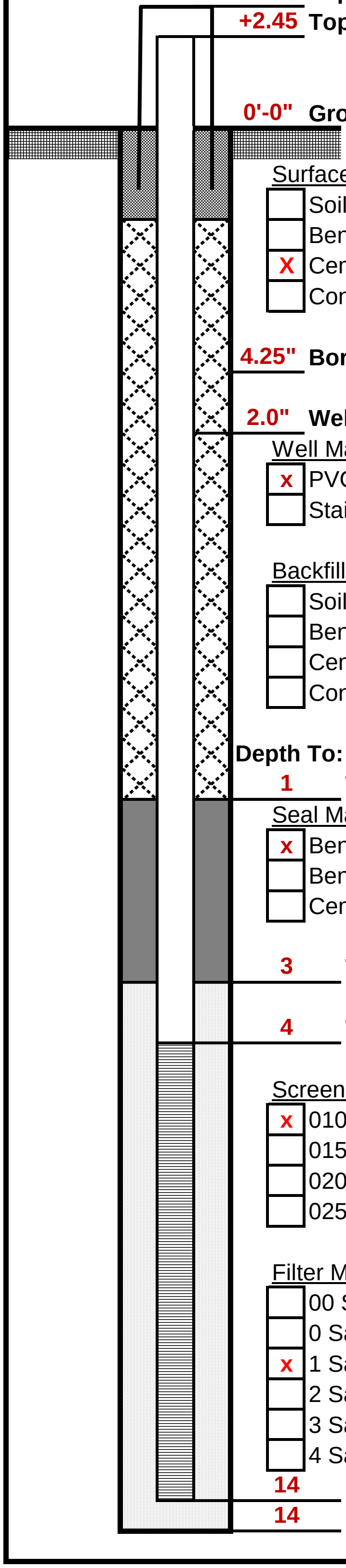
Well No.: MW5
Project No.: J53002002
Surface Elev.: 581 (estimate)
Datum:
Start Date: 3/16/16
Finish Date: 3/16/15
Inspector: AD

Project Name: Queen City Landing Remedial Investigation
Location: 975 Furhmann Blvd
Client: R&P Oakhill
Drilling Firm: NYEG
Drill Rig: CME-55
Casing: 4.25 HAS

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: dedicated bailer for purging, purged 12 gallons; water was turbid, no better than at the start. Well near southern property line near building at 1005 Fuhrmann

Depth to water below is measured from top of riser.



N/A **Top Protective Casing**
+2.45 **Top of Riser**
0'-0" **Ground Surface**

Surface Backfill Material
- ☐ Soil Cuttings
- ☐ Bentonite Slurry
- ☒ Cement/Bentonite Grout
- ☐ Concrete

4.25" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
- ☒ PVC
- ☐ Stainless Steel

Backfill Material **(N/A)**
- ☐ Soil Cuttings
- ☐ Bentonite Slurry
- ☐ Cement/Bentonite Grout
- ☐ Concrete

Depth To:
1 **Top of Seal**

Seal Material
- ☒ Bentonite Chips/Pellets
- ☐ Bentonite Slurry
- ☐ Cement/Bentonite Grout

3 **Top of Filter Pack**

4 **Top of Screen**

Screen Slot Size
- ☒ 010 in
- ☐ 015 in
- ☐ 020 in
- ☐ 025 in

Filter Material
- ☐ 00 Sand Pack
- ☐ 0 Sand Pack
- ☒ 1 Sand Pack
- ☐ 2 Sand Pack
- ☐ 3 Sand Pack
- ☐ 4 Sand Pack

14 **Bottom of Screen**
14 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/18	8:30	9.65		N/A

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GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

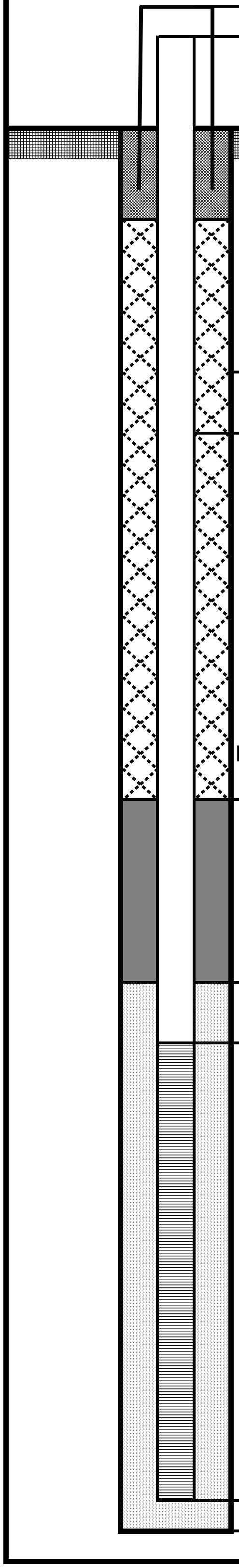
Well No.	**MW6**
Project No.:	J53002002
Surface Elev.:	576 (estimate)
Datum:	
Start Date:	3/16/16
Finish Date:	3/16/15
Inspector:	AD
Drill Rig:	CME-55
Casing:	4.25 HAS

Project Name: Queen City Landing Remedial Investigation
Location: 975 Furhmann Blvd
Client: R&P Oakhill
Drilling Firm: NYEG

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: dedicated bailer for purging, purged 12 gallons; water was turbid, no better than at the start. Well near southern property line near building at 1005 Fuhrmann

Depth to water below is measured from top of riser.



N/A **Top Protective Casing**
+3.1 **Top of Riser**
0'-0" **Ground Surface**

Surface Backfill Material
☐ Soil Cuttings
☐ Bentonite Slurry
☒ Cement/Bentonite Grout
☐ Concrete

4.25" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
☒ PVC
☐ Stainless Steel

Backfill Material **(N/A)**
☐ Soil Cuttings
☐ Bentonite Slurry
☐ Cement/Bentonite Grout
☐ Concrete

Depth To:
0-0.5 **Top of Seal**

Seal Material
☒ Bentonite Chips/Pellets
☐ Bentonite Slurry
☐ Cement/Bentonite Grout

2 **Top of Filter Pack**

3 **Top of Screen**

Screen Slot Size
☒ 010 in
☐ 015 in
☐ 020 in
☐ 025 in

Filter Material
☐ 00 Sand Pack
☐ 0 Sand Pack
☒ 1 Sand Pack
☐ 2 Sand Pack
☐ 3 Sand Pack
☐ 4 Sand Pack

13 **Bottom of Screen**
13 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/18	8:20	8.05		N/A

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GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

Well No.	MW7
Project No.:	J53002002
Surface Elev.:	576 (estimate)
Datum:	
Start Date:	3/17/16
Finish Date:	3/17/15
Inspector:	AD
Drill Rig:	CME-55
Casing:	4.25 HAS

Project Name: Queen City Landing Remedial Investigation

Location: 975 Furhmann Blvd

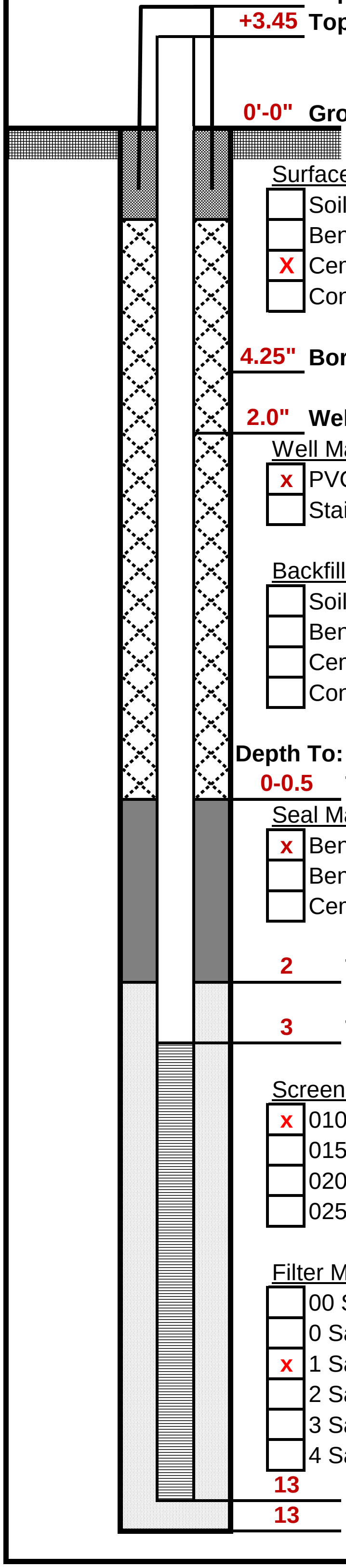
Client: R&P Oakhill

Drilling Firm: NYEG

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: dedicated bailer for purging, purged 15 gallons; water was turbid. Well just north of building at 975.

Depth to water below is measured from top of riser.



N/A **Top Protective Casing**

+3.45 **Top of Riser**

0'-0" **Ground Surface**

Surface Backfill Material
- ☐ Soil Cuttings
- ☐ Bentonite Slurry
- ☒ Cement/Bentonite Grout
- ☐ Concrete

4.25" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
- ☒ PVC
- ☐ Stainless Steel

Backfill Material (N/A)
- ☐ Soil Cuttings
- ☐ Bentonite Slurry
- ☐ Cement/Bentonite Grout
- ☐ Concrete

Depth To:

0-0.5 **Top of Seal**

Seal Material
- ☒ Bentonite Chips/Pellets
- ☐ Bentonite Slurry
- ☐ Cement/Bentonite Grout

2 **Top of Filter Pack**

3 **Top of Screen**

Screen Slot Size
- ☒ 010 in
- ☐ 015 in
- ☐ 020 in
- ☐ 025 in

Filter Material
- ☐ 00 Sand Pack
- ☐ 0 Sand Pack
- ☒ 1 Sand Pack
- ☐ 2 Sand Pack
- ☐ 3 Sand Pack
- ☐ 4 Sand Pack

13 **Bottom of Screen**

13 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/18	8:30	5.95		N/A

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GROUNDWATER OBSERVATION WELL CONSTRUCTION LOG

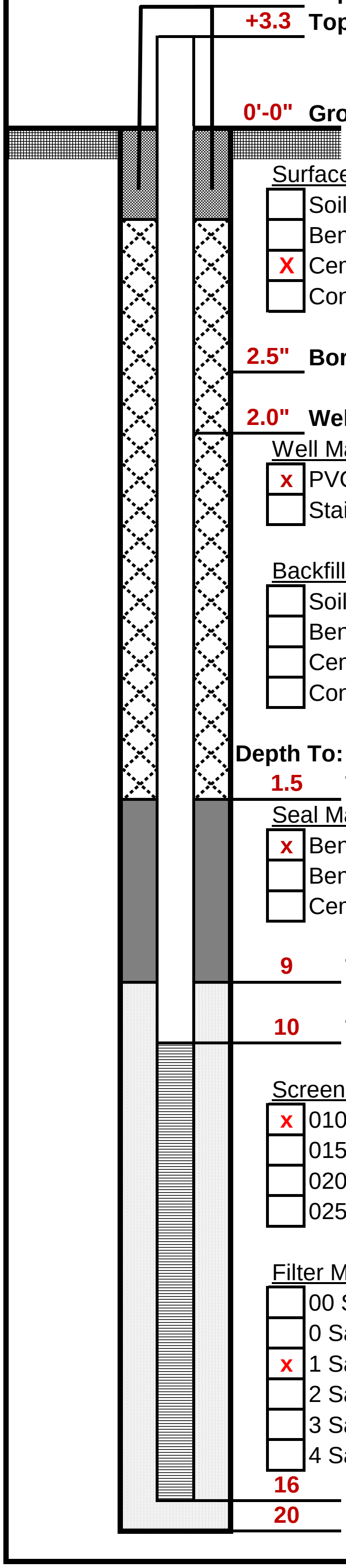
Well No.	**MW8**
Project No.:	J53002002
Surface Elev.:	576 (estimate)
Datum:	
Start Date:	3/23/16
Finish Date:	3/23/16
Inspector:	CM

Project Name: Queen City Landing Remedial Investigation
Location: 975 Furhmann Blvd
Client: R&P Oakhill
Drilling Firm: NYEG
Drill Rig: Geoprobe 7720DT
Casing: 2"

Notes: (provide description of observation well location, method of construction, development method and any other information)

Development Info: dedicated bailer for purging, purged ......gallons; water was turbid. Well just west of building at site.

Depth to water below is measured from top of riser.



N/A **Top Protective Casing**
+3.3 **Top of Riser**
0'-0" **Ground Surface**

Surface Backfill Material
☐ Soil Cuttings
☐ Bentonite Slurry
☒ Cement/Bentonite Grout
☐ Concrete

2.5" **Bore Hole Diameter (ID)**

2.0" **Well Diameter**

Well Material
☒ PVC
☐ Stainless Steel

Backfill Material **(N/A)**
☐ Soil Cuttings
☐ Bentonite Slurry
☐ Cement/Bentonite Grout
☐ Concrete

Depth To:
1.5 **Top of Seal**

Seal Material
☒ Bentonite Chips/Pellets
☐ Bentonite Slurry
☐ Cement/Bentonite Grout

9 **Top of Filter Pack**

10 **Top of Screen**

Screen Slot Size
☒ 010 in
☐ 015 in
☐ 020 in
☐ 025 in

Filter Material
☐ 00 Sand Pack
☐ 0 Sand Pack
☒ 1 Sand Pack
☐ 2 Sand Pack
☐ 3 Sand Pack
☐ 4 Sand Pack

16 **Bottom of Screen**
20 **Bottom of Bore Hole**

Groundwater Measurement Data

Date	Time	Depth to Water	Water Elevation	Tide Status
3/23/16	10:30	8.05		N/A

APPENDIX D

EXCAVATION WORK PLAN

BROWNFIELD CLEANUP PROGRAM SITE MANAGEMENT PLAN

APPENDIX D
EXCAVATION WORK PLAN

QUEEN CITY LANDING
NYSDEC SITE NUMBER: C915304
BUFFALO, NEW YORK

October 2018 0424-017-001

Prepared for:

APARTMENTS AT QUEEN CITY LANDING

Queen City Landing
3275 North Benzing Road
Orchard Park, New York 14127

Prepared By:

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SITE MANAGEMENT PLAN
APPENDIX D: EXCAVATION PLAN
QUEEN CITY LANDING

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D-1 NOTIFICATION

At least 15 days prior to the start of any activity that is anticipated to encounter remaining contamination, the site owner or their representative will notify the NYSDEC. Table D-1 includes contact information for the above notification. The information on this table will be updated as necessary to provide accurate contact information. A full listing of site-related contact information is provided in Appendix B.

Table D-1: Notifications*

NYSDEC Regional HW Engineer Chad Staniszewski, P.E.	716-851-7220 chad.staniszewski@dec.ny.gov
NYSDEC Project Manager Jaspal Walia, P.E.	716-851-7220 jaspal.walia@dec.ny.gov
NYSDEC Site Control Kelly A. Lewandowski, P.E	518-402-9543 kelly.lewandowski@dec.ny.gov

* Note: Notifications are subject to change and will be updated as necessary.

This notification will include:

- A detailed description of the work to be performed, including the location and areal extent of excavation, plans/drawings for site re-grading, intrusive elements or utilities to be installed below the soil cover, estimated volumes of contaminated soil to be excavated and any work that may impact an engineering control;
- A summary of environmental conditions anticipated to be encountered in the work areas, including the nature and concentration levels of contaminants of concern, potential presence of grossly contaminated media, and plans for any pre-construction sampling;
- A schedule for the work, detailing the start and completion of all intrusive work;
- A summary of the applicable components of this EWP;

- A statement that the work will be performed in compliance with this EWP and 29 CFR 1910.120;
- A copy of the contractor's health and safety plan (HASP), in electronic format, if it differs from the HASP provided in Appendix E of this SMP;
- Identification of disposal facilities for potential waste streams; and
- Identification of sources of any anticipated backfill, along with all required chemical testing results.

D-2 SOIL SCREENING METHODS

Visual, olfactory and instrument-based (e.g. photoionization detector) soil screening will be performed by a qualified environmental professional during all excavations into known or potentially contaminated material (remaining contamination). Soil screening will be performed when invasive work is done and will include all excavation and invasive work performed during development, such as excavations for foundations and utility work, after issuance of the COC.

Soils will be segregated based on previous environmental data and screening results into material that requires off-site disposal and material that requires testing to determine if the material can be reused on-site as soil beneath a cover or if the material can be used as cover soil. Further discussion of off-site disposal of materials and on-site reuse is provided in Sections D-6 and D-7, respectively, of this Appendix.

D-3 SOIL STAGING METHODS

Soil stockpiles will be continuously encircled with a berm and/or silt fence. Hay bales will be used as needed near catch basins, surface waters and other discharge points.

Stockpiles will be kept covered at all times with appropriately anchored tarps. Stockpiles will be routinely inspected and damaged tarp covers will be promptly replaced.

Stockpiles will be inspected at a minimum once each week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC.

D-4 MATERIALS EXCAVATION AND LOAD-OUT

A qualified environmental professional or person under their supervision will oversee all invasive work and the excavation and load-out of all excavated material.

The owner of the property and remedial party (if applicable) and its contractors are responsible for safe execution of all invasive and other work performed under this Plan.

The presence of utilities and easements on the site will be investigated by the qualified environmental professional. It will be determined whether a risk or impediment to the planned work under this SMP is posed by utilities or easements on the site.

Loaded vehicles leaving the site will be appropriately lined, tarped, securely covered, manifested, and placarded in accordance with appropriate Federal, State, local, and NYSDOT requirements (and all other applicable transportation requirements).

A truck wash will be operated on-site, as appropriate. The qualified environmental professional will be responsible for ensuring that all outbound trucks will be washed at the truck wash before leaving the site until the activities performed under this section are complete Truck wash waters will be collected and disposed of off-site in an appropriate manner.

Locations where vehicles enter or exit the site shall be inspected daily for evidence of off-site soil tracking.

The qualified environmental professional will be responsible for ensuring that all egress points for truck and equipment transport from the site are clean of dirt and other materials derived from the site during intrusive excavation activities. Cleaning of the adjacent streets will be performed as needed to maintain a clean condition with respect to site-derived materials.

D-5 MATERIALS TRANSPORT OFF-SITE

All transport of materials will be performed by licensed haulers in accordance with appropriate local, State, and Federal regulations, including 6 NYCRR Part 364. Haulers will be appropriately licensed and trucks properly placarded.

Material transported by trucks exiting the site will be secured with tight-fitting covers. Loose-fitting canvas-type truck covers will be prohibited. If loads contain wet material capable of producing free liquid, truck liners will be used.

Truck transport routes shall be selected to involve the shortest commute but are anticipated to follow: Exit Site onto Fuhrmann Boulevard and head south along Fuhrmann Boulevard. In approximately 1 mile at the intersection of Fuhrman Boulevard and Tift Street are the entrances to the north and south bound Route 5. One will be selected based on the location of the destination.

All trucks loaded with site materials will exit the vicinity of the site using only these approved truck routes. This is the most appropriate route and takes into account: (a) limiting transport through residential areas and past sensitive sites; (b) use of city mapped truck routes; (c) prohibiting off-site queuing of trucks entering the facility; (d) limiting total distance to major highways; (e) promoting safety in access to highways; and (f) overall safety in transport.

Trucks will be prohibited from stopping and idling in the neighborhood outside the project site.

Egress points for truck and equipment transport from the site will be kept clean of dirt and other materials during site remediation and development.

Queuing of trucks will be performed on-site in order to minimize off-site disturbance. Off-site queuing will be prohibited.

D-6 MATERIALS DISPOSAL OFF-SITE

All material excavated and removed from the site will be treated as contaminated and regulated material and will be transported and disposed in accordance with all local, State (including 6NYCRR Part 360) and Federal regulations. If disposal of material from this site is proposed for unregulated off-site disposal (i.e. clean soil removed for development purposes), a formal request with an associated plan will be made to the NYSDEC. Unregulated off-site management of materials from this site will not occur without formal NYSDEC approval.

Off-site disposal locations for excavated soils will be identified in the pre-excavation notification. This will include estimated quantities and a breakdown by class of disposal facility if appropriate, i.e. hazardous waste disposal facility, solid waste landfill, petroleum treatment facility, C/D recycling facility, etc. Actual disposal quantities and associated documentation will be reported to the NYSDEC in the Periodic Review Report. This documentation will include: waste profiles, test results, facility acceptance letters, manifests, bills of lading, and facility receipts.

Non-hazardous historic fill and contaminated soils taken off-site will be handled, at minimum, as a Municipal Solid Waste per 6NYCRR Part 360-1.2. Material that does not meet Unrestricted SCOs is prohibited from being taken to a New York State recycling facility (6NYCRR Part 360-16 Registration Facility).

D-7 MATERIALS REUSE ON-SITE

The qualified environmental professional will ensure that procedures defined for materials reuse in this SMP are followed and that unacceptable material does not remain on-site. Contaminated on-site material, including historic fill and contaminated soil, that is acceptable for reuse on-site will be placed below the demarcation layer or impervious surface, and will not be reused within a cover soil layer, within landscaping berms, or as backfill for subsurface utility lines.

Any demolition material proposed for reuse on-site will be sampled for asbestos and the results will be reported to the NYSDEC for acceptance. Concrete crushing or processing on-site will not be performed without prior NYSDEC approval. Organic matter (wood, roots, stumps, etc.) or other solid waste derived from clearing and grubbing of the site will not be reused on-site.

D-8 FLUIDS MANAGEMENT

All liquids to be removed from the site, including but not limited to, excavation dewatering, decontamination waters and groundwater monitoring well purge and development waters, will be handled, transported and disposed in accordance with applicable local, State, and Federal regulations. Dewatering, purge, and development fluids will not be recharged back to the land surface or subsurface of the site, and will be managed off-site, unless prior approval is obtained from NYSDEC.

Discharge of water generated during large-scale construction activities to surface waters (i.e. a local pond, stream, or river) will be performed under a SPDES permit.

D-9 COVER SYSTEM RESTORATION

After the completion of soil/fill removal and any other invasive activities the cover system will be restored in a manner that complies with the Decision Document. The existing cover system is comprised of a minimum of 24-inches of clean soil and a minimum of 6-inches of hardscape (e.g., asphalt pavement, concrete covered sidewalks and concrete building, etc.). The demarcation layer, consisting of orange mesh material or equivalent material will be replaced to provide a visual reference to the top of the remaining contamination zone, the zone that requires adherence to special conditions for disturbance of remaining contaminated soils defined in this SMP. If the type of cover system changes from that which exists prior to the excavation (i.e., a soil cover is replaced by asphalt), this will constitute a modification of the cover element of the remedy and the upper surface of the remaining contamination. A figure showing the modified surface will be included in the subsequent Periodic Review Report and in an updated SMP.

D-10 BACKFILL FROM OFF-SITE SOURCES

All materials proposed for import onto the site will be approved by the qualified environmental professional and will be in compliance with provisions in this SMP prior to receipt at the site. A Request to Import/Reuse Fill or Soil form, which can be found at **http://www.dec.ny.gov/regulations/67386.html**, will be prepared and submitted to the NYSDEC project manager allowing a minimum of 5 business days for review.

Material from industrial sites, spill sites, or other environmental remediation sites or potentially contaminated sites will not be imported to the site.

All imported soils will meet the backfill and cover soil quality standards established in 6NYCRR 375-6.7(d). Based on an evaluation of the land use, protection of groundwater and protection of ecological resources criteria, the resulting soil quality standards are listed in Table 8. Soils that meet ‘exempt’ fill requirements under 6 NYCRR Part 360, but do not meet backfill or cover soil objectives for this site, will not be imported onto the site without prior approval by NYSDEC. Solid waste will not be imported onto the site.

The specific criteria under which off-site material may be used as cover or backfill are presented below.

- **Off-Site Soil:** Off-Site soil may be used as backfill provided that it originates from: 1) an NYSDEC-approved borrow site; or 2) a known source having no evidence of disposal or releases of hazardous substances, hazardous, toxic, radioactive wastes, or petroleum. In both instances the imported soil must be tested as discussed herein and demonstrated to meet restricted-residential SCOs or lesser as published in 6NYCRR Part 375-6.8(b). In addition, no off-site materials meeting the definition of a solid waste as defined in 6NYCRR, Part 360-1.2 (a) shall be used as backfill.

- **Other Off-Site Material:** Certain material may be imported as backfill or cover, without chemical testing, provided it contains less than 10% (by weight) material that would pass through a size 80 sieve: 1) Rock or stone, consisting of virgin material from a permitted mine or quarry; 2) steel slag under BUD#555-9-152; 3) Recycled concrete, brick, or asphalt from a NYSDEC-registered or permitted construction and demolition (C&D) debris processing facility (as specified in Section 360-16.1 of 6NYCRR Part 360) that conforms to Section 304 of the New York State Department of Transportation Standard Specifications Construction and Materials Volume 1 (2002). As stated in Section 360-16.4(b)(2), the facility may only accept recognizable, uncontaminated, non-pulverized C&D debris or C&D debris from other authorized C&D processing facilities. According to Section 360-16.2(c), "uncontaminated" means C&D debris that is not mixed or commingled with other solid waste at the point of generation, processing, or disposal, and that is not contaminated with spills of a petroleum product, hazardous waste, or industrial waste.

D-10.1 Quality Assurance Requirements

The contractor will be required to collect the specified number of samples and submit the samples to an independent, NYSDOH ELAP-certified laboratory for analysis. The NYSDEC will be notified of the sampling and provided an opportunity to observe the sample collection work.

All analyses will be in accordance with USEPA SW-846 methodology. The laboratory data package will be a Category A deliverable; however, the NYSDEC may request, at any time, to upgrade the deliverable to Category B. Each import soil source shall be analyzed for the following parameters as more specifically listed in 6NYCRR Part 375-6:

- VOCs – Method 8260
- SVOCs – Method 8270
- Organochlorine Pesticides and PCBs – Method 8081/8082
- Metals, excluding mercury – Method 6010
- Mercury – Method 7471
- Cyanide – Method 9013

Each import soil source shall be subject to testing in accordance with the following schedule per NYSDEC DER-10 Table 5.4(e)10:

Contaminant:	**VOCs**	**SVOCs, Inorganics & PCBs/Pesticides**	
Soil Quantity (cubic yards)	**Discrete Samples**	**Composite**	**Discrete Samples/Composite**
0-50	1	1	3-5 discrete samples from different locations in the fill being provided will comprise a composite sample for analysis
50-100	2	1	
100-200	3	1	
200-300	4	1	
300-400	4	2	
400-500	5	2	
500-800	6	2	
800-1,000	7	2	
1,000 or greater	Add an additional 2 VOC and 1 composite for each additional 1,000 cubic yards or consult with DER		

Grab samples will be required for VOC analysis. For all other required analyses, a minimum of four grab samples will be collected to form a single composite sample. Approximately equal aliquots of the grab samples will be composited in the field using a stainless steel trowel and bowl. The trowel and bowl shall be decontaminated with a non-phosphate detergent (e.g., Alconox®) and potable water wash solution followed by a distilled water rinse between sampling locations).

Import criteria are restricted-residential SCOs or lesser as published in 6NYCRR Part 375-6.8(b).

Trucks entering the site with imported soils will be securely covered with tight fitting covers. Imported soils will be stockpiled separately from excavated materials and covered to prevent dust releases.

D-11 STORMWATER POLLUTION PREVENTION

Barriers and hay bale checks will be installed and inspected once a week and after every storm event. Results of inspections will be recorded in a logbook and maintained at the site and available for inspection by the NYSDEC. All necessary repairs shall be made immediately.

Accumulated sediments will be removed as required to keep the barrier and hay bale check functional.

All undercutting or erosion of the silt fence toe anchor shall be repaired immediately with appropriate backfill materials.

Manufacturer's recommendations will be followed for replacing silt fencing damaged due to weathering.

Erosion and sediment control measures identified in the SMP shall be observed to ensure that they are operating correctly. Where discharge locations or points are accessible, they shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters.

Silt fencing or hay bales will be installed around the entire perimeter of the construction area.

D-12 EXCAVATION CONTINGENCY PLAN

If underground tanks or other previously unidentified contaminant sources are found during post-remedial subsurface excavations or development related construction, excavation activities will be suspended until sufficient equipment is mobilized to address the condition.

Sampling will be performed on product, sediment and surrounding soils, etc. as necessary to determine the nature of the material and proper disposal method. Chemical analysis will be performed for a full list of analytes (TAL metals; TCL volatiles and semi-volatiles, TCL pesticides and PCBs), unless the site history and previous sampling results provide a sufficient justification to limit the list of analytes. In this case, a reduced list of analytes will be proposed to the NYSDEC for approval prior to sampling.

Identification of unknown or unexpected contaminated media identified by screening during invasive site work will be promptly communicated by phone to NYSDEC's Project Manager. Reportable quantities of petroleum product will also be reported to the NYSDEC spills hotline. These findings will be also included in the Periodic Review Report.

D-13 COMMUNITY AIR MONITORING PLAN

A figure showing the location of air sampling station based on generally prevailing wind conditions (southwesterly) is shown in Figure 2. The location will be adjusted on a daily or more frequent basis based on actual wind directions to provide an upwind and at least two downwind monitoring stations.

Exceedances of action levels listed in the CAMP will be reported to NYSDEC and NYSDOH Project Managers.

D-14 ODOR CONTROL PLAN

This odor control plan is capable of controlling emissions of nuisance odors at on and off-site locations. Specific odor control methods to be used on a routine basis will include foam suppressants, if necessary. If nuisance odors are identified at the Site boundary, or if odor complaints are received, work will be halted and the source of odors will be identified and corrected. Work will not resume until all nuisance odors have been abated. NYSDEC and NYSDOH will be notified of all odor events and of any other complaints about the project. Implementation of all odor controls, including the halt of work, is the responsibility of the remedial party's Remediation Engineer, and any measures that are implemented will be discussed in the Periodic Review Report.

All necessary means will be employed to prevent on- and off-site nuisances. At a minimum, these measures will include: (a) limiting the area of open excavations and size of soil stockpiles; (b) shrouding open excavations with tarps and other covers; and (c) using foams to cover exposed odorous soils. If odors develop and cannot be otherwise controlled, additional means to eliminate odor nuisances will include: (d) direct load-out of soils to trucks for off-site disposal; (e) use of chemical odorants in spray or misting systems; and, (f) use of staff to monitor odors in surrounding neighborhoods.

If nuisance odors develop during intrusive work that cannot be corrected, or where the control of nuisance odors cannot otherwise be achieved due to on-site conditions or close proximity to sensitive receptors, odor control will be achieved by sheltering the excavation and handling areas in a temporary containment structure equipped with appropriate air venting/filtering systems.

D-15 DUST CONTROL PLAN

A dust suppression plan that addresses dust management during invasive on-site work will include, at a minimum, the items listed below:

- Dust suppression will be achieved through the use of a dedicated on-site water truck for road wetting. The truck will be equipped with a water cannon capable of spraying water directly onto off-road areas including excavations and stockpiles.
- Clearing and grubbing of larger sites will be done in stages to limit the area of exposed, unvegetated soils vulnerable to dust production.
- Gravel will be used on roadways to provide a clean and dust-free road surface.
- On-site roads will be limited in total area to minimize the area required for water truck sprinkling.

D-16 OTHER NUISANCES

A plan for rodent control will be developed and utilized by the contractor prior to and during site clearing and site grubbing, and during all remedial work.

A plan will be developed and utilized by the contractor for all remedial work to ensure compliance with local noise control ordinances.

APPENDIX E

HEALTH & SAFETY PLAN

SITE HEALTH AND SAFETY PLAN
for
BROWNFIELD CLEANUP PROGRAM BCP ACTIVITIES

QUEEN CITY LANDING SITE

BUFFALO, NEW YORK

October 2017 0424-017-001

Prepared for:

QUEEN CITY LANDING, LLC

Prepared by:

BENCHMARK
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QUEEN CITY LANDING SITE
HEALTH AND SAFETY PLAN FOR RI ACTIVITIES

ACKNOWLEDGEMENT

Plan Reviewed by (initial):

Corporate Health and Safety Director: Thomas H. Forbes, P.E.

Project Manager: Christopher Boron.

Designated Site Safety and Health Officer: Christopher Boron

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

QUEEN CITY LANDING SITE
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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 Benchmark Environmental Engineering & Science, PLLC and TurnKey Environmental Restoration, LLC employees (referred to jointly hereafter as "Benchmark-TurnKey") during Brownfield Cleanup Program (BCP) redevelopment activities at the Queen City Landing Site (Site) located in the City of Buffalo, Erie County, New York. This HASP presents procedures for Benchmark-TurnKey employees who will be involved with BCP redevelopment 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. Benchmark-TurnKey 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 Site is located in Buffalo, Erie County, New York and is identified as the eastern portion of Section 132.06 Block 1 and Lot 1.1 (975 Fuhrmann Boulevard, 7.24 acres) and Section 132.06 Block 1 and Lot 1.2 (1005 Fuhrmann Boulevard, 0.48 acres) on the Erie County Tax Map (see Figure 3). The site is an approximately 7.72-acres and is bounded by commercial property used for boat storage to the north, Lake Erie/Small boat Harbor to the south, Fuhrmann Boulevard to the east, and vacant land/Lake Erie to the west.

The Site is the former Freezer Queen facility and operated as a warehouse and manufacturer of frozen foods for approximately 75 years, when food operations ceased in 2004. The Site is undergoing redevelopment for a mixed residential and commercial use. The former structures have been demolished and the Site has been covered/grades raised to prepare for redevelopment activities. The Site was re-zoned in 2008 from M3 - Heavy

Industrial to CM – General Commercial and this revised zoning is grandfathered from the terms of the City of Buffalo Green Code. There are no Site occupants at the time of the submittal of this SMP, but after redevelopment the anticipated occupants will be residential along with associated amenities (restaurant, and other commercial entities).

1.3 Parameters of Interest

Previous investigations and remedial actions completed at the Site have identified contaminants at the Site, as follows.

- Polycyclic aromatic hydrocarbons (PAHs) have been identified in some of the soil/fill present in the Site.
- Metal analytes, particularly mercury, have been detected in the soil/fill present at the Site.

1.4 Overview of BCP Redevelopment Activities

Benchmark-TurnKey personnel will be on-site to assist, as necessary, with BCP redevelopment activities that require the implementation of the Site Management Plan. These activities could include:

1. **Test Pit or Excavations that penetrate the Cover System**.
2. **Removal of Concrete Foundations**.
3. **Import of Backfill Materials for use a Fill at the Site requiring Analytical Sampling**.
4. **Export of Materials from the Site that will require Analytical Sampling.**
5. **Community Air Monitoring while Excavating Potentially Impacted Materials.**

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 Benchmark-Turnkey 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 Benchmark-TurnKey Corporate Health and Safety Director is ***Mr. Thomas Forbes, P.E.***. The Corporate Health and Safety Director is 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 Benchmark-TurnKey'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. Christopher Boron.*** The Project Manager has the responsibility and authority to direct all Benchmark-TurnKey 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 Benchmark-TurnKey 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. Christopher Boron***. 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 Benchmark-TurnKey personnel on the Site.
- Serving as the point of contact for safety and health matters.
- Ensuring that Benchmark-TurnKey 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 Benchmark-TurnKey's HASP. Benchmark-TurnKey assumes no responsibility for the health and safety of anyone outside its direct employ. Each Contractor's HASP shall cover all non-Benchmark/TurnKey Site personnel. Each Contractor shall assign a SSHO who will coordinate with Benchmark-TurnKey's SSHO as necessary to ensure effective lines of communication and consistency between contingency plans.

In addition to Benchmark-TurnKey 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, parameters of interest have been identified through investigation and remedial activities. Table 1 lists exposure limits for airborne concentrations of the parameters of interest in Section 1.3 of this HASP. Brief descriptions of the toxicology of the prevalent COPCs and related health and safety guidance and criteria are provided below.

- **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.
- **Cadmium (CAS # 7440-43-9)** 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 a natural inorganic element and is usually combined with one or more elements, such as oxygen, chloride or sulfur. The common forms of chromium are hexavalent (CR+6) and trivalent (CR+3). The hexavalent form is associated with significantly greater potential health impacts than the trivalent form. 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.
- **Mercury (CAS #7439-97-6)** is used in industrial applications for the production of caustic and chlorine, and in electrical control equipment and apparatus. Over-exposure to mercury may cause coughing, chest pains, bronchitis, pneumonia, indecision, headaches, fatigue and salivation. Mercury is a skin and eye irritant.

With respect to the anticipated BCP redevelopment activities discussed in Section 1.4, 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

Redevelopment activities at the Queen City Landing Site may present the following physical hazards:

- The potential for physical injury during heavy construction equipment use, such as backhoes, excavators and truck traffic.
- 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 redevelopment 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

Benchmark-TurnKey and other construction-related personnel performing BCP-related activities at the Site 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. General construction or other Site personnel that are not expected to be engaged in redevelopment activities involving hazardous waste and/or hazardous substance operations will not be required to have training in accordance with 29 CFR 1910.120(e).

The 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 Benchmark-TurnKey'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 Site visitors and other non-Benchmark/TurnKey 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 Benchmark-TurnKey employees as stipulated under 29 CFR Part 1910.120(f). These exams include initial employment, annual and employment termination physicals for all Benchmark-TurnKey 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 Benchmark-TurnKey. 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 Benchmark-TurnKey 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, Benchmark-TurnKey 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 Benchmark-TurnKey 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 Benchmark-TurnKey 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 Benchmark-TurnKey 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, Benchmark-TurnKey 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 previous investigations and the nature of the redevelopment activities at the Site, the possibility exist that organic vapors and/or particulates may be released to the air during intrusive activities that penetrate the cover system that was installed as part of the BCP remedial work.

8.1.1 On-Site Work Zone Monitoring

Benchmark-TurnKey personnel will conduct routine, real-time air monitoring during intrusive construction activities that involve penetration of the cover system, only. The work area will be monitored at regular intervals using a photo-ionization detector (PID) 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 Benchmark-TurnKey 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 downwind portion of the Site perimeter will be conducted during intrusive construction activities that involve penetration of the cover system, only. 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 that involve the penetration of the cover system include excavation, test pitting, or trenching, and the removal of building foundations and basement floors.

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 Benchmark-TurnKey personnel to monitor organic vapor concentrations as specified in this HASP. Fugitive dust/particulate concentrations will be monitored during major soil intrusion of soil/fill present beneath the cover system 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 Benchmark-TurnKey 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 intrusive activities that involve handling of Site soil/fill located beneath the cover system. 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. 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 Benchmark-TurnKey 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 sustained organic vapor level is above 25 ppm 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.
- **ORGANIC VAPOR CONTINGENCY MONITORING PLAN:**
    - If the sustained organic vapor level is greater than 5 ppm 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, sustained organic levels persist above 5 ppm 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 sustained 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 MAJOR VAPOR EMISSION RESPONSE PLAN:

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 sustained 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.

o AIRBORNE PARTICULATE COMMUNITY AIR MONITORING

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 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 Appendix A 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 Benchmark-TurnKey employees. The Site Safety and Health Officer and/or his or her designee will be responsible for monitoring Benchmark-TurnKey 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 Benchmark-TurnKey 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 BCP related activities will be established on a daily basis and communicated to employees and other Site users by the SSHO. It shall be each Contractor's Site Safety and Health Officer's responsibility to ensure that 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 Benchmark-TurnKey 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 Benchmark-TurnKey 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 Benchmark-TurnKey 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.

Benchmark-TurnKey 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 Benchmark-TurnKey employees is not anticipated to be necessary to complete the RI 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 Benchmark-TurnKey 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 Benchmark-TurnKey's corporate Health and Safety Director. Benchmark-TurnKey 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.

TABLES

TABLE 1

TOXICITY DATA FOR CONSTITUENTS OF POTENTIAL CONCERN

Site Health & Safety Plan
Queen City Landing
Buffalo, New York

Parameter	Synonyms	CAS No.	Code	Concentration Limits [1]		
				PEL	TLV	IDLH
Polycyclic Aromatic Hydrocarbons (PAHs): ppm						
Benz(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*	--	--	--
Benzo(g,h,i)perylene	*none*	191-24-2	*none*	--	--	--
Fluoranthene	*none*	206-44-0	*none*	--	--	--
Phenanthrene	*none*	85-01-8	*none*	--	--	--
Indeno(1,2,3-cd)pyrene	*none*	193-39-5	*none*	--	--	--
Inorganic Compounds: mg/m^3						
Arsenic	*none*	7440-38-2	*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	0.5	250
Lead	*none*	7439-92-1	*none*	0.05	0.15	100
Mercury	*none*	7439-97-6	C-0.1	0.1	0.05	10

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:

C-## = Ceiling Level equals the maximum exposure concentration allowable during the work day.

IDLH = Immediately Dangerous to Life or Health.

TLV = Threshold Limit Value, established by American Conference of Industrial Hygienists (ACGIH), equals the maximum exposure concentration allowable for 8 hours/day @ 40 hr

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

Site Health & Safety Plan
Queen City Landing
Buffalo, New York

Activity [1]	Direct Contact with Soil/Fill	Inhalation of Vapors or Dust
Redevelopment Activities That May Penetrate the Cover System		
Test Pit or Excavations that penetrate the Cover System to Remove Soil Beneath	x	x
Removal of Concrete Foundations	x	x
Import of Backfill Materials for use a Fill at the Site requiring Analytical Sampling	x	x
Export of Materials from the Site that will require Analytical Sampling	x	x
Community Air Monitoring while Excavating Potentially Impacted Materials	x	x

Notes:

1. Activity as described in Section 1.4 of the Health and Safety Plan.

TABLE 3

REQUIRED LEVELS OF PROTECTION FOR BCP REDEVELOPMENT TASKS

Site Health & Safety Plan
Queen City Landing
Buffalo, New York

Activity	Respiratory Protection [1]	Clothing	Gloves [2]	Boots [2, 3]	Other Required PPE/Modifications [2, 4]
Remedial Investigation Tasks					
Test Pit or Excavations that penetrate the Cover System to Remove Soil Beneath	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
Removal of Concrete Foundations	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	SGSS
Import of Backfill Materials for use a Fill at the Site requiring Analytical Sampling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	SGSS
Export of Materials from the Site that will require Analytical Sampling	Level D (upgrade to Level C if necessary)	Work Uniform or Tyvek	L/N	outer: L inner: STSS	HH SGSS
Community Air Monitoring while Excavating Potentially Impacted Materials	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

F:\CAD\Benchmark\Queen City Landing\SMP\Figure 1; Site Location and Vicinity Map.dwg, DWG To PDF.pc3

FIGURE 1

SCALE: 1 INCH = 2,500 FEET
SCALE IN FEET
(approximate)

LEGEND:

🟥 BCP SITE BOUNDARY

*BASEMAP ADAPTED FROM BING MAPS

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

PROJECT NO.: 0424-017-001

DATE: OCTOBER 2017

DRAFTED BY: RFL

SITE LOCATION AND VICINITY MAP

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

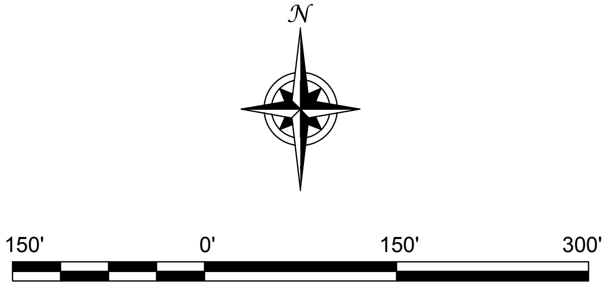
QUEEN CITY LANDING SITE
BCP SITE NO. 915304
BUFFALO, NEW YORK
PREPARED FOR
QUEEN CITY LANDING, LLC

F:\CAD\Benchmark\Queen City Landing\SMP\Figure 2; Site Layout Map.dwg, DWG To PDF.pc3

LEGEND:

🟥 BCP SITE BOUNDARY

NOTES:
1. AERIAL IMAGE FROM GOOGLE EARTH PRO 2015.



SCALE: 1 INCH = 150 FEET
SCALE IN FEET
(approximate)

DATE: OCTOBER 2017
DRAFTED BY: RFL

BENCHMARK
ENVIRONMENTAL
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SCIENCE, PLLC

2558 HAMBURG TURNPIKE
SUITE 300
BUFFALO, NY 14218
(716) 856-0599

JOB NO.: 0424-017-001

SITE LAYOUT MAP

SITE MANAGEMENT PLAN
BROWNFIELD CLEANUP PROGRAM

QUEEN CITY LANDING SITE
BCP SITE NO. C915304
BUFFALO, NEW YORK
PREPARED FOR
QUEEN CITY LANDING, LLC

FIGURE 2

ATTACHMENT A

EMERGENCY RESPONSE PLAN

EMERGENCY RESPONSE PLAN
for
BROWNFIELD CLEANUP PROGRAM ACTIVITIES

QUEEN CITY LANDING SITE
BUFFALO, NEW YORK

October 2017 0424-017-001

Prepared for:

QUEEN CITY LANDING, LLC

Prepared by:

BENCHMARK
ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

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QUEEN CITY LANDING SITE
HEALTH AND SAFETY PLAN FOR BCP ACTIVITIES
APPENDIX A: EMERGENCY RESPONSE PLAN

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LIST OF FIGURES

1.0 GENERAL

This report presents the site-specific Emergency Response Plan (ERP) referenced in the Site Health and Safety Plan (HASP) prepared for Brownfield Cleanup Program related activities at the Queen City Landing Site in Buffalo, 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	1 (minimum)	All heavy equipment and 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 Benchmark personnel field vehicle.

5.0 EMERGENCY CONTACTS

The following identifies the emergency contacts for this ERP.

Emergency Telephone Numbers:

Project Manager: ***Christopher Boron***
Work: (716) 856-0599
Mobile: (716) 846-2726

Corporate Health and Safety Director: ***Thomas H. Forbes, P.E.***
Work: (716) 856-0599
Mobile: (716) 864-1730

Site Safety and Health Officer (SSHO): ***Christopher Boron***
Work: (716) 856-0599
Mobile: (716) 864-2726

Alternate SSHO: ***Nathan Munley***
Work: (716) 856-0635
Mobile: (716) 289-1072

MERCY HOSPITAL (ER):	(716) 826-7000
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:

975 and 1005 Fuhrmann Boulevard
Buffalo, New York 14203
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 <u>must</u> 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 Benchmark-TurnKey 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 (***Christopher***

Boron 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 Mercy Hospital (see Figure 1):

The following directions describe the best route from the Site to Buffalo General Hospital:

- Travel south along Fuhrmann Boulevard for 1.0 mile
- Turn left on Tift Street and travel 3.7 miles
- Turn right on McKinley Parkway and travel for 0.1 miles
- Turn left onto Lorraine Avenue and travel (0.2 miles)
- Hospital on the right (565 Abbott Rd, Buffalo, NY 14220)

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

ATTACHMENT B

HOT WORK PERMIT FORM

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

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 1A
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 1B
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 F

SITE MANAGEMENT FORMS

New York State Department of Environmental Conservation
Division of Environmental Remediation, 11th Floor
625 Broadway, Albany, New York 12233-7011
Phone: (518) 402-9553 **Fax:** (518) 402-9577
Website: www.dec.ny.gov

45-Day Reminder Notice: Site Management Periodic Review

,

September 29, 2009
Site Name:
Site No.:
Site Address:
, NY

Dear :

This is a reminder that as part of the last phase of a site's remedial program (i.e., "Site Management" (SM)), a progress report for your site is to be submitted by you, the site owner or Remedial Party, to the New York State Department of Environmental Conservation (Department) by . This report, now referred to as the Periodic Review Report (PRR) documents the implementation of and compliance with the Site Management requirements for this site. SM is a concept defined in regulation (6 NYCRR 375-1.2(at)). A suggested outline for the PRR is enclosed. If the site is comprised of multiple properties or parcels, then you as the owner or Remedial Party must arrange to submit one PRR for all parcels that comprise the site.

Depending on the age of the remedial program for your site, the document(s) governing SM for your site will be different. Previously, SM requirements were contained in separate documents with specific titles (e.g., Operation, Maintenance, and Monitoring Plan or Soil Management Plan) and are now being incorporated into one comprehensive "Site Management Plan" (SMP). A SMP may contain one or all of the following elements as applicable to the site; a plan to maintain institutional and/or engineering controls ("IC/EC Plan"), a plan for monitoring the performance and effectiveness of the selected remedy ("Monitoring Plan"), and/or a plan for the operation and maintenance of the selected remedy ("O&M Plan"). Additionally, the requirements for SM are normally stated in the decision document (e.g., Record of Decision) and/or the legal agreement directing the remediation of the site (e.g., order on consent, voluntary agreement, etc.).

When you submit the PRR (by the due date above), please sign and include the enclosed forms documenting that all SM requirements are being met. If there is some reason you cannot certify that all SM requirements are being met, you should indicate this and include a statement of explanation in the PRR with a schedule for addressing the problem(s). The Periodic Review process will not be considered complete until all necessary corrective measures are completed and any required controls are certified. Instructions for completing the certifications are enclosed.

Enclosures

ec: , Project Manager
, Bureau Director
Hazardous Waste Remediation Engineer, Region
Gary Litwin, DOH

cc:

Enclosure
Periodic Review Report (PRR) General Guidance

I. Introduction: (½-page or less)

- A. Provide a brief summary of site, nature and extent of contamination, and remedial history.
- B. Effectiveness of the Remedial Program - Provide overall conclusions regarding;
    1. progress made during the reporting period toward meeting the remedial objectives for the site
    2. the ultimate ability of the remedial program to achieve the remedial objectives for the site.
- C. Compliance
    1. Identify any areas of non-compliance regarding the major elements of the Site Management Plan (SMP, i.e., the Institutional/Engineering Control (IC/EC) Plan, the Monitoring Plan, and the Operation & Maintenance (O&M) Plan).
    2. Propose steps to be taken and a schedule to correct any areas of non-compliance.
- D. Recommendations
    1. recommend whether any changes to the SMP are needed
    2. recommend any changes to the frequency for submittal of PRRs (increase, decrease)
    3. recommend whether the requirements for discontinuing site management have been met.

II. Site Overview (one page or less)

- A. Describe the site location, boundaries (figure), significant features, surrounding area, and the nature and extent of contamination prior to site remediation.
- B. Describe the chronology of the main features of the remedial program for the site, the components of the selected remedy, cleanup goals, site closure criteria, and any significant changes to the selected remedy and site that have been made since remedy selection.

III. Evaluate Remedy Performance, Effectiveness, and Protectiveness

- A. Using tables, graphs, charts and bulleted text to the extent practicable, describe the effectiveness of the remedy in achieving the remedial goals for the site. Base findings, recommendations, and conclusions on objective data. Evaluations should be presented simply and concisely.

IV. IC/EC Plan Compliance Report (if applicable)

- A. IC/EC Requirements and Compliance
    1. Describe each control, its objective, and how performance of the control is evaluated.
    2. Summarize the status of each goal (whether it is fully in place and its effectiveness).
    3. Corrective Measures: describe steps proposed to address any deficiencies in ICECs.
    4. Conclusions and recommendations for changes.
- B. IC/EC Certification
    1. The certification must be complete (even if there are IC/EC deficiencies), and certified by the appropriate party as set forth in a Department-approved certification form(s).

V. Monitoring Plan Compliance Report (if applicable)

- A. Components of the Monitoring Plan (tabular presentations preferred) - Describe the requirements of the monitoring plan by media (i.e., soil, groundwater, sediment, etc.) and by any remedial technologies being used at the site.
- B. Summary of Monitoring Completed During Reporting Period - Describe the monitoring tasks actually completed during this PRR reporting period. Tables and/or figures should be used to show all data.
- C. Comparisons with Remedial Objectives - Compare the results of all monitoring with the remedial objectives for the site. Include trend analyses where possible.
- D. Monitoring Deficiencies - Describe any ways in which monitoring did not fully comply with the monitoring plan.
- E. Conclusions and Recommendations for Changes - Provide overall conclusions regarding the monitoring completed and the resulting evaluations regarding remedial effectiveness.

VI. Operation & Maintenance (O&M) Plan Compliance Report (if applicable)

- A. Components of O&M Plan - Describe the requirements of the O&M plan including required activities, frequencies, recordkeeping, etc.
- B. Summary of O&M Completed During Reporting Period - Describe the O&M tasks actually completed during this PRR reporting period.
- C. Evaluation of Remedial Systems - Based upon the results of the O&M activities completed, evaluated the ability of each component of the remedy subject to O&M requirements to perform as designed/expected.
- D. O&M Deficiencies - Identify any deficiencies in complying with the O&M plan during this PRR reporting period.
- E. Conclusions and Recommendations for Improvements - Provide an overall conclusion regarding O&M for the site and identify problems, their severity, and any suggested improvements requiring changes in the O&M Plan.

VII. Overall PRR Conclusions and Recommendations

- A. Compliance with SMP - For each component of the SMP (i.e., IC/EC, monitoring, O&M), summarize;
  1. whether all requirements of each plan were met during the reporting period
  2. any requirements not met such as new completed exposure pathways resulting in unacceptable risk
  3. proposed plans and a schedule for coming into full compliance.
- B. Performance and Effectiveness of the Remedy - Based upon your evaluation of the components of the SMP, form conclusions about the performance of each component and the ability of the remedy to achieve the remedial objectives for the site.
- C. Future PRR Submittals
  1. Recommend, with supporting justification, whether the frequency of the submittal of PRRs should be changed (either increased or decreased).
  2. If the requirements for site closure have been achieved, contact the Department's Project Manager for the site to determine what, if any, additional documentation is needed to support a decision to discontinue site management.

VIII. Additional Guidance

- A. Additional guidance regarding the preparation and submittal of an acceptable PRR can be obtained from the Department's Project Manager for the site.

WHERE to mail the signed Certification Form by :

New York State Department of Environmental Conservation

Attn: , Project Manager

Please note that extra postage may be required.

Enclosure 1
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Site Management Periodic Review Report Notice
Institutional and Engineering Controls Certification Form

Site Details **Box 1**

Site No.

Site Name

Site Address: Zip Code:
City/Town:
County:
Allowable Use(s) (if applicable, does not address local zoning):
Site Acreage:
Owner:
, , NY

Reporting Period: to

Box 2

Verification of Site Details

	YES	NO
1. Is the information in Box 1 correct?	☐	☐
If NO, are changes handwritten above or included on a separate sheet?	☐	
2. Has some or all of the site property been sold, subdivided, merged, or undergone a tax map amendment during this Reporting Period?	☐	☐
If YES, is documentation or evidence that documentation has been previously submitted included with this certification?	☐	
3. Have any federal, state, and/or local permits (e.g., building, discharge) been issued for or at the property during this Reporting Period?	☐	☐
If YES, is documentation (or evidence that documentation has been previously submitted) included with this certification?	☐	
4. If use of the site is restricted, is the current use of the site consistent with those restrictions?	☐	☐
If NO, is an explanation included with this certification?	☐	
5. For non-significant-threat Brownfield Cleanup Program Sites subject to ECL 27-1415.7(c), has any new information revealed that assumptions made in the Qualitative Exposure Assessment regarding offsite contamination are no longer valid?	☐	☐
If YES, is the new information or evidence that new information has been previously submitted included with this Certification?	☐	
6. For non-significant-threat Brownfield Cleanup Program Sites subject to ECL 27-1415.7(c), are the assumptions in the Qualitative Exposure Assessment still valid (must be certified every five years)?	☐	☐
If NO, are changes in the assessment included with this certification?	☐	

SITE NO. Box 3

Description of Institutional Controls

Box 4

Description of Engineering Controls

Box 5

Periodic Review Report (PRR) Certification Statements

1. I certify by checking "YES" below that:

   a) the Periodic Review report and all attachments were prepared under the direction of, and reviewed by, the party making the certification;

   b) to the best of my knowledge and belief, the work and conclusions described in this certification are in accordance with the requirements of the site remedial program, and generally accepted engineering practices; and the information presented is accurate and compete.

   YES NO

   ☐ ☐

2. If this site has an IC/EC Plan (or equivalent as required in the Decision Document), for each Institutional or Engineering control listed in Boxes 3 and/or 4, I certify by checking "YES" below that all of the following statements are true:

   (a) the Institutional Control and/or Engineering Control(s) employed at this site is unchanged since the date that the Control was put in-place, or was last approved by the Department;

   (b) nothing has occurred that would impair the ability of such Control, to protect public health and the environment;

   (c) access to the site will continue to be provided to the Department, to evaluate the remedy, including access to evaluate the continued maintenance of this Control;

   (d) nothing has occurred that would constitute a violation or failure to comply with the Site Management Plan for this Control; and

   (e) if a financial assurance mechanism is required by the oversight document for the site, the mechanism remains valid and sufficient for its intended purpose established in the document.

   YES NO

   ☐ ☐

3. If this site has an Operation and Maintenance (O&M) Plan (or equivalent as required in the Decision Document);

   I certify by checking "YES" below that the O&M Plan Requirements (or equivalent as required in the Decision Document) are being met.

   YES NO

   ☐ ☐

4. If this site has a Monitoring Plan (or equivalent as required in the remedy selection document);

   I certify by checking "YES" below that the requirements of the Monitoring Plan (or equivalent as required in the Decision Document) is being met.

   YES NO

   ☐ ☐

IC CERTIFICATIONS
SITE NO.

Box 6

SITE OWNER OR DESIGNATED REPRESENTATIVE SIGNATURE

I certify that all information and statements in Boxes 2 and/or 3 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I ______________________________ at ____,
print name print business address

am certifying as ____(Owner or Remedial Party)

for the Site named in the Site Details Section of this form.

____ _________________
Signature of Owner or Remedial Party Rendering Certification Date

---

IC/EC CERTIFICATIONS

Box 7

QUALIFIED ENVIRONMENTAL PROFESSIONAL (QEP) SIGNATURE

I certify that all information in Boxes 4 and 5 are true. I understand that a false statement made herein is punishable as a Class "A" misdemeanor, pursuant to Section 210.45 of the Penal Law.

I ______________________________ at ____,
print name print business address

am certifying as a Qualified Environmental Professional for the ______________________________

(Owner or Remedial Party) for the Site named in the Site Details Section of this form.

____ ________________ _________
Signature of Qualified Environmental Professional, for the Owner or Remedial Party, Rendering Certification Stamp (if Required) Date

Enclosure 2

Certification Instructions

I. Verification of Site Details (Box 1 and Box 2):

Answer the six questions in the Verification of Site Details Section. Questions 5 and 6 only refer to sites in the Brownfield Cleanup Program. The Owner and/or Qualified Environmental Professional (QEP) may include handwritten changes and/or other supporting documentation, as necessary.

II. Certification of Institutional / Engineering Controls (Boxes 3, 4, and 5)

1. Review the listed IC/ECs, confirming that all existing controls are listed, and that all existing controls are still applicable. If there is a control that is no longer applicable the Owner / Remedial Party is to petition the Department requesting approval to remove the control.

2. In Box 5, complete certifications for all Plan components, as applicable, by checking the corresponding checkbox.

3. If you cannot certify "YES" for each Control and/or certify the other SM Plan components that are applicable, continue to complete the remainder of this **Certification** form. Attach supporting documentation that explains why the **Certification** cannot be rendered, as well as a statement of proposed corrective measures, and an associated schedule for completing the corrective measures. Note that this **Certification** form must be submitted even if an IC or EC cannot be certified; however, the certification process will not be considered complete until corrective action is completed.

   If the Department concurs with the explanation, the proposed corrective measures, and the proposed schedule, a letter authorizing the implementation of those corrective measures will be issued by the Department's Project Manager. Once the corrective measures are complete, a new Periodic Review Report (with IC/EC Certification) is to be submitted within 45 days to the Department. If the Department has any questions or concerns regarding the PRR and/or completion of the IC/EC Certification, the Project Manager will contact you.

III. IC/EC Certification by Signature (Box 6 and Box 7):

If you certified "YES" for each Control, please complete and sign the IC/EC Certifications page. Where the only control is an Institutional Control on the use of the property the certification statement in Box 6 shall be completed and may be made by the property owner. Where the site has Institutional and Engineering Controls, the certification statement in Box 7 must be completed by a Professional Engineer or Qualified Environmental Professional (see table below).

Table 1. Signature Requirements for Control Certification Page

Type of Control	Example of IC/EC	Required Signatures
EC which does not include a treatment system or engineered caps.	Fence, Clean Soil Cover, Individual House Water Treatment System, Vapor Mitigation System	A site or property owner or remedial party, and a QEP. (P.E. license not required)
EC that includes treatment system or an engineered cap.	Pump & Treat System providing hydraulic control of a plume, Part 360 Cap.	A site or property owner or remedial party, and a QEP with a P.E. license.

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DAILY LOG			
DATE			
NO.			
SHEET	OF		

FIELD ACTIVITY DAILY LOG

PROJECT NAME:	PROJECT NO.
PROJECT LOCATION:	CLIENT:
FIELD ACTIVITY:	

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.:	Notes:

PERSONNEL ON SITE:

SIGNATURE

DATE:

APPENDIX G

RESPONSIBILITIES OF OWNER & REMEDIAL PARTY

G-1 RESPONSIBILITIES

The responsibilities for implementing the Site Management Plan ("SMP") for the Queen Site Landing Site (the "site"), number C915304, are divided between the site owner(s) and a Remedial Party, as defined below. The owner(s) is/are currently listed as:

- Queen City Landing, LLC, Gerald Buchheit (the "owner").
  3275 North Benzing Road, Orchard Park, New York 14127
  716-823-7704

Solely for the purposes of this document and based upon the facts related to a particular site and the remedial program being carried out, the term Remedial Party ("RP") refers to any of the following: certificate of completion holder, volunteer, applicant, responsible party, and, in the event the New York State Department of Environmental Conservation ("NYSDEC") is carrying out remediation or site management, the NYSDEC and/or an agent acting on its behalf. The RP is:

- Queen City Landing, LLC, Gerald Buchheit (the "owner").
  3275 North Benzing Road, Orchard Park, New York 14127
  716-823-7704

Nothing on this page shall supersede the provisions of an Environmental Easement, Consent Order, Consent Decree, agreement, or other legally binding document that affects rights and obligations relating to the site.

G-2 SITE OWNER'S RESPONSIBILITIES:

1) The owner shall follow the provisions of the SMP as they relate to future construction and excavation at the site.

2) In accordance with a periodic time frame determined by the NYSDEC, the owner shall periodically certify, in writing, that all Institutional Controls set forth in a(n) Environmental Easement remain in place and continue to be complied with. The owner shall provide a written certification to the RP, upon

the RP's request, in order to allow the RP to include the certification in the site's Periodic Review Report (PRR) certification to the NYSDEC.

3) In the event the site is delisted, the owner remains bound by the Environmental Easement and shall submit, upon request by the NYSDEC, a written certification that the Environmental Easement is still in place and has been complied with.

4) The owner shall grant access to the site to the RP and the NYSDEC and its agents for the purposes of performing activities required under the SMP and assuring compliance with the SMP.

5) The owner is responsible for assuring the security of the remedial components located on its property to the best of its ability. In the event that damage to the remedial components or vandalism is evident, the owner shall notify the site's RP and the NYSDEC in accordance with the timeframes indicated in Section 1.3 - Notifications.

6) In the event some action or inaction by the owner adversely impacts the site, the owner must notify the site's RP and the NYSDEC in accordance with the time frame indicated in [Section 1.3] – Notifications and (ii) coordinate the performance of necessary corrective actions with the RP.

7) The owner must notify the RP and the NYSDEC of any change in ownership of the site property (identifying the tax map numbers in any correspondence) and provide contact information for the new owner of the site property. 6 NYCRR Part contains notification requirements applicable to any construction or activity changes and changes in ownership. Among the notification requirements is the following: Sixty days prior written notification must be made to the NYSDEC. Notification is to be submitted to the NYSDEC Division of Environmental Remediation's Site Control Section. Notification requirements for a change in use are detailed in Section 2.4 of the SMP. A 60-Day Advance Notification Form and Instructions are found at **http://www.dec.ny.gov/chemical/76250.html**.

8) The owner will ultimately responsible for maintaining the engineering controls.

G-3 REMEDIAL PARTY RESPONSIBILITIES

1) The RP must follow the SMP provisions regarding any construction and/or excavation it undertakes at the site.

2) The RP shall report to the NYSDEC all activities required for remediation, operation, maintenance, monitoring, and reporting. Such reporting includes, but is not limited to, periodic review reports and certifications, electronic data deliverables, corrective action work plans and reports, and updated SMPs.

3) Before accessing the site property to undertake a specific activity, the RP shall provide the owner advance notification that shall include an explanation of the work expected to be completed. The RP shall provide to (i) the owner, upon the owner's request, (ii) the NYSDEC, and (iii) other entities, if required by the SMP, a copy of any data generated during the site visit and/or any final report produced.

4) If the NYSDEC determines that an update of the SMP is necessary, the RP shall update the SMP and obtain final approval from the NYSDEC. Within 5 business days after NYSDEC approval, the RP shall submit a copy of the approved SMP to the owner(s).

5) The RP shall notify the NYSDEC and the owner of any changes in RP ownership and/or control and of any changes in the party/entity responsible for the operation, maintenance, and monitoring of and reporting with respect to any remedial system (Engineering Controls). The RP shall provide contact information for the new party/entity. Such activity constitutes a Change of Use pursuant to 375-1.11(d) and requires 60-days prior notice to the NYSDEC. A 60-Day Advance Notification Form and Instructions are found at **http://www.dec.ny.gov/chemical/76250.html**.

6) The RP shall notify the NYSDEC of any damage to or modification of the systems as required under Section 1.3 – Notifications of the SMP.

7) Prior to a change in use that impacts the remedial system or requirements and/or responsibilities for implementing the SMP, the RP shall submit to the NYSDEC for approval an amended SMP.

8) Any change in use, change in ownership, change in site classification (*e.g.*, delisting), reduction or expansion of remediation, and other significant changes related to the site may result in a change in responsibilities and, therefore,

necessitate an update to the SMP and/or updated legal documents. The RP shall contact the Department to discuss the need to update such documents.

Change in RP ownership and/or control and/or site ownership does not affect the RP's obligations with respect to the site unless a legally binding document executed by the NYSDEC releases the RP of its obligations.

Future site owners and RPs and their successors and assigns are required to carry out the activities set forth above.

APPENDIX H

FIELD OPERATING PROCEDURES

FIELD OPERATING PROCEDURES

BENCHMARK ENVIRONMENTAL ENGINEERING & SCIENCE, PLLC

FOP Number	Description
002.0	Abandonment of Monitoring Wells 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
011.1	Calibration and Maintenance of Portable Photoionization Detector
012.0	Calibration and Maintenance of Portable Specific Conductance Meter
013.0	Composite Sample Collection Procedure for Non-Volatile Organic Analysis
022.0	Groundwater Level Measurement
023.1	Groundwater Purging Procedures Prior to Sample Collection
024.1	Groundwater Sample Collection Procedures
025.0	Hand Augering Procedure
031.2	Low Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedure
040.1	Non-Disposable and Non-Dedicated Sampling Equipment Decontamination
046.0	Sample Labeling, Storage and Shipment Procedures
048.0	Screening of Soil Samples for Organic Vapors During UST Removal Activities
054.2	Soil Description Procedures Using The Visual-Manual Method
057.0	Soil Sample Collection for VOC Analysis - EnCore Sampling
065.1	Test Pit Excavation and Logging Procedures
073.2	Real-Time Air Monitoring During Intrusive Activities
079.0	Stockpile Sampling Procedures for Chemical Analysis
082.0	Waste Sampling Procedures
084.0	Calibration and Maintenance of Portable Particulate Meter
085.0	Field Quality Control Procedures

Notes:
1. FOPs are identified by the sequential FOP number and revision number.

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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 Benchmark'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.

Benchmark 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.

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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]

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FIELD OPERATING PROCEDURES

Calibration and 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)

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EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name: ______________________ Date: ______________

Project No.: ______________________

Client: ______________________ Instrument Source: ☐ BM ☐ 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		[illegible] 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:** ______________

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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)

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EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name:

Date:

Project No.:

Client:

Instrument Source: ☐ BM ☐ 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:**

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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)

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EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name: Date:

Project No.:

Client: Instrument Source: ☐ BM ☐ 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	60698[illegible]		[illegible] 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:**

BENCHMARK
ENVIRONMENTAL
ENGINEERING &
SCIENCE, PLLC

FIELD OPERATING PROCEDURES

Calibration and Maintenance of Portable Photoionization Detector (PID)

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.

CALIBRATION AND MAINTENANCE OF PORTABLE PHOTOIONIZATION DETECTOR

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	

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[illegible]		< 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[illegible]			open air zero _____ ppm Iso. Gas		MIBK response factor = 1.0
☐ Dissolved Oxygen	ppm		YSI Model 5[illegible]	[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(phenylisocyanate), 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				

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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)

EQUIPMENT CALIBRATION

PROJECT INFORMATION:

Project Name:

Date:

Project No.:

Client:

Instrument Source: ☐ BM ☐ 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			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/					background area		
☐								

ADDITIONAL REMARKS:

PREPARED BY: **DATE:**

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FIELD OPERATING PROCEDURES

Composite Sample Collection Procedure for Non-VOC Analysis

FOP 013.0

COMPOSITE SAMPLE COLLECTION PROCEDURE FOR NON-VOLATILE ORGANIC ANALYSIS

PURPOSE

This guideline addresses the procedure to be used when soil samples are to be composited in the field.

PROCEDURE

1. Transfer equal weighted aliquots of soil from individual split-spoon samples, excavator bucket, hand auger or surface soil sample location to a large precleaned stainless steel (or Pyrex glass) mixing bowl.
2. Thoroughly mix (homogenize) and break up the soil using a stainless steel scoop or trowel.
3. Spread the composite sample evenly on a stainless steel tray and quarter the sample.
4. Discard alternate (i.e., diagonal) quarters and, using a small stainless steel scoop or spatula, collect equal portions of subsample from the remaining two quarters until the amount required for the composite sample is acquired. Transfer these subsamples to a precleaned stainless steel (or Pyrex glass) mixing bowl and re-mix.
5. Transfer the composite sample to the laboratory provided, precleaned sample jars. Store any excess sample from the stainless steel tray in a separate, precleaned, wide-mouth sample jar and refrigerate for future use, if applicable.
6. Decontaminate all stainless steel (or Pyrex glass) equipment in accordance with Benchmark's Non-disposable and Non-dedicated Sampling Equipment Decontamination procedures.
7. Prepare samples in accordance with Benchmark's Sample Labeling, Storage and Shipment FOP.

8. Record all sampling details in the Project Field Book and on the Soil/Sediment Sample Collection Summary Log (sample attached).

ATTACHMENTS

Soil/Sediment Sample Collection Summary Log (sample)

REFERENCES

<u>Benchmark FOPs:</u>

040 Non-disposable and Non-dedicated Sampling Equipment Decontamination
046 Sample Labeling, Storage and Shipment

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SOIL/SEDIME
SAMPLE COLLECTION SUMMARY L

Field ID	Location	QC Type	Depth (feet)		Analytical Parameters	Containers	Date	Time	Sampler Initials	Comments (e.g. problems encountered, ref. to varian location changes, depth changes, import matrix observations or description, grav thickness, etc.)
			from	to						

Equipment Rinsate Blanks *- Pour clean deionized water [illegible] d sa[illegible]uipment into sample containers. Collect at a frequency of 1 per sampling method per day. Analyze for all those parameters analyzed for in the samples coll the same day. HSL Metals can be substituted by only the Metals an[illegible] [illegible]exa[illegible] [illegible]romium which needs a separate container). Match equipment used for constituents of concern to rinsate analyte. Note deionzied water lot # or distilay. manufacturers info & date.*

MS/MSD/MSB *- Collect at a frequency of 1 per 20 samples of each matri[illegible] [illegible]or 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' sectio*

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.

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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 Benchmark 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

Benchmark FOPs:

040 Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

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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 Benchmark 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 Benchmark 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 Benchmark 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 Benchmark 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:

$$V = 0.0408[(B)^2 \text{ x } \{(A) – (C)\}]$$

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:

   - Bailer – 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.

   - Well Wizard Purge Pump (or similar) – 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.

- <u>Submersible Pump (12 or 24 volt, or similar)</u> – 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.

- <u>Waterra™ Pump</u> – 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 Benchmark 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 Benchmark 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

Benchmark FOPs:
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*

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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 ☐ Sample
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:			Date: (if different from above)						
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sample
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:			Date: (if different from above)						
	S1								
	S2								

REMARKS:

Note: All water level 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

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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:

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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 Benchmark 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 Benchmark 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 Benchmark 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 Benchmark 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 Benchmark 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 Benchmark 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 Benchmark 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 Benchmark 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 Benchmark 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

Benchmark 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 ☐ Sample
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:			Date: (if different from above)						
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sample
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:			Date: (if different from above)						
	S1								
	S2								

REMARKS:

Note: All water level 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

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FIELD OPERATING PROCEDURES

Hand Augering Procedures

FOP 025.0

HAND AUGERING PROCEDURES

PURPOSE

This guideline presents a method for hand augering, which enables the recovery of representative surface and shallow subsurface samples for classification and sample collection (ASTM D1452).

PROCEDURE

1. Review project objectives and the Project Health and Safety Plan (HASP).
2. Follow Benchmark's FOP: Drill Site Selection Procedure prior to implementing any hand augering activity.
3. Establish a central staging area for storage of augering supplies and for equipment decontamination (include plastic-covered work bench/table as necessary). Locate a secure storage area for augered samples.
4. Assemble auger and decontaminate in accordance with Benchmark's FOP: Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.
5. Cover the area to be sampled with plastic sheeting, as determined by the Project Work Plan.
6. Make the auger boring through the plastic sheeting by rotating and advancing the auger to the desired depth below ground surface.
7. Withdraw the auger from the hole and remove soil for examination, soil classification, on-site testing (if applicable) and laboratory physical/chemical sample collection (if applicable) in accordance with specific Benchmark FOPs (Soil Description Procedures Using the Unified Soil Classification System; Composite Sample Collection Procedure for Non-Volatile Organic Analysis; and/or Soil Sample Handling for VOC Analysis) and as directed by the Project Work Plan.

8. Document all properties and sample locations in the Project Field Book and Hand Auger Borehole Log (sample attached). Specifically, total depth, borehole diameter, depth of sample collection, personnel, etc. should be recorded.

9. Place sample in appropriate container(s), label and store for future reference or ship to laboratory for analysis in accordance with Benchmark's Field Operating Procedure for Sample Labeling, Storage and Shipment.

10. Decontaminate auger in accordance with Benchmark's Field Operating Procedure for Non-Disposable and Non-Dedicated Sampling Equipment Decontamination.

11. Advance auger to next sample interval and repeat steps 7 through 12 as necessary.

12. Backfill auger holes in accordance with approved procedures outlined in the Project Work Plan.

ATTACHMENTS

Hand Auger Borehole Log (sample)

REFERENCES

Benchmark FOPs:

013	*Composite Sample Collection Procedure for Non-Volatile Organic Analysis*
017	*Drill Site Selection Procedure*
040	*Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046	*Sample Labeling, Storage and Shipment*
054	*Soil Description Procedures Using the Unified Soil Classification System*
057	*Soil Sample Handling for Volatile Organic Compound Analysis – Encore Sampling*

HAND AUGER BOREHOLE LOG

Project:	BOREHOLE I.D.:
Project No.:	Excavation Date:
Client:	Excavation Method:
Location:	Logged / Checked By:

Hand Auger Location: *NOT TO SCALE*

Hand Auger Cross Section:

Grade - 0'
2'
4'
6'
8'
10'

TIME	BOREHOLE DIMENSIONS
Start:	Diameter: (approx.)
End:	Depth: (approx.)

Depth (fbgs)	SAMPLE DESCRIPTION USCS Classification: Color, Moisture Condition, % of Soil Type, Texture, Plasticity, Fabric, Bedding, Weathering/Fracturing, Odor, Other	PID Scan (ppm)	Photos Y / N	Samples Collected (fbgs)

COMMENTS:

GROUNDWATER ENCOUNTERED:	yes	no	If yes, depth to GW:
VISUAL IMPACTS:	yes	no	Describe:
OLFACTORY OBSERVATIONS:	yes	no	Describe:
NON-NATIVE FILL ENCOUNTERED:	yes	no	
OTHER OBSERVATIONS:	yes	no	Describe:
SAMPLES COLLECTED:	yes	no	Sample I.D.:
			Sample I.D.:
			Sample I.D.:

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FIELD OPERATING PROCEDURES

Low-Flow (Minimal Drawdown) Groundwater Purging & Sampling Procedure

FOP 031.2

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 Benchmark'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 Benchmark's Groundwater Level Measurement FOP and decontaminate the e-line probe and a lower portion of cable following the procedures referenced in the Benchmark'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 Benchmark'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 Benchmark'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 Benchmark'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.) <u>slowly</u> 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 Benchmark'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.*

Benchmark 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*
024	*Groundwater Sample Collection Procedures*
040	*Non-Disposable and Non-Dedicated Sampling Equipment Decontamination*
046	*Sample Labeling, Storage and Shipment Procedures*

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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 ☐ Sample
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:			Date: (if different from above)						
	S1								
	S2								

Well No.	Diameter (inches):	Sample Time:
Product Depth (fbTOR):	Water Column (ft):	DTW when sampled:
DTW (static) (fbTOR):	Casing Volume:	Purpose: ☐ Development ☐ Sample
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:			Date: (if different from above)						
	S1								
	S2								

REMARKS:

Note: All water level 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:

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FIELD OPERATING PROCEDURES

Non-Disposable and Non-Dedicated Sampling Equipment Decontamination

FOP 040.1

NON-DISPOSABLE AND NON-DEDICATED SAMPLING EQUIPMENT DECONTAMINATION

PURPOSE

This procedure is to be used for the decontamination of non-disposable and non-dedicated equipment used in the collection of environmental samples. The purpose of this procedure is to remove chemical constituents from previous samples from the sampling equipment. This prevents these constituents from being transferred to later samples, or being transported out of controlled areas.

HEALTH AND SAFETY

Nitric acid is a strong oxidizing agent as well as being extremely corrosive to the skin and eyes. Solvents such as acetone, methanol, hexane and isopropanol are flammable liquids. Limited contact with skin can cause irritation, while prolonged contact may result in dermatitis. Eye contact with the solvents may cause irritation or temporary corneal damage. Safety glasses with protective side shields, neoprene or nitrile gloves and long-sleeve protective clothing must be worn whenever acids and solvents are being used.

PROCEDURE – GENERAL EQUIPMENT

Bailers, split-spoons, steel or brass split-spoon liners, Shelby tubes, submersible pumps, soil sampling knives, and similar equipment will be decontaminated as described below.

1. Wash equipment thoroughly with non-phosphate detergent and potable-quality water, using a brush where possible to remove any particulate matter or surface film. If the sampler is visibly coated with tars or other phase-separated hydrocarbons, pre-wash with acetone or isopropanol, or by steam cleaning. Decontamination will adhere to the following procedure:

   a. Rinse with potable-quality water; if the sampling equipment is very oily and use of a solvent is necessary, rinse with pesticide-grade isopropanol.

   b. Rinse with potable-quality water;

   c. Rinse with deionized water demonstrated analyte-free, such as distilled water;

   d. Air dry; and

   e. Store in a clean area or wrap in aluminum foil (shiny side out) or new plastic sheeting as necessary to ensure cleanliness.

2. All non-dedicated well evacuation equipment, such as submersible pumps and bailers, which are put into the well, must be decontaminated following the procedures listed above. All evacuation tubing must be dedicated to individual wells (i.e., tubing cannot be reused). However, if submersible pump discharge tubing must be reused, the tubing and associated sample valves or flow-through cells used in well purging or pumping tests will be decontaminated as described below:

   a. Pump a mixture of potable water and a non-phosphate detergent through the tubing, sample valves and flow cells, using the submersible pump.

   b. Steam clean or detergent wash the exterior of the tubing, sample valves, flow cells and pump.

   c. Pump potable water through the tubing, sample valve, and flow cell until no indications of detergent (e.g. foaming) are observed.

   d. Double rinse the exterior of the tubing with potable water.

   e. Rinse the exterior of the tubing with distilled water.

   f. Store in a clean area or wrap the pump and tubing assembly in new plastic sheeting as necessary to ensure cleanliness until ready for use.

3. All unused sample bottles and sampling equipment must be maintained in such a manner that there is no possibility of casual contamination.

4. Manage all waste materials generated during decontamination procedures as described in the Benchmark Field Operating Procedure for Management of Investigation Derived Waste.

PROCEDURE – SUBMERSIBLE PUMPS

Submersible pumps used in well purging or purging tests will be decontaminated thoroughly each day before use as well as between well locations as described below:

Daily Decontamination Procedure:

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

2. Wash: Operate the pump in 8 to 10 gallons of non-phosphate detergent solution (i.e., Alconox) for 5 minutes and flush other equipment with fresh detergent solution for 5 minutes.

3. Rinse: Operate the pump in a basin of potable water for 5 minutes and flush other equipment with potable water for 5 minutes.

4. Disassemble pump.

5. Wash pump parts with a non-phosphate detergent solution (i.e., Alconox). Scrub all pump parts with a test tube brush or similar device.

6. Rinse pump with potable water.

7. Rinse the inlet screen, the shaft, the suction interconnection, the motor lead assembly, and the stator housing with distilled/deionized water.

8. Rinse the impeller assembly with 1% nitric acid (HNO_3).

9. Rinse the impeller assembly with isopropanol.

10. Rinse the impeller assembly with distilled/deionized water.

Between Wells Decontamination Procedure:

1. Pre-rinse: Operate the pump in a basin containing 8 to 10 gallons of potable water for 5 minutes.

2. Wash: Operate the pump in 8 to 10 gallons of non-phosphate detergent solution (i.e., Alconox) for 5 minutes.

3. Rinse: Operate the pump in a basin of potable water for 5 minutes.

4. Final rinse the pump in distilled/deionized water.

ATTACHMENTS

None

REFERENCES

Benchmark FOPs:
032 Management of Investigation-Derived Waste

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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 Benchmark 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 Benchmark 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

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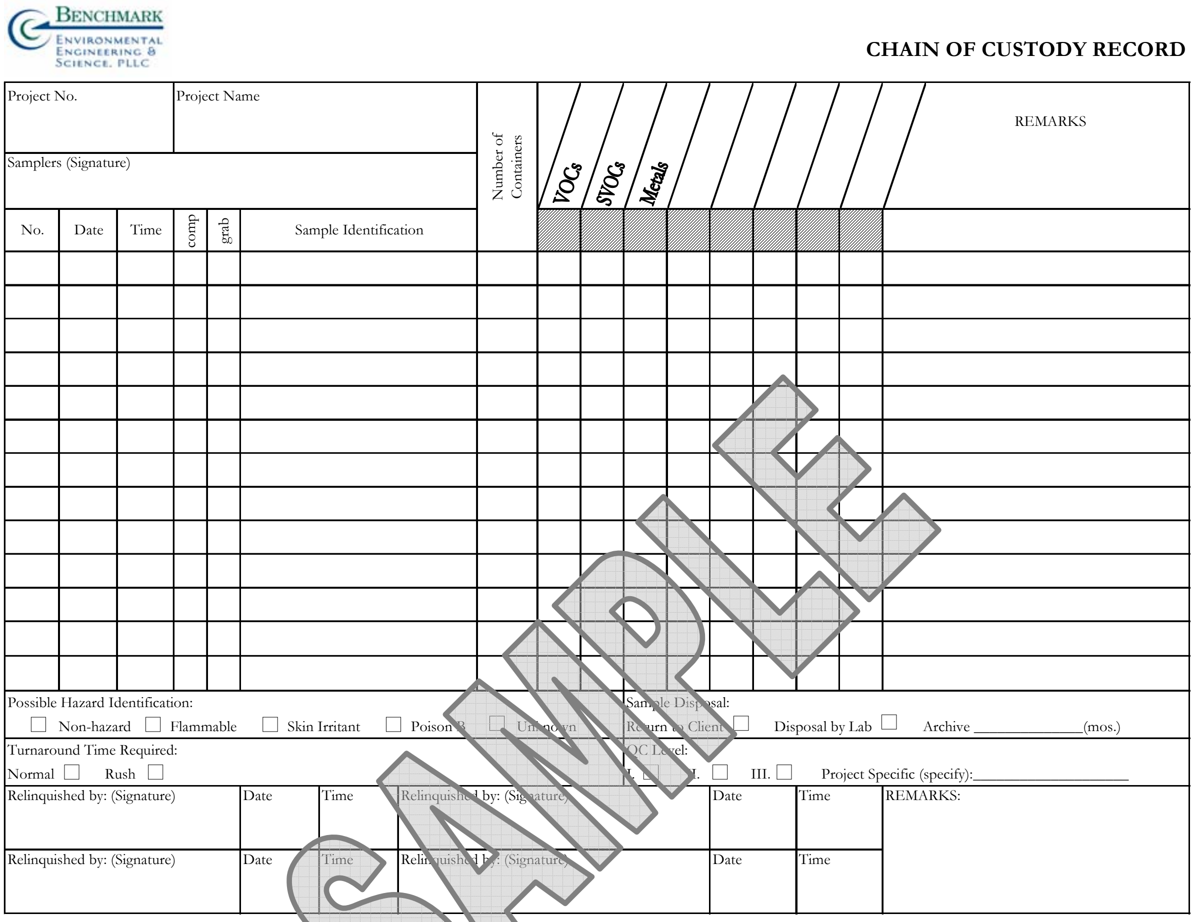
AIR SAMPLE COLLECTION SUMMARY LOG

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.



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CHAIN OF CUSTODY RECORD

Project No.	Project Name
Samplers (Signature)	

No.	Date	Time	comp	grab	Sample Identification	Number of Containers	VOCs	SVOCs	Metals						REMARKS
							▨	▨	▨	▨	▨	▨	▨	▨	

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	

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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

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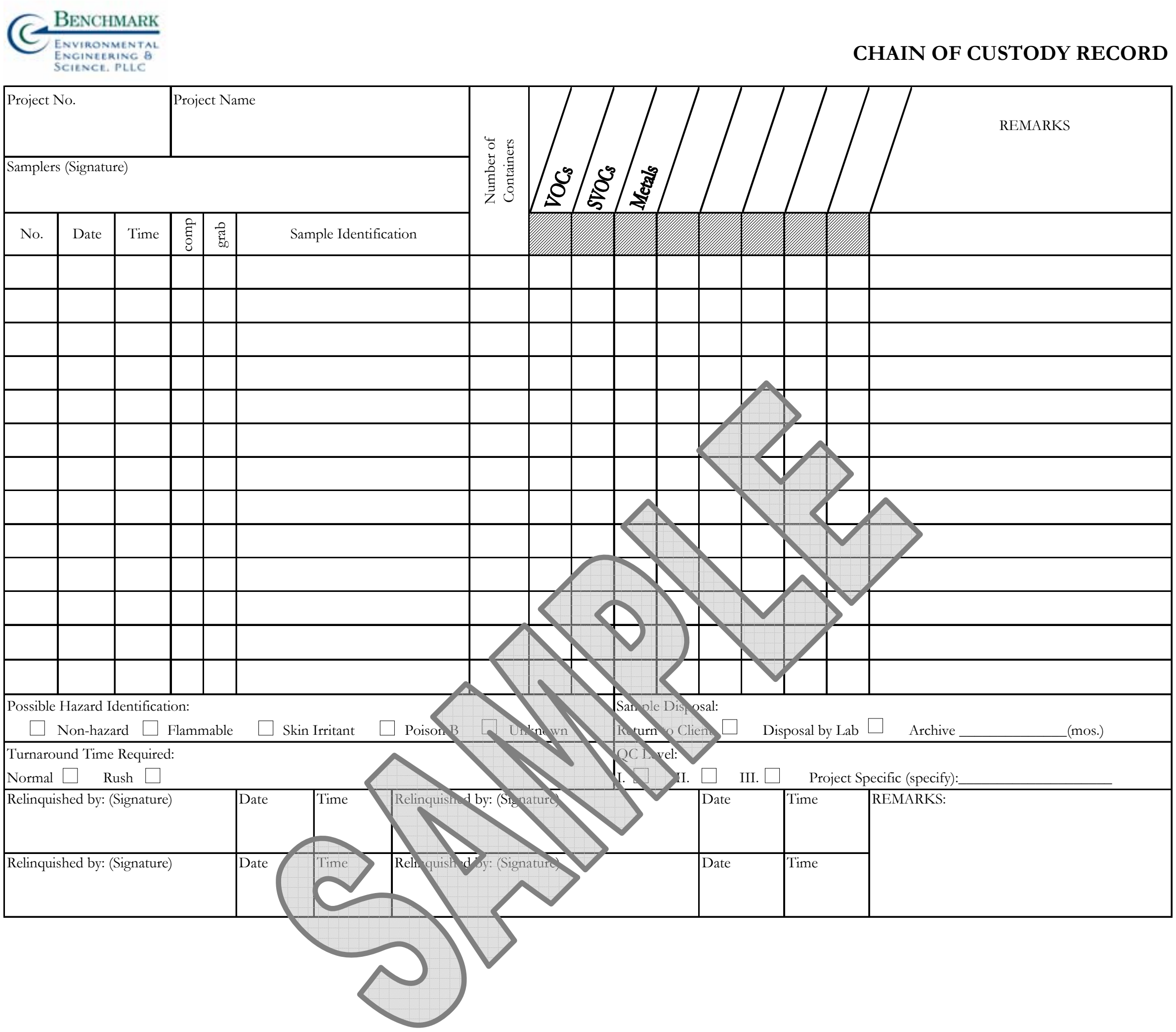
AIR SAMPLE COLLECTION SUMMARY LOG

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.



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CHAIN OF CUSTODY RECORD

Project No.

Project Name

Samplers (Signature)

No.	Date	Time	comp	grab	Sample Identification	Number of Containers	VOCs	SVOCs	Metals						REMARKS
							▨	▨	▨	▨	▨	▨	▨	▨	

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	

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FIELD OPERATING PROCEDURES

Screening of Soil Samples for Organic Vapors During Impacted Soil Removal Activities

FOP 048.0

SCREENING OF SOIL SAMPLES FOR ORGANIC VAPORS DURING IMPACTED SOIL REMOVAL ACTIVITIES

PURPOSE

This procedure is used to screen soil samples for the presence of volatile organic constituents (VOCs) using a field organic vapor meter. The field meter should either be a photoionization detector (PID) or flame-ionization detector (FID) type. This type of screening is generally performed during underground storage tank (UST) and/or impacted soil removal activities as a procedure for ensuring the health and safety of the community and personnel at the site as well as to identify potential VOC-impacted soil samples for laboratory analysis (i.e., confirmatory or verification samples). Soil samples are also screened in the field to provide assessment criteria to determine horizontal and vertical extents of VOC-impacts in order to ensure soils that may have been impacted by volatile organic substances are removed.

PROCEDURE

1. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

2. Perform community air monitoring in accordance with the Project Work Plan and/or Benchmark's FOP: Real-Time Air Monitoring During Intrusive Activities.

3. Upon proper removal of any identified UST in accordance with NYSDEC Division of Environmental Remediation, Spill Response Unit or Bulk Storage Unit guidelines and/or Benchmark's FOP: Underground Storage Tank Removal Procedures; examine the four sidewalls and bottom of the excavation for visually impacted (i.e., stained) soils.

4. If visually impacted soils are identified, direct the excavating equipment operator to scrape the impacted area (i.e., sidewall or bottom of the excavation) and present the scraped soil for evaluation. NOTE: Under no circumstances should anyone enter an excavation greater than 4 feet in depth, unless absolutely necessary. Excavation entry may only occur under strict confined space entry procedures following implementation of specific engineering controls (i.e., continuous air monitoring, excavation shoring, trench box installation, benching).

5. Visually inspect and perform an open air PID/FID scan of the scraped soil sample noting stratification, visible staining, or other evidence of impact (i.e., presence of non-aqueous phase liquid, NAPL).

6. Collect a representative sample (approximately 100 milligrams (mg)) of soil using a decontaminated or dedicated stainless steel sampling tool (i.e., spoon, spatula, scoop, or approved equivalent), for field headspace determination of VOC-impact. Place the representative soil sample 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 sample may be placed into a clean, re-sealable plastic bag and sealed. Be sure to leave adequate headspace above the soil sample within either sealed container.

7. Place the field screening sample (i.e., jar or bag) in a location where the ambient temperature is at least 70° Fahrenheit for at least 15 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 depth, sample location (i.e., sidewall, bottom) and <u>maximum</u> reading in parts per million by volume (ppmv) in the Project Field Book and Impacted Soil Excavation Log (sample attached), at the depth interval corresponding to the depth of sample collection.

10. The representative soil samples collected from the excavation will be used to assess the vertical and horizontal limits of VOC-impact and guide the impacted soil removal activities in accordance with project requirements (i.e., PID scans less than 20 ppm will not require removal unless laboratory analytical results exceed regulatory limits).

11. Collect verification/confirmation samples in accordance with NYSDEC Division of Environmental Remediation, Spill Response Unit or Bulk Storage Unit guidelines and/or Benchmark's FOP: Surface and Subsurface Soil Sampling Procedures.

ATTACHMENTS

Impacted Soil Excavation Log (sample)

REFERENCES

<u>Benchmark FOPs:</u>

010 *Calibration and Maintenance of Portable Flame Ionization Detector*
011 *Calibration and Maintenance of Portable Photoionization Detector*
063 *Surface and Subsurface Soil Sampling Procedures*
073 *Real-Time Air Monitoring During Intrusive Activities*
074 *Underground Storage Tank Removal Procedures*

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IMPACTED SOIL EXCAVATION LOG

Project:	EXCAVATION I.D.:
Project No.:	Excavation Date:
Client:	Excavation Method:
Location:	CQA Observer:

Excavation Location: *NOT TO SCALE*
(approximate)

Excavation Cross Section:

Grade - 0'
2'
4'
6'
8'
10'
12'
14'
16'
18'
20'

TIME	Length:	(approx.)
Start:	Width:	(approx.)
End:	Depth:	(approx.)

Verification Sample I.D.	Depth (fbgs)	Location Within Excavation (sidewall/bottom)	PID Scan (ppm)	PID Headspace (ppm)	Photos Y / N	

COMMENTS:

UST ENCOUNTERED: ☐ yes ☐ no If yes, Describe (type, material, size, capacity etc.):

GROUNDWATER ENCOUNTERED: ☐ yes ☐ no If yes, depth to GW:

VISUAL IMPACTS: ☐ yes ☐ no Describe:

OLFACTORY OBSERVATIONS: ☐ yes ☐ no Describe:

NON-NATIVE FILL ENCOUNTERED: ☐ yes ☐ no

OTHER OBSERVATIONS: ☐ yes ☐ no Describe:

QUANTITY OF IMPACTED SOIL REMOVED:

FINAL DESTINATION OF IMPACTED SOIL:

TYPE OF BACKFILL:

SURFACE COMPLETION:

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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 Benchmark's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

2. Collect desired soil sample in accordance with appropriate Benchmark 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 Benchmark'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 Benchmark's Sample Labeling, Storage and Shipment Procedures FOP.

9. All remaining soil from soil sample collection activities shall be containerized in accordance with Benchmark'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, Benchmark 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).*

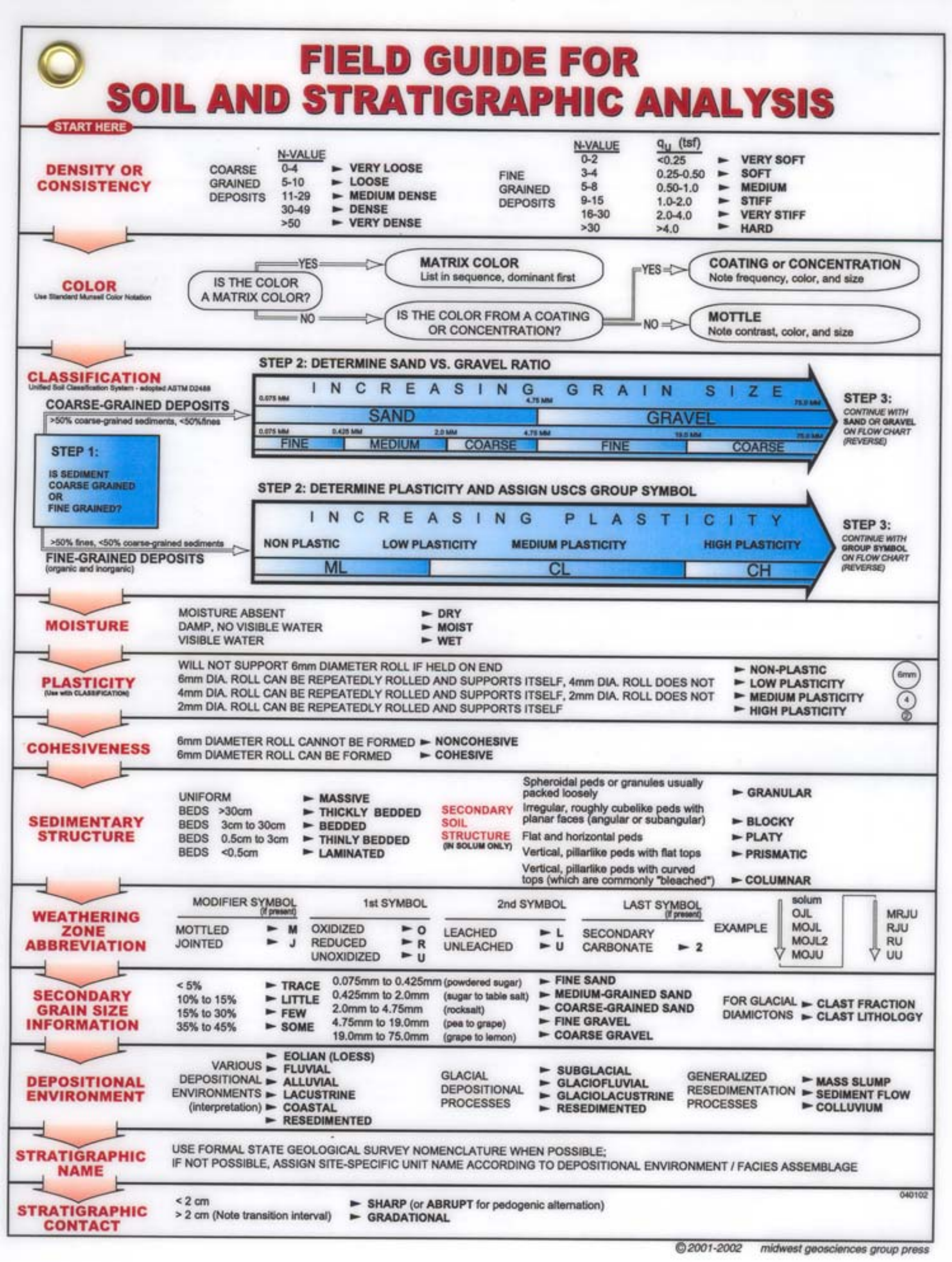
State of California, Department of Transportation, Engineering Service Center, Office of Structural Foundations, August 1996. *Soil & Rock Logging Classification Manual (Field Guide), by Joseph C. de Larios.*

Benchmark 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

	N-VALUE	
COARSE GRAINED DEPOSITS	0-4	► VERY LOOSE
	5-10	► LOOSE
	11-29	► MEDIUM DENSE
	30-49	► DENSE
	>50	► VERY DENSE

	N-VALUE	q_u (tsf)	
FINE GRAINED DEPOSITS	0-2	<0.25	► VERY SOFT
	3-4	0.25-0.50	► SOFT
	5-8	0.50-1.0	► MEDIUM
	9-15	1.0-2.0	► STIFF
	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

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

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**

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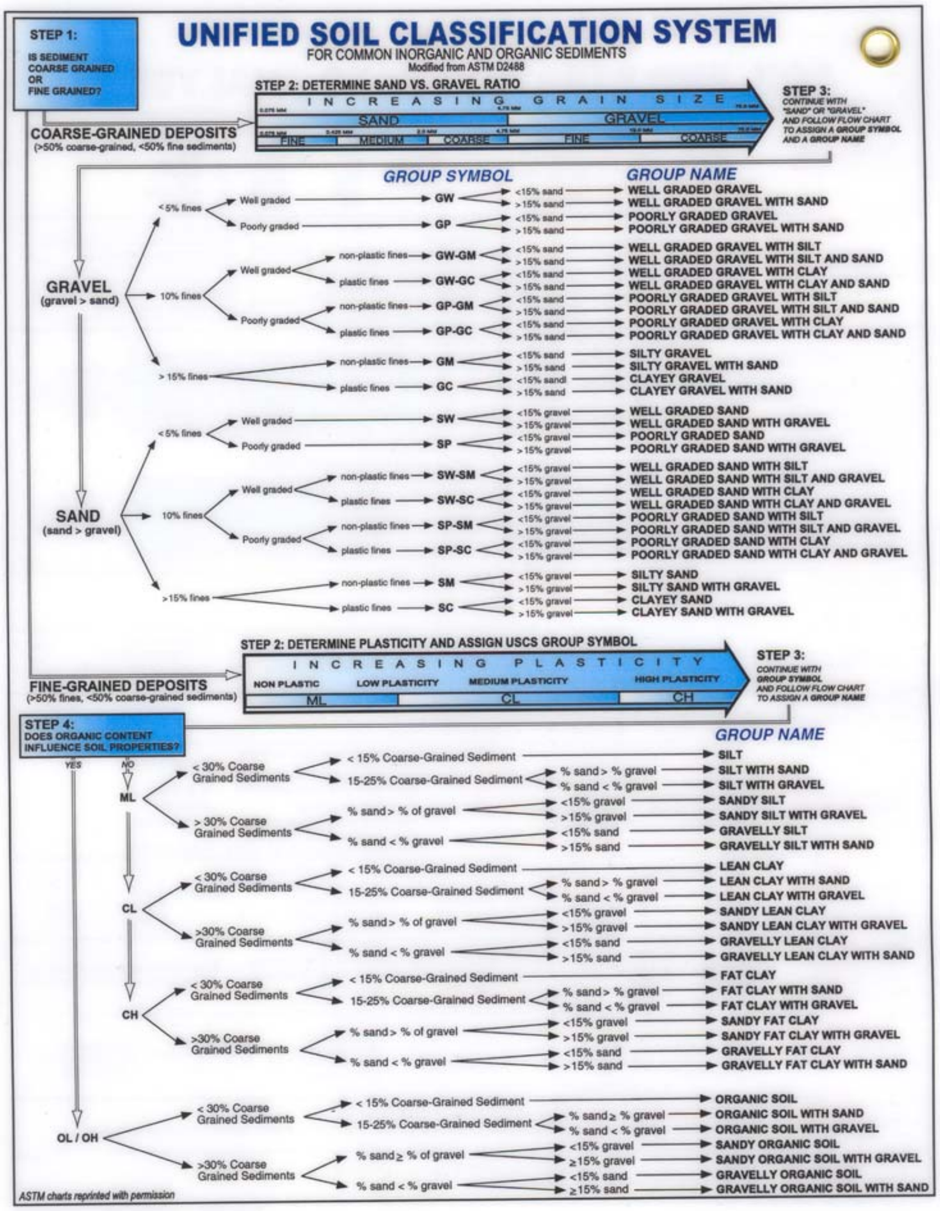
FIGURE 2

USCS SOIL CLASSIFICATION FLOW CHART
(MODIFIED FROM ASTM D2488)



ASTM charts reprinted with permission

FIGURE 3

ILLUSTRATION OF PARTICLE SIZES

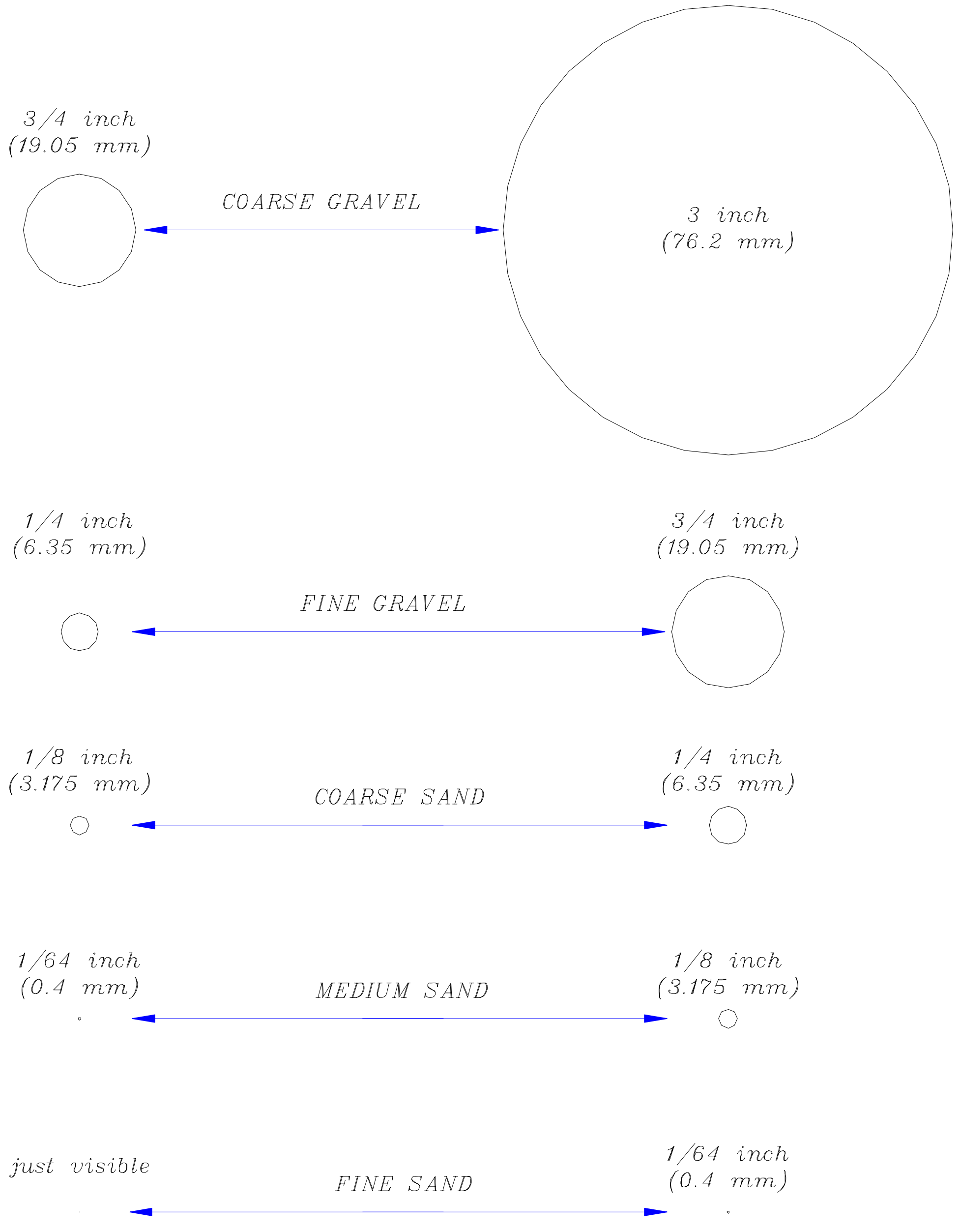


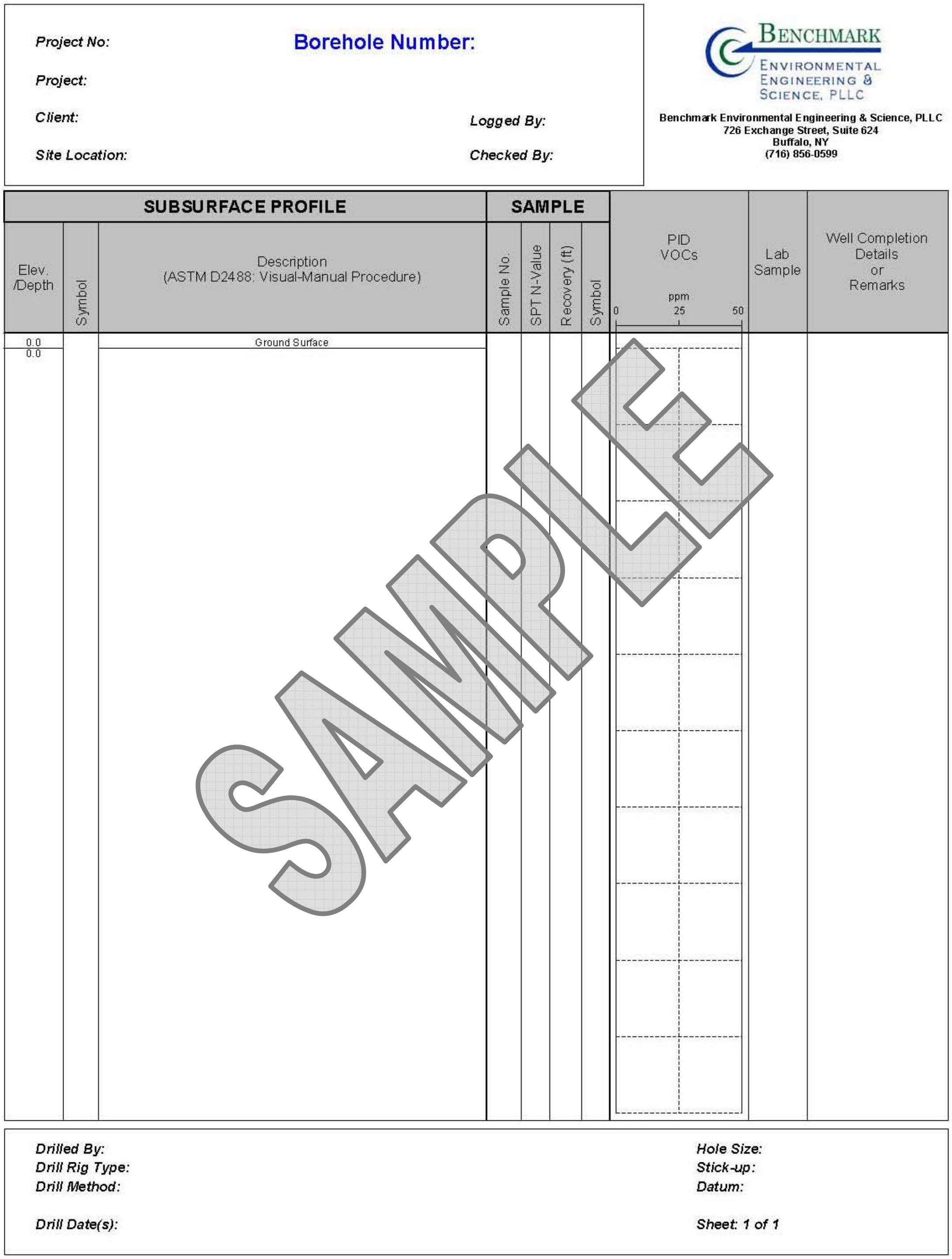
FIGURE 4

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:**

Benchmark Environmental Engineering & Science, PLLC
726 Exchange Street, Suite 624
Buffalo, NY
(716) 856-0599

SUBSURFACE PROFILE			SAMPLE				PID VOCs ppm 0 25 50	Lab Sample	Well Completion Details or Remarks
Elev. /Depth	Symbol	Description (ASTM D2488: Visual-Manual Procedure)	Sample No.	SPT N-Value	Recovery (ft)	Symbol			
0.0 0.0		Ground Surface							

Drilled By:
Drill Rig Type:
Drill Method:

Drill Date(s):

Hole Size:
Stick-up:
Datum:

Sheet: 1 of 1

BENCHMARK
ENVIRONMENTAL
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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 and 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 Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

ATTACHMENTS

EnCore™ Sampling Procedure (manufacturers instructions)

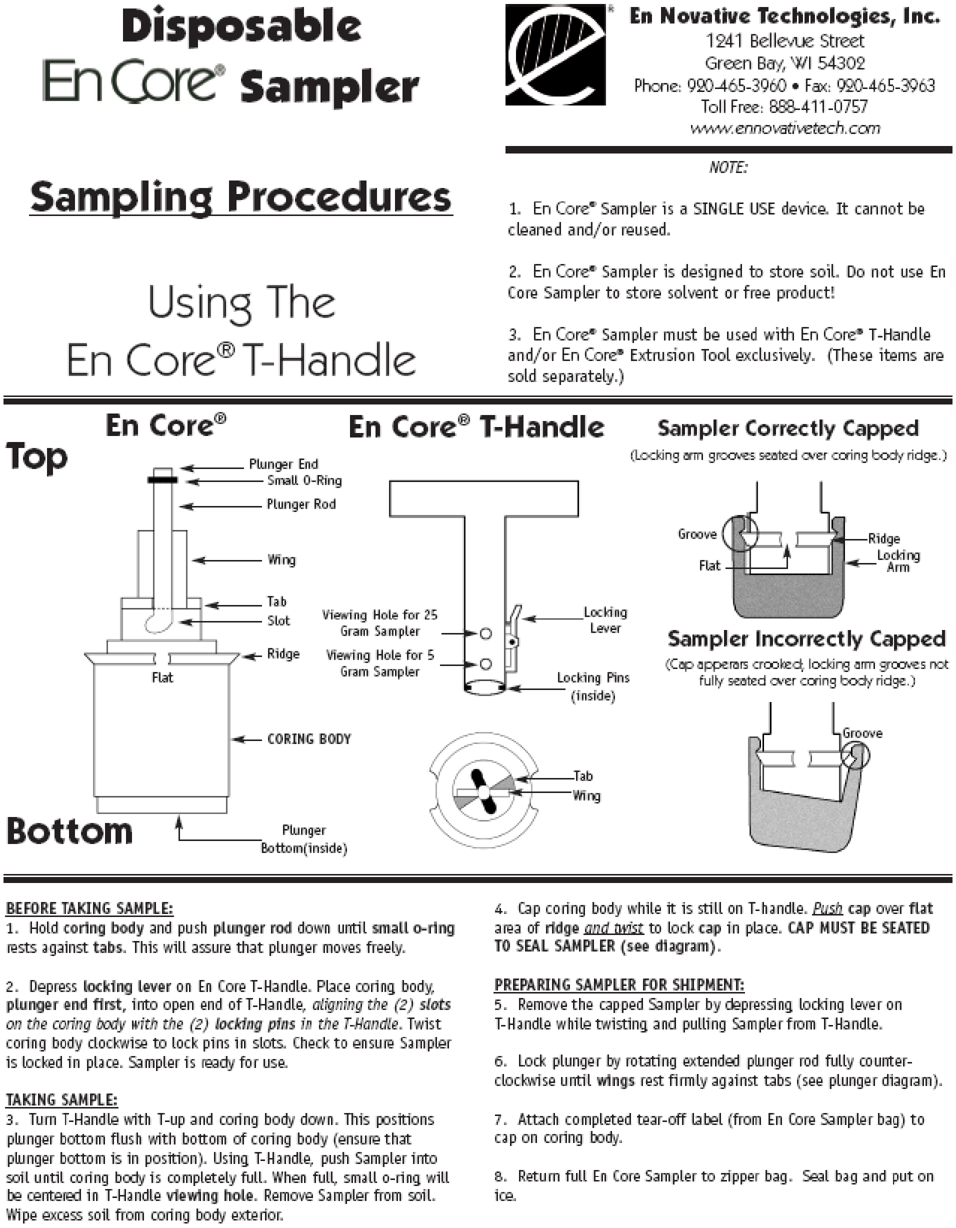
REFERENCES

Benchmark FOPs:

046 Sample Labeling, Storage and Shipment Procedures

ATTACHMENT

EnCore™ Sampling Procedure (manufacturers instructions)



Disposable En Core® Sampler

Sampling Procedures

Using The
En Core® T-Handle

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Toll Free: 888-411-0757
www.ennovativetech.com

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).**

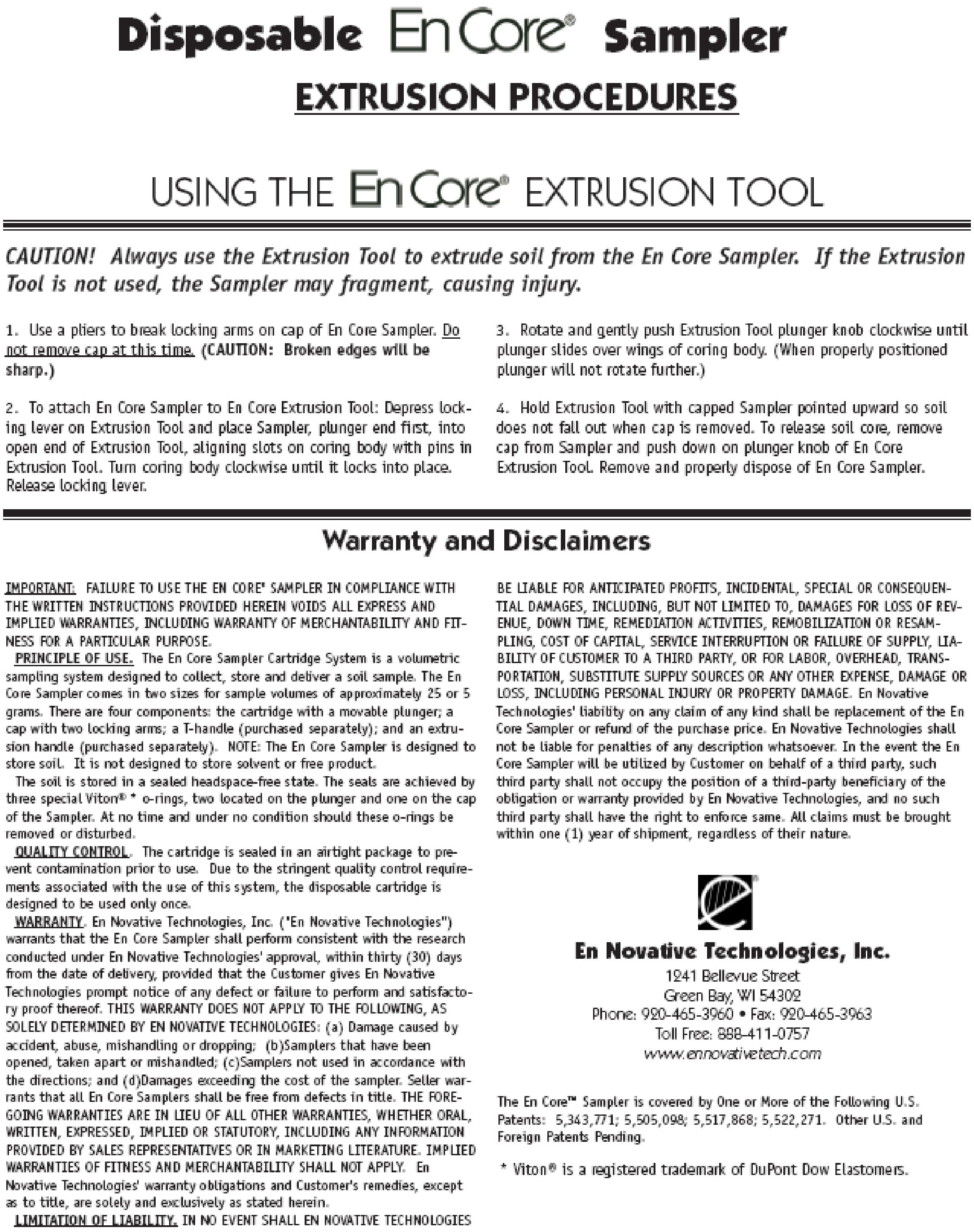
PREPARING SAMPLER FOR SHIPMENT:

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.

BENCHMARK
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FIELD OPERATING PROCEDURES

Test Pit Excavation and Logging Procedures

TEST PIT EXCAVATION & LOGGING PROCEDURES

PURPOSE

This procedure describes the methods for completing test pits, trenches, and other excavations that may be performed to expose subsurface soils or materials. In most cases, these pits will be mechanically excavated, using a backhoe, trackhoe, or other equipment. Because pits and other excavations can represent a substantial physical hazard, it requires a particular focus on safety procedures. The Project Health and Safety Plan identifies practices related to excavation permits, entry, and control that must be incorporated into excavation activities.

EXCAVATION PROCEDURE

1. Review project objectives and the Project Health and Safety Plan (HASP).

2. Perform excavation equipment safety checks with the operator. Specific concerns should include, but not limited to, no leaking hydraulic lines, fire extinguisher on board of the excavation equipment, operator experience etc.

3. Conduct tailgate health and safety meeting with project team and excavation operator(s) by completing the Tailgate Safety Meeting Form (sample attached).

4. Calibrate air-monitoring equipment in accordance with the appropriate Benchmark's Field Operating Procedures or manufacturers recommendations for calibration of field meters.

5. Conduct air monitoring as required by the HASP and/or Project Work Plan. Record all results on the Real Time Air Monitoring Log (sample attached).

6. Mobilize the excavation equipment to the site and position over the required location.

7. Select excavation locations, which provide necessary information for achieving objectives. Check locations with owner/operator to ensure excavation

operations will not interfere with site operations, and select appropriate access routes.

8. Stake locations in the field and measure distance from locations to nearest landmarks. Survey location, if required.

9. Obtain clearances from appropriate utilities and, if buried waste/metallic objects are suspected, screen location with appropriate geophysical methods, as necessary.

10. Decontaminate excavation equipment in accordance with Benchmark's Drilling and Excavation Equipment Decontamination procedures.

11. Excavate pits. In uncontrolled areas, excavate only as many test pits as can be backfilled during the same day. Generally, allow equal time for excavation and backfilling. To the extent practicable, no pits should be left open overnight in an uncontrolled area. If sudden weather changes or other unforeseen events necessitate this, pits will be covered and/or barricaded and flagged with caution/hazard tape. These pits should be backfilled as soon as possible.

12. The Benchmark field geologist or experienced professional should determine the depth of excavation. The depth is generally limited by the safe reach of the selected equipment, but may also be limited by the stability of the excavated materials (i.e. wall stability).

13. Excavate the test pits in compliance with applicable safety regulations. In no case should a pit deeper than 4 feet be entered without first stabilizing the sidewalls by using forms, or by terracing or sloping (2:1 slope maximum) the sidewalls.

14. Excavated spoils must be placed no closer than 2 feet from the open excavation.

15. Collect soil samples from pit sidewalls in accordance with Benchmark's Surface and Subsurface Soil Sampling Procedures. If the test pit is greater than 4 feet in depth, it will not be entered for sampling. In this event, collect

samples using the backhoe bucket, then fill sample containers from the center of the bucket using the stainless steel sampling equipment (i.e., spoon, spade, trowel etc.) or drive a Shelby tube or EnCore™ sampler for VOCs.

16. Record excavation observations in the Project Field Book or Test Pit Excavation Log form (sample attached). Information recorded should include:

    - Physical dimension of the pit;
    - A scaled sketch of one side of the pit showing any lithologic contacts, zones of groundwater seepage, other special features (jointing, boulders, cobbles, zones of contamination, color abnormalities, etc.)
    - General information such as project number, pit designation number, depth, date, name of responsible professional (i.e., geologist), type of excavating equipment utilized, time of excavation and backfilling, method of collecting samples and amount of sample collected (if applicable);
    - Rate of groundwater inflow, depth to groundwater and time of measurement; and
    - Unified Soil Classification System (USCS) designation of each distinctive unit.

17. Photograph each excavation, highlighting unique or important features. Use a ruler or other suitable item for scale. Include a label with the pit designation so the developed picture will be labeled.

18. Backfill pit to match the existing grade compacting in 2 to 3 foot lifts. Since the excavated material should be cover soil, the excess soil will be placed back into the hole. The Benchmark Field Team Leader will provide direction on whether excavated soils may be used as fill, or these materials are to be containerized as investigation derived waste.

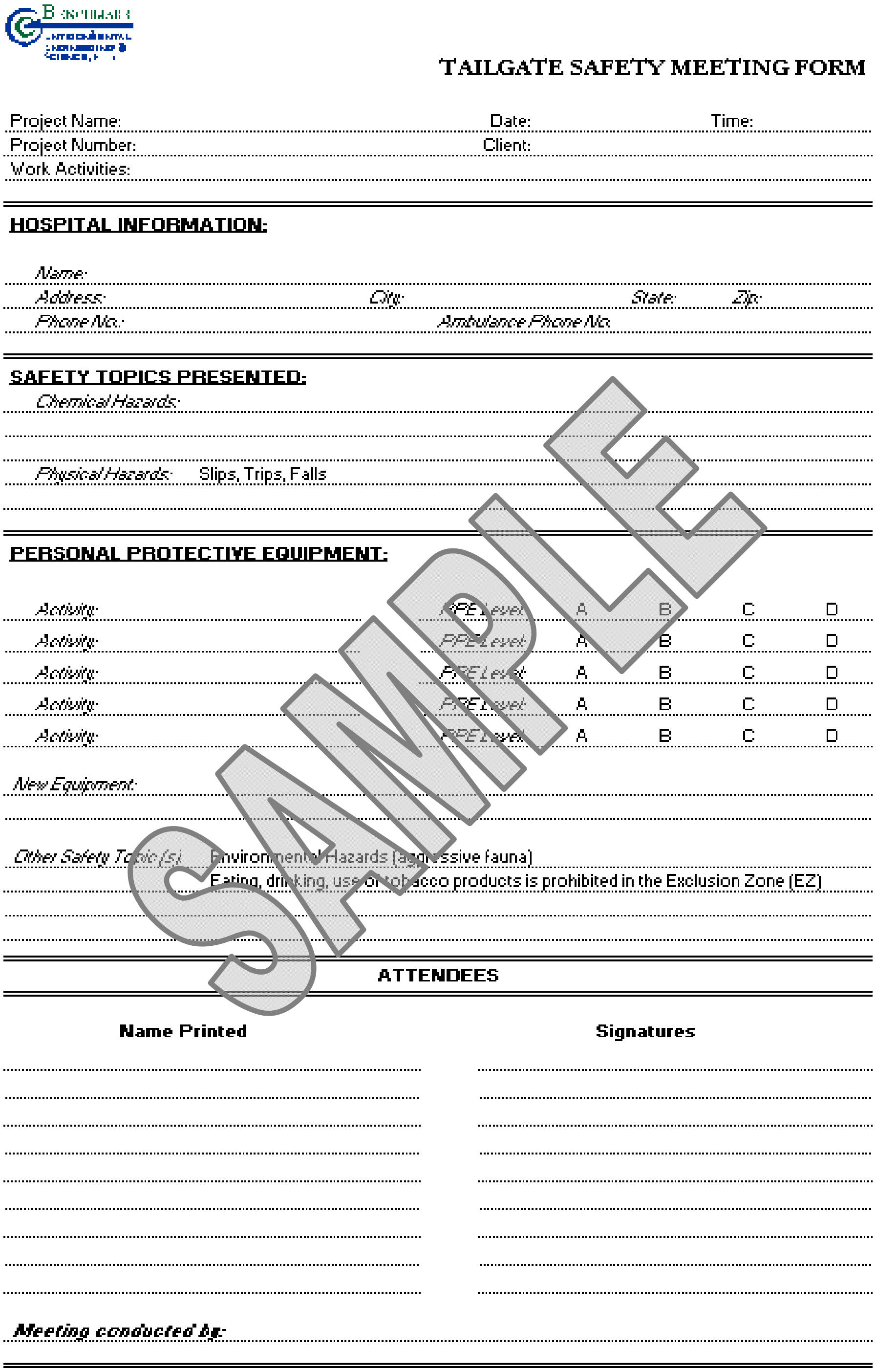
ATTACHMENTS

Tailgate Safety Meeting Form (sample)
Real Time Air Monitoring Log (sample)
Test Pit Excavation Log (sample)

REFERENCES

Benchmark FOPs:

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*
018	*Drilling and Excavation Equipment Decontamination*
063	*Surface and Subsurface Soil Sampling Procedures*



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:

REAL TIME AIR MONITORING LOG

Date:

Project Name:

Project Number:

Project Location:

Client:

Purpose of Air Monitoring:

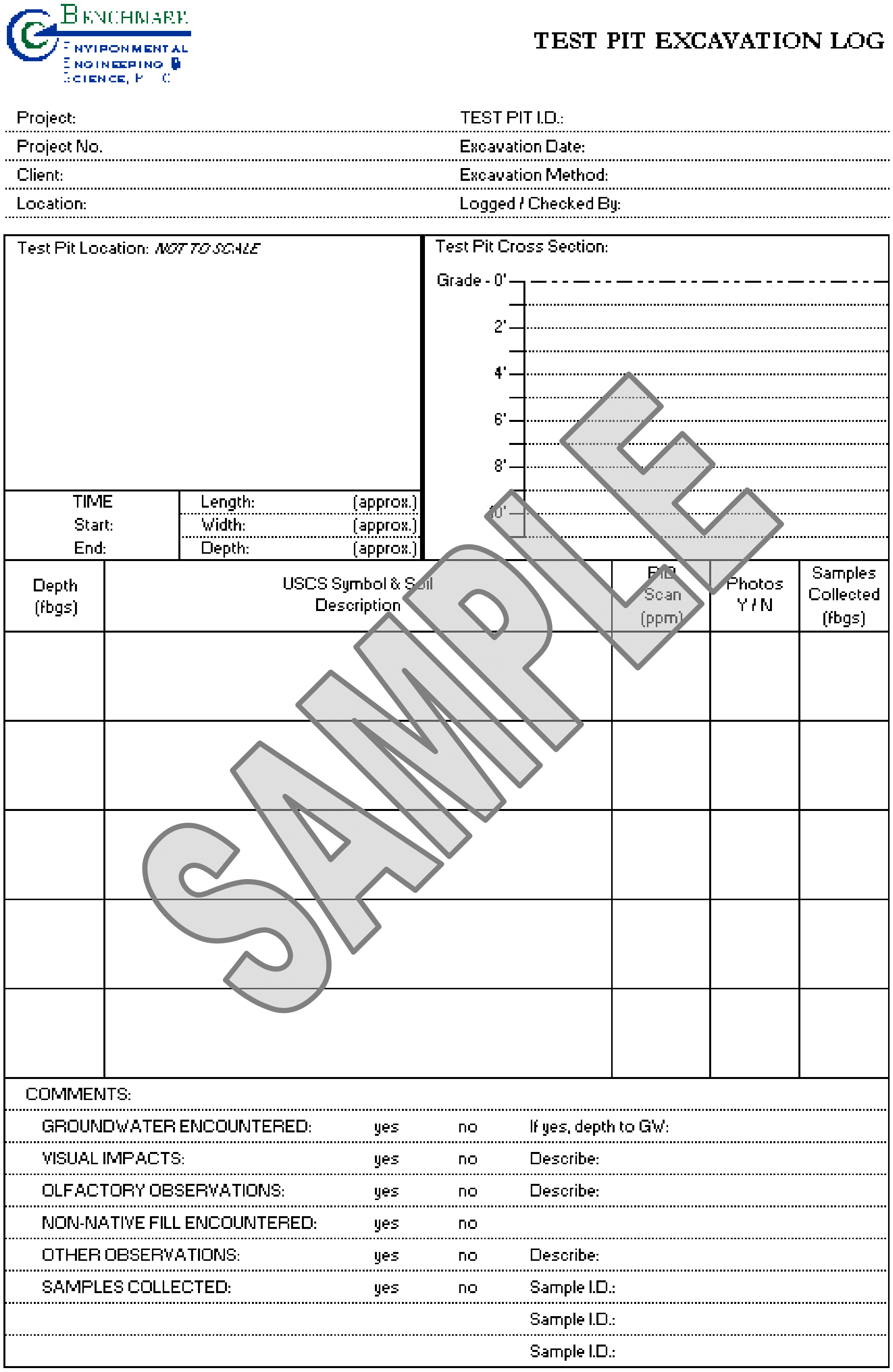
WEATHER CONDITIONS:

Time of Day:	A.M.	P.M.
Ambient Air Temp.:		
Wind Direction:		
Wind Speed:		
Precipitation:		

Date	Personnel	Time	Air Monitoring Meter Measurement (Units)							Location/Activity/Comments
			PID (ppm)	LEL (%)	H_2S (ppm)	O_2 (%)	CO (ppm)	Particulates (mg/m^3)	Other	

NOTE: SEE EQUIPMENT CALIBRATION LOG FOR DESCRIPTION OF EQUIPMENT TYPE.

Prepared By: Date:



Benchmark Environmental Engineering & Science, PLLC

TEST PIT EXCAVATION LOG

Project:
TEST PIT I.D.:
Project No.
Excavation Date:
Client:
Excavation Method:
Location:
Logged / Checked By:

Test Pit Location: *NOT TO SCALE*

Test Pit Cross Section:

TIME
Start:
End:

Length: (approx.)
Width: (approx.)
Depth: (approx.)

Depth (fbgs)	USCS Symbol & Soil Description	PID Scan (ppm)	Photos Y / N	Samples Collected (fbgs)

COMMENTS:

GROUNDWATER ENCOUNTERED: yes no If yes, depth to GW:
VISUAL IMPACTS: yes no Describe:
OLFACTORY OBSERVATIONS: yes no Describe:
NON-NATIVE FILL ENCOUNTERED: yes no
OTHER OBSERVATIONS: yes no Describe:
SAMPLES COLLECTED: yes no Sample I.D.:
Sample I.D.:
Sample I.D.:

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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.

- **<u>Special Requirements for Work Within 20 Feet of Potentially Exposed Individuals or Structures</u>**

  - 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 AIR MONITORING LOG

Date:
Project Name:
Project Number:
Project Location:
Client:
Purpose of Air Monitoring:

WEATHER CONDITIONS:

Time of Day:	A.M.	P.M.
Ambient Air Temp.:		
Wind Direction:		
Wind Speed:		
Precipitation:		

Date	Personnel	Time	Air Monitoring Meter Measurement (Units)							Location/Activity/Comments
			PID (ppm)	LEL (%)	H_2S (ppm)	O_2 (%)	CO (ppm)	Particulates (mg/m^3)	Other	

NOTE: SEE EQUIPMENT CALIBRATION LOG FOR DESCRIPTION OF EQUIPMENT TYPE.

Prepared By: Date:

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FIELD OPERATING PROCEDURES

Stockpile Sampling Procedures for Chemical Analysis

FOP 079.0

STOCKPILE SAMPLING PROCEDURES FOR CHEMICAL ANALYSIS

PURPOSE

This guideline presents a method for collecting representative soil samples from stockpiled borrow source material for chemical analysis.

GENERAL

In general, off-site soil that is brought to a Site for use as supplemental fill is subject to Quality Assurance sampling and analysis. If QA is required, all off-site soil proposed for use as Site backfill shall be documented by the subcontractor in writing to have originated from locations having no evidence of disposal or release of hazardous, toxic or radioactive substances, wastes or petroleum products. If the subcontractor designates a source as "virgin" soil, it shall be further documented in writing to be native soil material having not supported any known past industrial or commercial development or agricultural use. Borrow soils can be used as backfill once concentrations are confirmed to meet project designated criteria for the Constituents of Primary Concern (COPCs) and NYSDEC TAGM HWR-94-4046 recommended soil cleanup objectives (SCOs) or NYSDEC 6NYCRR Part 375 SCOs.

Sample collection equipment will include stainless steel mixing bowls, stainless steel mixing spoons, and a stainless steel hand auger with extension rods or a stainless steel spade or equivalent. It may be necessary to use a backhoe or drilling rig to facilitate sample collection.

STOCKPILE SAMPLING PROCEDURES FOR CHEMICAL ANALYSIS

SAMPLING PLAN

1. Virgin Sources – Virgin borrow sources will be confirmed acceptable for use as site backfill through collection of a single composite soil sample representative of the borrow pit or stockpile.

2. Non-Virgin Sources – Prior to sampling, determine the amount of soil that will be sampled. The soil will be tested via collection of one composite sample per 250 cubic yards of material from each source area. If more than 1,000 cubic yards of soils are excavated from a given off-site source area and all samples of the first 1,000 cubic yards meet project designated criteria, the sample collection frequency may be reduced to one composite for each additional 1,000 cubic yards of soils from the same source area, up to 5,000 cubic yards. For borrow sources greater than 5,000 cubic yards, sampling frequency may be reduced to one sample per 5,000 cubic yards, providing all earlier samples meet project designated criteria. Sampling procedure for non-virgin sources is described in the next section.

SAMPLE COLLECTION AND HANDLING

The following procedure will be used to collect representative soil samples from a non-virgin soil stockpile.

1. Using a stainless steel spade (or hand auger), a backhoe, or drilling rig, penetrate the pile to a depth of approximately 2 to 3 feet and collect four (4) representative grab samples of approximate equal volume from the top, middle, and bottom.

2. Transfer each grab into a small stainless steel mixing bowl.

3. **VOC Analysis:** Using a clean stainless steel spoon, transfer equal amounts from each small mixing bowl into a laboratory-supplied, 4 oz. VOC sample jar. This should be performed by randomly transferring several small aliquots from each bowl, taking care to minimize disturbance of the soil.

4. **Other COPCs:** Transfer equal aliquots from each small bowl into a large mixing bowl and homogenize the sample. Fill the remaining laboratory-supplied jars with the homogenized soil for all other project required COPCs (i.e., SVOCs, PCBs, Pesticides, Herbicides, inorganics, etc.).

5. Label each set of jars with the following information:
    - Project and site name
    - Sample Code
    - Project Number
    - Date/Time
    - Sample type (soil composite or grab)
    - Sampler's initials
    - Sample Preservation
    - Required analysis

    The sample code will consist of a unique, alphanumeric identification code keyed to the sampling location. Identify the sampling location on a field sketch.

6. Record all information associated with sample collection in the Project Field Book.

7. Label, store, and ship the samples in accordance with the Benchmark Field Operating Procedure for Sample Labeling, Storage and Shipment Procedures.

8. Clean the sampling and mixing equipment with Alconox and deionized water and repeat steps 1 through 7 for the remaining samples.

REFERENCES

Benchmark FOPs:
046 Sample Labeling, Storage and Shipment Procedures

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FIELD OPERATING PROCEDURES

Waste Sampling Procedures

FOP 082.0

WASTE SAMPLING PROCEDURES

PURPOSE

This guideline describes the equipment and procedures that can safely be used to collect waste samples from open and closed units.

INTRODUCTION

Hazardous wastes are regulated by the USEPA under 40 CFR Parts 260-265. Therefore, many of the methods that are used to manage, store, treat, and dispose hazardous wastes and potential hazardous wastes are of concern to both the regulators and the regulated community. Samples are often required of regulated or potentially regulated materials. While it is understood that each facility and waste stream may present its own unique sampling and analytical challenges, this procedure will list equipment and enumerate procedures that have been used by the USEPA to safely and successfully sample specific waste units.

SAFETY

Sampling of waste units should be assessed for potential hazards by both the Project Manager (PM) and the site safety officer (SSO). It is the SSOs responsibility to enforce the site Health and Safety Plan (HASP), and to ensure that procedures used during waste sampling are in accordance with current company protocol. Sampling equipment contaminated during waste sampling investigations should be cleaned with laboratory detergent and rinsed with tap water prior to returning the equipment from the field. Contaminated sampling equipment that is to be discarded must be disposed of properly in accordance with the site-specific Work Plan.

It should be noted that although Benchmark does not readily perform field activities with highly hazardous materials, we do occasionally oversee contractors who do. Therefore, it is prudent on our part to recognize those situations and be prepared to ensure the activities of our subcontractors comply with the site-specific HASP as well as those procedures discussed herein. Any reference within this procedure to personal protective equipment (PPE) upgrades above a modified level C (i.e., Tyvek, nitrile gloves, and full-face respirator) relates solely to our subcontractors.

QUALITY CONTROL PROCEDURES

In some instances, special decontamination procedures will be necessary and should be developed on a case-by-case basis according to the specific material encountered. Any cleaning procedures and equipment repairs conducted in the field deviating from those specified in the associated FOPs or the site-specific Work Plan, should be discussed with the Project Manager, and thoroughly documented in the Project Field Book.

All air monitoring and field analytical/screening equipment (i.e., photoionization detectors) should be checked and calibrated per manufacturer's specifications before being used to collect any waste stream unit sample (open or closed). The Field Team Leader should record all calibration results on appropriate field forms.

WASTE UNIT TYPES

Waste management units can be generally categorized into two types: open and closed. In general, open units are larger than closed units and include waste piles and surface impoundments whereas closed units include containers and tanks as well as ancillary tank equipment. Besides containers and tanks, sumps may also be considered closed units because they are designed to collect the spillage of liquid wastes and are sometimes configured as a confined space.

Although both may pose hazards, units that are open to the environment are generally less hazardous than closed units. Sampling of closed units is considered a higher hazard risk because of the potential of exposure to toxic gases and flammable/explosive atmospheres. Because closed units prevent the dilution of the wastes by environmental influences, they are more likely to contain materials that have concentrated levels of hazardous constituents. While opening closed units for sampling purposes, investigators/contractor's shall use Level B PPE, air monitoring instruments to ensure that the working environment does not contain hazardous levels of flammable/explosive gasses or toxic vapors, and follow the appropriate safety requirements stipulated in the site-specific HASP.

Buried waste materials should be located and excavated with extreme caution. Once the buried waste is uncovered, the appropriate safety and sampling procedures utilized will depend on the type of waste unit.

Open Units

While open units may contain many types of wastes and come in a variety of shapes and sizes, they can be generally regarded as either waste piles or surface impoundments.

Definitions of these two types of open units from 40 CFR Part 260.10 are:

- Waste pile -- any non-containerized accumulation of solid, non-flowing hazardous waste that is used for treatment or storage and that is not a containment building.

- Surface impoundment -- "...a facility or part of a facility which is a natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it may be lined with man-made materials), which is designed to hold the accumulation of liquid wastes or wastes containing free liquids, and which is not an injection well. Examples of surface impoundments are holding, storage, settling and aeration pits, ponds, and lagoons."

One of the distinguishing features between waste piles and surface impoundments is the state of the waste. Waste piles typically contain solid or non-flowing materials whereas liquid wastes are usually contained in surface impoundments. The nature of the waste will also determine the mode of delivering the waste to the unit. Wastes are commonly pumped or gravity fed into impoundments while heavy equipment or trucks may be used to dump wastes in piles. Once the waste has been placed in an open unit, the state of the waste may be altered by environmental factors (e.g., temperature, precipitation, etc.).

Surface impoundments may contain several phases such as floating solids, liquid phase(s), and sludges. Waste piles are usually restricted to solids and semi-solids. All of the potential phases contained in a waste unit should be considered in developing the sample design to meet the study's objective.

Closed Units

There are a variety of designs, shapes, sizes, and functions of closed units. In addition to the challenges of the various designs and the safety requirements for sampling them, closed units are difficult to sample because they may contain liquid, solid, semi-solid/sludge, or any combination of phases. Based on the study's design, it may be necessary to obtain a cross sectional profile of the closed unit in an attempt to characterize the unit. The following are definitions of types of closed waste units described in 40 CFR Part 260.10:

- Container -- any portable device in which a material is stored, transported, treated, disposed, or otherwise handled. Examples of containers are drums, overpacks, pails, totes, and roll-offs.

- Tank -- a stationary device, designed to contain an accumulation of hazardous waste constructed primarily of non-earthen materials, which provide structural support.

Portable tanks, tank trucks, and tank cars vary in size and may range from simple to extremely complex designs. Depending on the unit's design, it may be convenient to consider some of these storage units as tanks for sampling purposes even though they meet the definition of a container.

- Ancillary equipment (tank) -- any device including, but not limited to, such devices as piping, fittings, flanges, valves, and pumps that is used to distribute, meter, or control the flow of hazardous waste from its point of generation to a storage or treatment tank(s), between hazardous waste storage and treatment tanks to a point of disposal on-site, or to a point of shipment for disposal off-site.

- Sump -- any pit or reservoir that meets the definition of a tank and those troughs/trenches connected to it that serve to collect hazardous wastes.

Note: some outdoor sumps may be considered open units/surface impoundments.

Although any of the closed units may not be completely sealed and may be partially open to the environment, the unit needs to be treated as a closed unit for sampling purposes until a determination can be made. Once a closed unit is opened, a review of the proposed sampling procedures and level of protection can be performed to determined if the (PPE) is suitable for the site conditions.

Samples collected from different waste units should not be composited into one sample container without additional analytical and/or field screening data to determine if the materials are compatible and will not cause an inadvertent chemical reaction.

EQUIPMENT

Selecting appropriate equipment to sample wastes is a challenging task due to the uncertainty of the physical characteristics and nature of the wastes. It may be difficult to separate, homogenize and/or containerize a waste due to its physical characteristics (viscosity, particle size, etc.). In addition, the physical characteristics of a waste may change with temperature, humidity, or pressure. Waste streams may vary depending on how and when a waste was generated, how and where it was stored/disposed, and the conditions under which it was stored/disposed. Also, the physical location of the wastes or the unit configuration may prevent the use of conventional sampling equipment.

Given the uncertainties that a waste may present, it is desirable to select sampling equipment that will facilitate the collection of samples that will meet the study's objective, and that will not unintentionally bias the sample by excluding some of the sample population that is under consideration. However, due to the nature of some waste matrices or the physical constraints of some waste units, it may be necessary to collect samples knowing that a portion of the desired population was omitted due to limitations of the equipment. Any deviations from the study plan or difficulties encountered in the field concerning sample collection that may have an effect on the study's objective should be documented in a log book, reviewed with the analytical data, and presented in the report.

WASTE SAMPLING EQUIPMENT

Waste sampling equipment should be made of non-reactive materials that will neither add to nor alter the chemical or physical properties of the material that is being sampled. The attached Table 1 lists some conventional equipment for sampling waste units/phases and some potential limitations of the equipment. Another reference for selecting sampling equipment is the ASTM, Standard Guide for Selection of Sampling Equipment for Wastes and Contaminated Media Data Collection Activities, D6232-98.

WASTE SAMPLING PROCEDURES

Waste Piles

Waste piles vary in size, shape, composition, and compactness, and may vary in distribution of hazardous constituents and characteristics (strata). These variables will affect safety and access considerations. The number of samples, the type of sample(s), and the sample location(s) should be based on the study's objectives. Commonly used equipment to collect samples from waste piles are listed in Table 1. All equipment should be compatible with the waste and should have been cleaned to prevent any cross contamination of the sample.

Surface Impoundments

Surface impoundments vary in size, shape, and waste content, and may vary in distribution of hazardous constituents and characteristics (strata). The number of samples, the type of sample(s), and the sample location(s) should be based on the study's objectives. Commonly used equipment to collect samples from surface impoundments are listed in Table 1. All equipment should be compatible with the waste and should have been cleaned to prevent any cross contamination of the sample.

Because of the potential danger of sampling waste units suspected of containing elevated levels of hazardous constituents, personnel should never attempt to sample surface impoundments used to manage potentially hazardous wastes from a boat. All sampling should be conducted from the banks or piers of surface impoundments. Any exception must be approved by the appropriate site safety officer and/or the Occupational Health and Safety Designee (OHSD).

Drums

Drums are the most frequent type of containers sampled by field investigators for chemical analyses and/or physical testing. Caution should be exercised by the field investigators when sampling drums because of the potential presence of explosive/flammable gases and/or toxic vapors. Therefore, the following procedures should be used when collecting samples from drums of unknown material:

1. Visually inspect all drums that are being considered for sampling for the following:
    - pressurization (bulging/dimples);
    - crystals formed around the drum opening;
    - leaks, holes, stains;

- labels, markings;
- composition and type (steel/poly and open/bung);
- condition, age, rust
- sampling accessibility

Drums showing evidence of pressurization and crystals should be furthered assessed to determine if remote drum opening is needed. If drums cannot be accessed for sampling, heavy equipment is usually necessary to stage drums for the sampling activities. Adequate time should be allowed for the drum contents to stabilize after a drum is handled.

2. Identify each drum that will be opened (e.g., paint sticks, spray paint, cones, etc).

LEVEL "B" PROTECTION IS REQUIRED FOR THE FOLLOWING PROCEDURES.

3. Before opening, ground each metal drum that is not in direct contact with the earth using grounding wires, alligator clips, and a grounding rod or metal structure. If a metal drum is in an overpack drum, the metal drum should be grounded.

4. Touch the drum opening equipment to the bung or lid and allow an electrical conductive path to form. Slowly remove the bung or drum ring and/or lid with spark resistant tools (brass/beryllium).

5. Screen drums for explosive gases and toxic vapor with air monitoring instruments as bung or drum lid is removed. Depending on site conditions screen for one or more of the following:
   - radioactivity
   - cyanide fumes
   - halogen vapors
   - pH
   - flash point (requires sample for testing)

   Note the state, quantity, phases, and color of the drum contents. Record all relevant results, observations, and information in a logbook.

6. Select the appropriate sampling equipment based on the state of the material and the type of container. Sampling equipment should be made of non-reactive materials that will meet the study's objective(s).

7. Place oil wipe (as necessary), sampling equipment, and sample containers near drum(s) to be sampled.

AIR MONITORING FOR TOXIC VAPORS AND EXPLOSIVE GASES AND OXYGEN DEFICIENT ATMOSPHERES SHOULD BE CONDUCTED DURING DRUM SAMPLING.

Liquids -- Slowly lower the COLIWASA or drum thief to the bottom of the container. Close the COLIWASA with the inner rod or create a vacuum with the sampler's gloved thumb on the end of the thief and slowly remove the sampling device from the drum. Release the sample from the device into the sample container. Repeat the procedure until a sufficient sample volume is obtained.

Solids/Semi-Solids -- Use a push tube, bucket auger, or screw auger or if conditions permit a pneumatic hammer/drill to obtain the sample. Carefully use a clean stainless steel spoon to place the sample into container(s) for analyses.

8. Close the drums when sampling is complete. Segregate contaminated sampling equipment and investigative derived wastes (IDW) containing incompatible materials as determined by the drum screening procedure (Step #5). At a minimum, contaminated equipment should be cleaned with laboratory detergent and rinsed with tap water prior to returning it from the field.

Tanks

Sampling tanks is considered hazardous due to the potential for them to contain large volumes of hazardous materials and therefore, appropriate safety protocols must be followed. Unlike drums, tanks may be compartmentalized or have complex designs.

Preliminary information about the tank's contents and configuration should be reviewed prior to the sampling operation to ensure the safety of sampling personnel and that the study's objectives can be achieved.

In addition to having discharge valves near the bottom of tanks and bulk storage units, most tanks have hatches at the top. It is desirable to collect samples from the top hatch because of the potential for the tank's contents to be stratified. Additionally, when sampling from the discharge valve, there is a possibility of a stuck or broken valve which could cause an uncontrolled release. Investigators should not utilize valves on tanks or bulk storage devices unless they are operated by the owner or operator of the facility, or a containment plan is in place should the valve stick or break. If the investigator must sample from a tank discharge valve, the valving arrangement of the particular tank must be clearly understood to insure that the compartment(s) of interest is sampled.

Because of the many different types of designs and materials that may be encountered, only general sampling procedures that outline sampling a tank from the top hatch are listed below:

1. All relevant information concerning the tank such as the type of tank, the tank capacity, markings, condition, and suspected contents should be documented in a logbook.

2. The samplers should inspect the ladder, stairs, and catwalk that will be used to access the top hatch to ensure that they will support the samplers and their equipment.

LEVEL "B" PROTECTION IS REQUIRED FOR THE FOLLOWING PROCEDURES.

3. Before opening, ground each metal tank using grounding wires, alligator clips, and a grounding rod or metal structure.

4. Any vents or pressure release valves should be slowly opened to allow the unit to vent to atmospheric pressure. Air monitoring for explosive/flammable gases and toxic vapors should be conducted during the venting with the results recorded in a log book. If dangerous concentrations of gases evolve from the vent or the pressure is too great, leave the area immediately.

5. Touch tank opening equipment to the bolts in the hatch lid and allow electrical conductive path to form. Slowly remove bolts and/or hatch with spark resistant tools (brass/beryllium). If a pressure build up is encountered or detected, cease opening activities and leave the area.

6. Screen tanks for explosive/flammable gases and toxic vapors with air monitoring instruments. Depending on the study objectives and site conditions, conduct characteristic screening (e.g., pH, halogen, etc.) as desired. Collect a small volume of sample for flash point testing, if warranted. Note the state, quantity, number of phases, and color of the tank contents. Record all relevant results, observations, and information in a logbook. Compare the screening results with any pre-existing data to determine if the tank should be sampled.

7. Select the appropriate sampling equipment based on the state of the material and the type of tank. Sampling equipment should be constructed of non-reactive materials that will meet the study's objective(s).

8. Place oil wipe (as necessary), sampling equipment, and sample containers near tanks(s) to be sampled.

AIR MONITORING FOR TOXIC VAPORS, EXPLOSIVE GASES AND OXYGEN DEFICIENT ATMOSPHERES SHOULD BE CONTINUOUS DURING TANK SAMPLING.

Liquids -- Slowly lower the bailer, bacon bomb, DipstickTM, COLIWASA, or Teflon® tubing to the desired sampling depth. (NOTE: In work areas where explosive/flammable atmospheres could occur, peristaltic pumps powered by 12 V. batteries should not be used.) Close the sampling device or create a vacuum and slowly remove the sampling device from the tank. Release the sample from the device into the sample container. Repeat the procedure until a sufficient sample volume is obtained.

Solids/Semi-Solids - Use a push tube, bucket auger, screw auger, MucksuckerTM, or if conditions permit a pneumatic hammer/drill to obtain the sample. Carefully extrude the sample from the sampling device or use a clean stainless steel spoon to place the sample into containers for analyses.

9. Close the tank when sampling is complete. Segregate contaminated sampling equipment and investigative derived wastes (IDW) containing incompatible materials as determined by the screening procedure (Step #6). At a minimum, contaminated equipment should be cleaned with laboratory detergent and rinsed with tap water prior to returning it from the field. IDW should be managed according to Section 5.15, and Region 4's Contaminated Media Policy.

Miscellaneous Contaminated Materials

Sampling may be required of materials or equipment (e.g., documents, building materials, equipment, etc.) to determine whether or not various surfaces are contaminated by hazardous constituents, or to evaluate the effectiveness of decontamination procedures.

Wipe or swab samples may be taken on non-absorbent, smooth surfaces such as metal, glass, plastic, etc. The wipe materials must be compatible with the solvent used and the analyses to be performed, and should not come apart during use. The wipes are saturated with a solvent; methylene chloride, hexane, isopropanol or analyte free water depending on the parameters to be analyzed. The laboratory performing the analyses can provide the appropriate solvent. Wipe samples should not be collected for volatile organic compounds analysis. Sampling personnel should be aware of hazards associated with the selected solvent and should take appropriate precautions to prevent any skin contact or inhalation of these solvents. All surfaces and areas selected for sampling should be based on the study's objectives. Typically, 10 cm by 10 cm templates are prepared from aluminum foil which are secured to the surface of interest. The prepared (saturated with solvent) wipe(s) is removed from its container with tongs or gloves, and used to wipe the entire area with firm strokes using only one side of the wipe. The goal is to systematically wipe the whole area. The wipe is then folded with the sample side inward and placed into the sample container. This procedure is repeated until the area is free of visible contamination or no more wipes remain. Care should be taken to keep the sample container tightly sealed to prevent evaporation of the solvent. Samplers must also take care to not touch the used side of the wipe.

For items with porous surfaces such as documents (usually business records), insulation, wood, etc., actual samples of the materials are required. It is therefore important, that during the collection and/or analyses of the sample that evidentiary material is not destroyed.

All secondary containing pails will be secured in the vehicles while transporting the samples from the field to the laboratory for analyses. In addition, each pail should indicate when protective equipment is recommended to handle the actual waste/sample material

REFERENCES

United States Environmental Protection Agency. November 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual.*

Benchmark FOPs:

011 *Calibration and Maintenance of Portable Photoionization Detector*

046 *Sample Labeling, Storage and Shipment Procedures*

TABLE 1

SAMPLING EQUIPMENT for VARIOUS WASTE UNITS

Equipment	Waste Units/Phases	Limitations
scoop with bracket/conduit	impoundments, piles, containers, tanks/liquids, solids, sludges	Can be difficult to collect deeper phases in multiphase wastes. Depth constraints.
spoon	impoundments, piles, containers/solids, sludges	Similar limitations as the scoop. Generally not effective in sampling liquids.
push tube	piles, containers/cohesive solids, sludges	Should not be used to sample solids with dimensions >'/2 the diameter of the tube. Depth constraints
auger	impoundments, piles, containers / solids	Can be difficult to use in an impoundment or a container, or for solidified wastes.
sediment sampler	impoundments, piles/solids, sludges	Should not be used to sample solids with dimensions >'/2 the diameter of the tube.
ponar dredge	impoundments/solids, sludges	Must have means to position equipment to desired sampling location. Difficult to decon.
COLIWASA or drum	impoundments, containers,	Not good with viscous wastes. Devices >_ 7'
thief	tanks/liquids	Require 2 samplers to use effectively.
DipstickTM /	impoundments, containers,	Not recommended for tanks >11 feet deep.
MucksuckerTM	tanks/liquids, sludges	Devices _> 7' require 2 samplers to use effectively
bacon bomb	impoundments, tanks/ liquids	Not good with viscous wastes.
bailer	impoundments, tanks/ liquids	Only if waste is homogeneous. Not good with viscous wastes
peristaltic pump with vacuum jug assembly	impoundments, tanks/liquids	Cannot be used in flammable atmospheres. Not good with viscous wastes
back-hoe bucket	piles/solids, sludges	May be difficult to access desired sampling location. Difficult to decon. Can lose volatiles.
split-spoon	piles/solids	Requires drill rig or direct push equipment.
roto-hammer	piles, containers/solids	Physically breaks up sample. May release volatiles. Not for flammable atmospheres.

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FIELD OPERATING PROCEDURES

Field Quality Control Procedures

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 Benchmark'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

Benchmark FOPs:

040 Non-disposable and Non-dedicated Sampling Equipment Decontamination

APPENDIX I

QUALITY ASSURANCE PROJECT PLAN
(QAPP)

QUALITY ASSURANCE PROJECT PLAN

QUEEN CITY LANDING
BUFFALO, NEW YORK
BCP SITE NO. C915304

October 2017 0424-017-001

Prepared for:

Queen City Landing, LLC

Prepared By:

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QUALITY ASSURANCE PROJECT PLAN (QAPP)

Queen City Landing Site

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) is an appendix to the Site Management Plan (SMP), which is required as an element of the remedial program at the Queen City Landing Site (hereinafter referred to as the "Site") under the New York State (NYS) Brownfield Cleanup Program (BCP), administered by New York State Department of Environmental Conservation (NYSDEC). The Site was remediated in accordance with Brownfield Cleanup Agreements (BCA) Index # C915304-06-16, Site C915304, which was executed in June 2016.

1.1 Site Location and Description

The Site is located at 975 and 1105 Fuhrmann Boulevard, in the City of Buffalo, County of Erie, New York. It is the location of the former Freezer Queen facility and operated as a warehouse and manufacturer of frozen foods for approximately 75 years, when food operations ceased in 2004. The site is an approximately 7.72-acres and is bounded by commercial property used for boat storage to the north, Lake Erie/Small boat Harbor to the south, Fuhrmann Boulevard to the east, and vacant land/Lake Erie to the west.

1.2 Scope of the QAPP

This QAPP was prepared to provide quality assurance (QA) guidelines to be implemented post-remedial activities. The QAPP will assure the accuracy and precision of data collection during post-remedial Site redevelopment and data interpretation. 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).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 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; and,
- 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.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The following section provides a generic organization for sampling activities, including roles, responsibilities, and required qualifications of these organizations.

2.1 NYSDEC and NYSDOH

It is the responsibility of the New York State Department of Environmental Conservation (NYSDEC), in conjunction with the New York State Department of Health, to review the project 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.

2.2 Property Owner

The property owner (Owner), or holder of the certificate of completion (COC) will be responsible for complying with the QA requirements as specified herein and for monitoring and controlling the quality of the Brownfield cleanup activities either directly or through their designated environmental consultant and/or legal counsel. The Owner will also have the authority to select Contractor(s) to assist them in fulfilling these responsibilities. The Owner is responsible for implementing the project, and has the authority to commit the resources necessary to meet project objectives and requirements.

2.3 Project Manager

The Project Manager has the responsibility for ensuring that the project meets the overall project objectives, reports directly to the Owner, coordinates with 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.

2.4 Field Team Leader:

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 develop 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.

2.5 Quality Assurance (QA) Officer

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 policies, and NYSDEC requirements. 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.

2.6 Laboratory Responsibilities

Any environmental laboratory utilized for sample analysis for this Site must be an independent, NY State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified facility approved to perform the analyses prescribed herein.

- *Laboratory Director:*

  The Laboratory Director is a technical advisor and is responsible for summarizing and reporting overall unit performance. Responsibilities of the TestAmerica Laboratory Director include:

  - Provide technical, operational, and administrative leadership.
  - Allocation and management of personnel and equipment resources.
  - Quality performance of the facility.
  - Certification and accreditation activities.
  - Blind and reference sample analysis.

- *Quality Assurance Manager (QA Manager):*

  The QA Manager has the overall responsibility for data after it leaves the laboratory. The QA Manager will be independent of the laboratory but will communicate data issues through the Laboratory Director. In addition, the QA Manager will:

  - Oversee laboratory QA.
  - Oversee QA/QC documentation.
  - Conduct detailed data review.
  - Determine whether to implement laboratory corrective actions, if required.
  - Define appropriate laboratory QA procedures.
  - Prepare laboratory SOPs.

3.0 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 soil, groundwater and air samples.
- Field data collection.
- Record keeping.
- Data management.
- Chain-of-custody procedures.
- Precision, accuracy, completeness, representativeness, for sample analysis and data management under EPA analytical methods.

3.1 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.

4.0 SAMPLE 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.

4.1 Field 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.

4.1.1 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. Sample parameter lists, holding times and sample container requirements are summarized on Table 1.

4.1.2 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.

4.1.3 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).

5.0 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.

5.1 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).

5.2 Preventative Maintenance

Each piece of field equipment is checked according to its routine maintenance schedule and before field activities begin. Field equipment that may be used at the Site includes:

- Photoionization detector (PID)
- Water quality meters (includes pH, turbidity, temperature, Eh, and specific conductance)
- Electric water level indicator

Field personnel will report all equipment maintenance and/or replacement needs to the Project QA Officer and will record the information on the daily field record.

6.0 DATA VALIDATION AND REPORTING

All data generated through field activities, or by the laboratory operation shall be reduced and validated (as required in the SMP) before reported.

6.1 Data Usability Evaluation

If requested by the NYSDEC, data evaluation will be performed by a 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.*

6.1.1 Procedures Used to Evaluate Field Data Usability

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.

6.1.2 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.

6.2 Data Reporting

6.2.1 Field Data Reporting

All field documents will be accounted for when they are completed. Accountable documents include items such as field notebooks, sample logs, field data records, photographs, data packages, computer disks, and reports.

6.2.2 Laboratory Data Reporting

Analytical data will be summarized in tabular format with such information as sample identification, sample matrix description, parameters analyzed and their corresponding detected concentrations, and the detection limit. Analytical results will be incorporated into reports as data tables, maps showing sampling locations and analytical results, and supporting text.

7.0 CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out of quality control performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented should be documented in the regular quality assurance reports to management. Corrective action should be implemented only after approval by the Project Manager, or his/her designee. If immediate corrective action is required, approvals secured by telephone from the Project Manager should be documented in an additional memorandum.

7.1 Field Corrective Action

If errors in field procedures are discovered during the observation or review of field activities by the Project QA Officer or his/her designee, corrective action will be initiated. Nonconformance to the QA/QC requirements of the field operating procedures will be identified by field audits or immediately by project staff who know or suspect that a procedure is not being performed in accordance with the requirements. The Project QA Officer or his designee will be informed immediately upon discovery of all deficiencies. Timely action will be taken if corrective action is necessary.

Corrective action in the field may be needed when the sample network is changed (i.e., more/less samples, sampling locations other than those specified in the Work Plan, etc.) or when sampling procedures and/or field analytical procedures require modification due to unexpected conditions. In general, the Project Manager and QA Officer may identify the need for corrective action. The Project Manager will approve the corrective measure that will be implemented by the field team. It will be the responsibility of the Project Manager to ensure that corrective action has been implemented.

If the corrective action will supplement the existing sampling using existing and approved procedures in the QAPP, corrective action approved by the Project Manager will be documented. If the corrective actions result in less samples (or analytical fractions), alternate locations, etc., which may result in non-achievement of project QA objectives, it will be necessary that all levels of project management, including the NYSDEC Project Coordinator, concur with the proposed action.

Corrective actions will be implemented and documented in the project field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are insufficient, work may be stopped by the NYSDEC Project Coordinator.

If at any time a corrective action issue is identified which directly impacts project data quality objectives, the NYSDEC Project Coordinator will be notified immediately.

7.2 Laboratory Corrective Action

Corrective actions may be initiated if the quality assurance goals are not achieved. The initial step in a corrective action is to instruct the analytical laboratory to examine its procedures to assess whether analytical or computational errors caused the anomalous result. If no error in laboratory procedures or sample collection and handling procedures can be identified, then the Project Manager will assess whether reanalysis or resampling is required or whether any protocol should be modified for future sampling events.

7.3 Data Validation & Assessment Corrective Action

The need for corrective action may be identified during the data validation or assessment processes. Potential types of corrective action may include resampling by the field team, or reinjection/reanalysis of samples by the laboratory.

These actions are dependent upon the ability to mobilize the field team, whether the data to be collected is necessary to meet the QA objectives (e.g., the holding time for samples is not exceeded, etc.). If the data validator identifies a corrective action situation, the Project Manager will be responsible for approving the corrective action implementation. All required corrective actions will be documented by the laboratory Quality Assurance Coordinator.

TABLE

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TABLE 1

SAMPLE CONTAINER, VOLUME, PRESERVATION & HOLDING TIME REQUIREMENTS

SITE MANAGEMENT PLAN

Queen City Landing
Buffalo, New York

Matrix	Parameter [1]	Method	Container Type	Minimum Volume	Preservation (Cool to 2-4 °C for all samples)	Holding Time from Sample Date
Soil/Fill	Part 375 VOCs/TICs/GRO	8260B/8015B	WMG	4 oz.	Cool to 2-4 °C, Zero Headspace	14 days
	Part SVOCs/TICs/DRO	8270C/8015B	WMG	8 oz.	Cool to 2-4 °C	14 days extrac./40 days
	Part 375 Metals	6010B/7470A	WMG	8 oz.	Cool to 2-4 °C	6 months/Hg 28 days
	PCBs	8082	WMG	4 oz.	Cool to 2-4 °C	14 days extrac./40 days

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

Acronyms:
VOCs = Volatile Organic Compounds
SVOCs = Semi-Volatile Organic Compounds
TICs = Tentatively Identified Compounds
PCBS = Polychlorinated Biphenyls
WMG = Wide Mouth Glass